AZERBAIJAN NATIONAL ACADEMY OF SCIENCES
COUNCIL OF YOUNG SCIENTISTS AND SPECIALISTS

YOUNG RESEARCHER

Scientific & practical journal

IX

2023
№ 3

Baku – 2023

Founder:

Azerbaijan National Academy of Sciences (ANAS)
Council of Young Scientists and Specialists

Head of the Advisory Council:
President of ANAS, Academician **Isa Habibbayli**

Scientific and Practical Journal of the Council of Young Scientists and Specialists of ANAS "Young Researcher" is published by the Decision (№ 8/4) of the Presidium of ANAS dated 12.03.2015. By the decision of the Presidium of the Higher Attestation Commission under the President of Azerbaijan from 31.03.2017 (Prot. No. 06-R) the journal "Young Researcher" is included in the list of periodical scientific journals recommended for the publication of the main results of dissertations. In the journal "Young Researcher" it is possible to publish the main results of dissertations carried out in the Republic of Azerbaijan and abroad in all sciences, except pedagogical.

Editorial address

Huseyn Javid 115, Yasamal, Baku, Azerbaijan, AZ1143
Main building of ANAS, III floor, room 324

genctedqiqatchi@gmail.com

AMEA Gənc Alim və Mütəxəssislər Şurası

gencalimler.az

CONTENT

I. Habibbayli. Academy's youth policy and scientific journal of young scientists 4

PHYSICS-MATHEMATICS AND TECHNICAL SCIENCES

A.Z. Abishov, S.Q. Mammadov. Thermoluminescence dating the age of ballabur castle..... 7
V.I. Karimli, F.R. Shikhieva. Dependence of water drop settling speed on turbulent diffusion coefficient in oil and modeling of physical processes..... 13
F.R. Shikhieva, V.I. Karimli, M.R. Manafov. Rheology of a heavy crude oil..... 20

CHEMICAL SCIENCES

E.V. Mirzazada, N.I. Valimatova, U.A. Guliyeva, M.A. Gurbanov. Study of the pyrolysis process of plastic waste by derivatographic analysis method..... 30
T.I. Suleymanova. Production of nanoparticles of $AgAsS_2$ and Ag_3AsS_3 compounds……38
G.M. Ashirov, K.N. Babanly, L.F. Mashadiyeva. Thermodynamic study of silver-silicon selenides (tellurides) by the EMF method with Ag_4RBI_5 solid electrolyte 45

EARTH SCIENCES

Adama Togola. Cartographic analysis of anthropogenic impact on the faya forest in Mali 58
N.Z. Mehdiyeva. Methods of soil improvement in Sumgayit-Siyazan massive 65

BIOLOGICAL AND MEDICAL SCIENCES

Ch.V. Aliyeva. Study of rabies virus in Azerbaijan 2016-2017 72
V.J. Abbasov. Large cattle coronavirus: epizootic status, genome structure, clinical symptoms and prevention-mini review..... 77
E.X. Salahova. Flowering and productivity of *berberis* l. species introduced to the Absheron peninsula..... 82

HUMANITARIAN SCIENCES

S.E. Garayeva. ADR in the Paris peace conference..... 92

SOCIAL SCIENCES

V.R. Zulfugarov, F.M. Gurbanov. Technoscience and digitality: an epistemological analysis of interactions..... 101
E. L. Hasanov. Research of some issues of historical genealogy in ganja from the renaissance period..... 112
N.G. Aghayeva. Multicultural values in the 19th century Ottoman Empire 119
E.M. Garayev, S.S. Huseynova. The small rutul people are part of a single Azerbaijani family..... 126
Ch.G. Safarova. The foreign policy of the republic of Turkey during the AK party..... 135
T.V. Alibeyova, F.M. Gurbanov. Unity of knowledge, expansion of rationality and "digital cognitive expansion": an Epistemological Approach 140
A.R. Rahimli. Perspectives of innovative development of science during the transition to digital economy..... 149

Isa HABIBBAYLI
President of ANAS, academician

ACADEMY'S YOUTH POLICY AND SCIENTIFIC JOURNAL OF YOUNG SCIENTISTS

The oversight of generational succession remains a paramount concern in the global academic scientific landscape. The typical age range academy members, who are often considered the cherished core, falls between 65 and 75 years. Only 7-10 percent of the actual academy members are under 50 years of age, while 15-20 percent are correspondent members. The core driving force of the Academy, mainly consisting of academicians and correspondent members, is predominantly comprises of scholars selected from among doctors of sciences, typically after the age of 65.

Given that the average age of doctors of science falls within the range of 47-55 years, achieving the status of a corresponding or active member of the Academy, representing the pinnacle of scientific recognition, requires considerable time, effort, and distinguished contributions among doctors of science, as well as obtaining the votes of the discerning academic community. According to these factors, the natural progression towards the highest levels within the scientific community is challenging and often delayed, which, in turn, postpones the emergence of opportunities for a new generation to assume its role in the world of science. Consequently, in most cases, the process of nurturing young scientists and their ascent within the academic hierarchy occurs at a sluggish pace. Academic science itself grapples with the ramifications of this situation. Estimates suggest that the Academies of Sciences encounter a significant personnel crisis approximately every 15-20 years. Therefore, a primary responsibility of these institutions is to consistently manage the generational turnover in the academic scientific arena.

In International academic scientific practice, various tools are employed to expedite the preparation and development of the new scientific generation. In some countries, steps to increase the admission quota for Doctor of Philosophy and Doctor of Sciences candidates or ease the requirements for dissertation defense occasionally accompany this process. While this may boost the quantitative statistics in science, it can result in a decline in qualitative standards. Furthermore, special positions are reserved for Doctors of Sciences under the age of 50 in elections to the Academies of Sciences. However, due to the limited number of Doctors of Sciences within this age group, their impact on the "aging" trend of Academy members is relatively insignificant.

In light of these experiences, maintaining a sustainable generational alternation process is perceived as a fundamental principle, with a consistent emphasis on the "rejuvenation" factor at all stages of acquiring scientific degrees and titles.

Nevertheless, the primary principle in international practice for instigating the "rejuvenation" policy in the generational alternation process in science commences with young scientists. In line with this, the Azerbaijan National Academy of Sciences (ANAS) is taking deliberate steps to lower the age limit for candidates pursuing Doctor of Philosophy and Doctor of Science degrees, without compromising on quality. Consequently, this approach aims to introduce relatively younger candidates in the elections for Academy membership. This potential shift in the quality of full and corresponding members of the Academy serves to significantly enhance the scientific capacity, which has been dedicated to societal progress for an extended period, and elevate the efficacy of science.

Comprehensive strategies have been outlined to enhance both the quality and quantity of young scientist training at ANAS. For the first time in the history of the Azerbaijan National Academy of Sciences, an extensive report on the science rejuvenation policy was thoroughly discussed at the Annual General Meeting of the Academy. Proposals have been drafted to endorse the promotion of individuals who successfully defend their doctoral dissertations before reaching the age of 50 within the Academy, allowing their participation in membership elections for this esteemed scientific institution.

Based on the decision of the Presidium of the Azerbaijan National Academy of Sciences in December 2022, the Academy's Youth Award was established to support the development of a new scientific generation. Starting from the results of 2023, the ANAS Youth Prize will be awarded for the first time to young scientists under the age of 29, specifically to the new generation of researchers who have successfully defended their dissertations. In addition, a historic milestone was reached in the National Academy of Sciences as a diploma for the "Young Scientist of the Year" was introduced, and it was stipulated that this diploma should be awarded to scientists who are actively contributing to both the scientific community and the public sphere. Special emphasis is also placed on facilitating opportunities for young scientists to partake in internships and scientific missions at international scientific centers, research organizations, and universities in developed countries.

Moreover, efforts have been made to expand the reach and impact of the "Young Researcher" journal, initially established to provide young scientists with a platform to disseminate their significant scientific research results to the public. It has been decided to increase the publication frequency of the "Young Researcher" journal from twice a year to four times a year, beginning in 2023. This change aims to create more opportunities for young scientists and specialists to publish their scientific articles, ultimately expediting the fulfilment of the requirements for dissertation defense.

To ensure the communication of vital scientific achievements by the new generation of scientists to the international scientific community, starting this year, one issue of the "Young Researcher" journal is published annually in English. The current English edition of the "Young Researcher" journal, presented to the scientific community in Azerbaijan, is the first English-language youth journal in our country. This initiative is a practical demonstration of the state's commitment to nurturing young scientists within the Azerbaijan National Academy of Sciences. It serves as an open avenue for presenting the significant scientific results of research conducted by young scientists to the world. The English-language issue of the "Young Researcher" journal will greatly contribute to the education and formation of a new generation of young researchers in our country.

Considering these factors, the editorial board of the "Young Researcher" journal should pay particular attention to maintaining the high scientific standards in this youth scientific journal. It is essential to ensure the "Young Researcher" journal is published in a high-quality manner, both in terms of scientific content and design. Young scholars should prioritize the preparation of articles for their scientific journal in accordance with the most current standards. We hope that the "Young Researcher" journal will play a significant role in shaping a new scientific generation with comprehensive training and strong scientific skills in independent Azerbaijan.

I extend my best wishes for success to the editorial staff and authors of the "Young Researcher" journal.

17 October 2023

PHYSICS-MATHEMATICS AND TECHNICAL SCIENCES

UDC: 544.54
ORCID: 0000-0003-2467-4344 (Abishov)
ORCID: 0000-0002-4547-4491 (Mammadov)

THERMOLUMINESCENCE DATING THE AGE OF BALLABUR CASTLE

Aqshin Zakir Abishov, Sahib Qiyas Mammadov
Institute of Radiation Problems of the Ministry of Science and Education
E-mail: a.abishov@irp.science.az
Received: 02.02.2023
Accepted: 25.07.2023

The presented work was the first attempt to increase the accuracy of dating natural archeological monuments, namely, the Ballabur castle in Lenkaran of Azerbaijan Republic, by employing the Thermoluminescence (TL) dating method. Luminescence measurements were performed to find out the equivalent dose (ED). Registration of TL signal was carried out using the HarshowTLD 3500 Manual Reader. The irradiation was performed at an ambient temperature from a ^{60}Co source at different dose levels, and a dose rate of the ^{60}Co source was determined by EPR spectrometric method using an individually wrapped Alanine Dosimeter. Soil samples were collected close to the pottery sample to determine the natural dose rate. Uranium, Thorium, and Potassium concentrations in soil. The annual dose rate was obtained using a γ-spectrometer with a hyper-pure germanium detector, which was 2.98±0.19 mGy/year. the cosmic dose rate, which pertains to radiation from cosmic sources, was also calculated and found to be 0.10±0.01 Gy/ka. Online dose rate and age calculator calculated the sample's age as 920±50 years which is in line with the age of this area estimated by historians.

Keywords: *Ballabur castle; Thermoluminescence dating; Annual dose rate; Quartz*
DOI: 10.59849/2409-4838.2023.3.7

INTRODUCTION

Determining the age of various archaeological objects is one of the most critical problems of geological science and practice. The thermoluminescence (TL) method is a well-established method for determining the age of archaeological ceramics [1–3]. This method is based on the effect of the accumulation of nonequilibrium charge carriers on defects in dielectrics, which is generated by ionizing radiation from natural radionuclides contained in dating objects or their environment. In the case of ceramics, the determined age corresponds to the time interval from the moment of the firing of the ceramics to the moment of its removal from the burial [4, 5].

Presently, the only ways to determine the age of the brickwork in many standing buildings from Azerbaijan's late medieval and early modern periods (11th to 19th centuries AD) are through historical records or by comparing their design and style. However, this typological dating method can only determine the age if there were any writing records. This research study seeks to establish a standard procedure for dating the bricks from medieval structures in Azerbaijan. We have collected two brick samples from an early medieval castle in Ballabur, Lankaran, Azerbaijan, where architectural experts have already assigned the dates as ~1000 years old.

MATERIAL AND METHODS

Quartz is a common mineral that is permanently present in raw ceramic paste. During its heat treatment (600-700^{0}C), the quartz contained in it loses all the previously accumulated charge carriers, the accumulation of which has occurred since the formation of quartz as a mineral. Thus, when

dating by the thermoluminescence method, a zero-moment is realized by heating during ceramics or pottery manufacturing.

However, in solids, including quartz crystals, traps for electrons and holes are located at different levels. To determine the age of ceramics, the lifetime of trapped electrons (holes) at ambient temperature should be at least 10–20 times greater than the age of the objects under study. In practice, it can be considered that in quartz and feldspars, the TL peaks with a luminescence maximum of 230-375◦C are suitable for dating. The methodology to use TL to determine the absolute (in years) age of various artifacts is based on the fact that, up to a specific limit, the accumulation of TL in traps occurs approximately in proportion to the radiation dose, which in turn depends on the irradiation intensity and exposure time [6].

It is possible to calculate the age of the material under study by experimentally determining the increase in TL per unit of absorbed radiation dose and the rate of natural radioactivity [7, 8].

1. Preparation of ceramic samples for research.

Luminescence measurements were performed to find out the equivalent dose (ED). The brick samples' outer surface was discarded, the rest was crushed into powder, and the remaining material was crushed and sieved into three-size fractions. The 90÷150 mm fraction was then etched in HF and washed in HCl [7]. The measurement sample comprised quartz inclusions with a size greater than 90 mm and a density between 2.63 and 2.67 g/cm3, separated using sodium poly tungstate [9, 10]. The grains were preheated before ED measurements to eliminate the influence of unstable traps on luminescence counts. The measurements showed that 200°C and 12 min were suitable for the sample. The measurements' uncertainties were calculated while considering the anomalous fading losses. As a result of the development of the methodology, it was found that the best measurement results are obtained when using powder samples, thus achieving more uniform heating; the weight of the sample is about 5 mg, and the particle size is 0.1-0.25 mm.

2. Measurement of TL of non-irradiated samples.

Registration of natural TL was carried out using the HarshowTLD 3500 Manual Reader. Five measurements were made for each of the non-irradiated samples. For TL analysis, an essential condition is the heating linearity. The linear heating rate of the sample was 5ºC/s in the temperature range of up to 400°C, which meets the requirements for instruments for TL analysis.

3. Measurement of artificial TL of irradiated samples.

The irradiation was performed at an ambient temperature from a ^{60}Co source at different dose levels ranging from 5 to 25 Gy. Magnettech Miniscope MS400 EPR Spectrometer using individually wrapped, barcode-labeled BioMax Alanine Dosimeter Films (developed by Eastman Kodak Company) has determined a dose rate of the ^{60}Co source. The irradiated samples were weighed to 5±0.5 mg and read out after one day in an N_2 atmosphere in a Harshaw 3500 manual reader using the linear heating rate of 5ºC/s.

Soil samples were collected close to the pottery sample to determine the natural dose rate. Uranium, Thorium, and Potassium concentrations in soil were measured by gamma spectrometry Canberra GR4520 that has a low-level gamma spectrometry system with 15 cm lead shielding and high-resolution GeHP hyper pure germanium detector, having 43.5% resolution efficiency for 661.6 keV.

RESULTS AND DISCUSSION

Quartz, a mineral commonly found in raw ceramic paste, undergoes a significant transformation when exposed to heat treatment (600-700°C). This transformation eradicates all previously accumulated charge carriers within the quartz, which have been accumulating since the mineral's formation. As a result, when utilizing the thermoluminescence method for dating, the heating process during ceramics, bricks, or pottery manufacturing effectively resets the quartz to a pristine state.

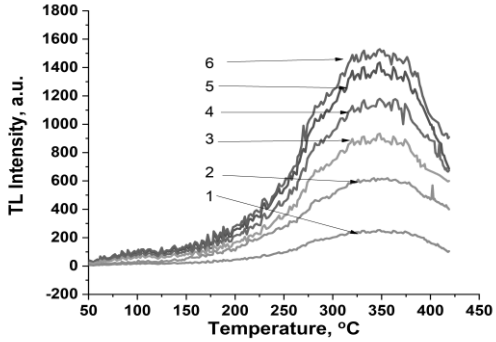


Fig. 1. Dose-dependent TL intensity of irradiated quartz at various doses: (1) Natural quartz extracted from the brick; Quartz irradiated at (2) 5 Gy, (3) 10 Gy, (4) 15 Gy, (5) 20 Gy, and (6) 25 Gy.

However, in solid materials like quartz crystals, there exist traps at various energy levels for both electrons and holes. In order to determine the age of ceramics, it is necessary for the trapped electrons (or holes) to have a lifetime at room temperature that is at least 10-20 times longer than the age of the studied objects. In practical terms, the TL peaks in quartz and feldspars, exhibiting a luminescence maximum of 230-375°C, are highly suitable for the purpose of dating.

Irradiated quartz grains exhibit several TL peaks when heated from room temperature to 500°C [11]. Two peaks above 300°C were observed for quartz inclusions extracted from pottery. The peak observed at 375°C is considered preferable to the peak on the lower shoulder of this peak, around 325°C. Another peak that emerges under laboratory irradiation is around 110°C that became the basis of the "pre-dose dating" method. It has demonstrated that the peak height could be used to monitor dose-dependent sensitivity changes observed after heating to 500°C. Figure 1 illustrates the dose dependence of the TL glow curve. Samples were irradiated with a ^{60}Co gamma source then TL glow-curves were measured after two days.

Soil sample collected from the proximity of the pottery sample was air-dried and kept in a closed environment for one month. The concentration of U, Th, and K are illustrated in Table 1.

Accurate determination of the environmental radiation dose rate is of utmost importance when employing trapped charge dating methods such as luminescence and electron spin resonance dating

Table 1.

The concentration of U, Th, and K in the brick sample from the Balabur castle

Uranium, ppm	Thorium, ppm	Potassium, %
2.21±0.20	9.71±1.10	1.90±0.10

Although the calculation of the environmental radiation dose rate itself may not be excessively complex, incorporating multiple variables and accounting for uncertainties can pose challenges. To address this issue, the Dose Rate and Age Calculator (DRAC) has been developed as a user-friendly web-based tool [12]. DRAC enables users to swiftly calculate environmental dose rates for various trapped charge dating applications by selecting a range of recently published attenuation and conversion factors. This ensures robust and reproducible calculations of the environmental radiation dose rate, thereby enhancing the accuracy of age estimations [12]. In this study, the DRAC version 1.2 software was utilized to perform dose rate and age calculations. Plotting the TL glow-curve intensity at 350°C against the dose adsorbed and backward extrapolation enables the estimated historical dose to equal 2.93±0.36 Gy (Figure 2).

The output results of the calculations indicate that the environmental dose rate was determined to be 2.98±0.19 Gy/ka (gray per kilo annum), which signifies the rate of radiation absorbed from the surrounding environment. The moisture content of a sample plays a significant role in trapped charge dating due to its impact on water dose absorption. When archaeological samples contain water, the water, hindering the radiation energy from reaching the quartz grains, absorbs a portion of the radiation. As a result, the dose rate of a dry sample can be higher than that of a moist sample. This disparity can potentially lead to an underestimation of the sample's age. Therefore, it is crucial to determine the percentage of water through laboratory analysis of the samples and consider it when calculating the dose rate.

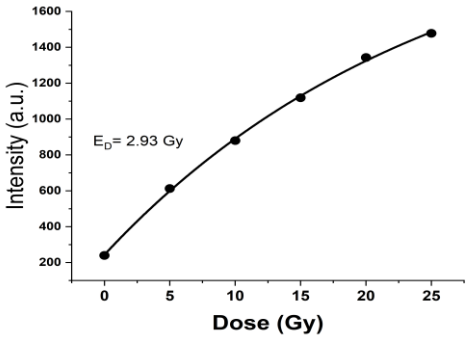


Fig . 2. Dependence of the intensity of the TL signal (in arbitrary units) in quartz extracted from bricks taken from the castle of Ballabur on the adsorbed dose

Furthermore, the cosmic dose rate, which pertains to radiation from cosmic sources, was also calculated and found to be 0.10±0.01 Gy/ka. Based on these dose rate calculations, the age of the sample was estimated to be 920±50 years.

These findings emphasize the significance of accurately assessing the environmental radiation dose rate in trapped charge dating. The utilization of tools like DRAC and careful consideration of factors such as moisture content contribute to more precise age estimations in archaeological research, enabling a deeper understanding of the timelines of ancient artifacts and structures.

CONCLUSION

Despite being in its initial phase and utilizing a limited number of samples, this study has effectively demonstrated the potential of using the thermoluminescence (TL) technique on quartz inclusions to determine the luminescence ages of late medieval bricks. The application of TL dating has yielded valuable insights into the age determination of archaeological ceramics, specifically in the context of the Ballabur castle in Lenkaran, Azerbaijan Republic. Through the analysis of TL peaks and measurements conducted on both irradiated and non-irradiated samples, significant progress has been made in establishing a standardized procedure for dating medieval brick structures.

The evaluation of environmental dose rate and cosmic dose rate, facilitated by software such as DRAC, has provided crucial information for age calculations. Taking into account factors like the concentration of Uranium, Thorium, and Potassium in the soil, as well as the historical dose estimation from TL glow-curve intensity, the age of the sample from the Ballabur castle was estimated to be approximately 920±50 years.

These findings underscore the importance of TL dating methods in archaeological research, particularly concerning historical ceramics. The methodology and measurements presented in this study contribute to a broader understanding and more precise dating of medieval structures in Azerbaijan. Ongoing advancements in TL dating techniques will further enrich our knowledge of ancient civilizations and assist in unraveling past mysteries.

REFERENCES

1. Altihan, M. Luminescence dating and mineralogical investigations of bricks from erikli basilica in Stratonikeia ancient city (SW-Turkey) / M.Altihan, T.Koralay, E.Sahiner [et al.] // Mediterranean Archaeology Archaeometry – 2018. №1, – p. 77-91.
2. Şahiner, E. Luminescence (IRSL) dating of Yeni Rabat church in Artvin, Turkey / E.Şahiner, N.Meriç, S.Uygun [et al] // Radiation Physical Chemistry, – 2013. – p. 68-73.
3. Ekdal, E. Luminescence dating studies of Yeşilova Hoyuk / E.Ekdal, A.Ege, T.Karali [et al.] // Geochronometria, – 2012. № 4. – p. 268-275.
4. Podoba, R. Research on historical bricks from a Baroque Church / R.Podoba, T.Kaljuvee, I.Štubňa [et al.] // Journal of Thermal Analytical Calorimetry, – 2014. № 2, – p. 591-595.
5. Zink, A., Porto, E. Luminescence dating of the Tanagra terrcottas of the Louvre colllections // Geochronometria, – 2005. – p. 21-26.
6. Wang, C.X. Quartz OSL and TL dating of pottery, burnt clay, and sediment from Beicun archaeological site, China / C.X.Wang, J.Zhu, Y.Zhang [et al.] // Quaternary Geochronology, – 2022. – p. 101281-101285.
7. Bailiff, I., Holland, N. Dating bricks of the last two millennia from Newcastle upon Tyne: a preliminary study // Radiation Measurements, – 2000. №5, – p. 615-619.
8. Wintle, A.G. Luminescence dating: Laboratory procedures and protocols // Radiation Measurements, – 1997. №5, – p. 769-817.
9. Singh, A.K. A new and effective method for quartz-feldspar separation for OSL and CRN dating / A.Singh, I.Manna, P.Kumar [et al.] // Quaternary Geochronology, – 2022. – p. 101315-101318.
10. Woor, S. Evaluating the effectiveness of heavy liquid density separation in isolating K-feldspar grains using alluvial sediments from the Hajar Mountains, Oman / S.Woor, J. Durcan, S.Burrough [et al.] // Quaternary Geochronology, – 2022. – p. 101368-101372.
11. Aitken, M.J. Thermoluminescence Dating / M.J.Aitken. – Academic Press, – 1985. – 141 p.
12. Durcan, J.A., King, G.E., Duller, G.A.T. DRAC: Dose Rate and Age Calculator for trapped charge dating // Quaternary Geochronology, – 2015. – p. 54-61.

TERMOLÜMİNESANS METODU İLƏ BALLABUR QALASININ YAŞININ TƏYİN OLUNMASI

A.Z. Abışov, S.Q. Məmmədov

Azərbaycan Respublikasının Lənkəran şəhərindəki Bəlləbür qalası kimi tanınan təbii arxeoloji abidələrin tarixinin dəqiqliyini artırmaq üçün Termolüminesans tarixləndirməarixi (TL) metodundan istifadə edilmişdir. Ekvivalent dozanı (ED) tapmaq üçün lüminesans ölçmələri aparılmlş və TL siqnalının qeydə alınması HarshowTLD 3500 Reader istifadə edərək həyata keçirilmişdir. Nümunələrin süalanması ^{60}Co mənbəyindən istifadə etməklə aparılmışdırş. ^{60}Co mənbəyinin doza gücü fərdi şəkildə sarılmış Alanin Dozimetrindən istifadə edərək EPR spektrometrik metodu ilə təyin edilmişdir. Təbii doza gücünü müəyyən etmək üçün nümunəyə yaxın olan yerdən torpaq nümunələri götürülmüşdür. Torpaqda uran, torium və kaliumun konsentrasiyaları müəyyən edilmişdir. İllik doza dərəcəsi hipertəmiz germanium detektoru ilə γ-spektrometrdən istifadə etməklə təyin edilmiş və 2,98±0,19 mGy/il olduğu müəyyən edilmişdir. Bundan əlavə kosmik doza gücü hesablanmış və 0,10±0,01 Gy/il olduğu müəyyən edilmişdir.

Abidənin yaşı onlayn doza gücü və yaş kalkulyatorundan istifadə edərək 920±50 il hesablanmışdır ki, bu da tarixçilərin bu abidə üçün müəyyən etdiyi təxmini yaşa uyğundur.

Açar sözlər: *Ballabur qalası, Termolüminesens yaş təyini, İllik doza gücü, Kvars*

ТЕРМОЛЮМИНЕСЦЕНТНАЯ ДАТИРОВКА ЭПОХИ ЗАМКА БАЛЛАБУР

А.З. Абышов, С.Г. Маммадов

Представленная работа была первой попыткой повысить точность датирования природных археологических памятников, а именно замка Баллабур в Ленкорани Азербайджанской Республики, с применением метода термолюминесцентного датирования (ТЛ). Измерения люминесценции проводились для определения эквивалентной дозы (ЭД). Регистрацию сигнала TL проводили с помощью считывателя HarshowTLD 3500 Manual Reader. Облучение проводили при температуре окружающей среды от источника 60Co при различных уровнях дозы, а мощность дозы источника 60Co определяли спектрометрическим методом ЭПР с использованием дозиметра с аланином в индивидуальной упаковке. Образцы почвы были отобраны рядом с образцом глиняной посуды для определения естественной мощности дозы. Содержание урана, тория и калия в почве. Годовая мощность дозы получена с помощью γ-спектрометра с детектором из сверхчистого германия и составила 2,98±0,19 мГр/год. мощность космической дозы, относящаяся к излучению космических источников, также была рассчитана и составила 0,10±0,01 Гр/тыс. лет.

Возраст образца был рассчитан онлайн-калькулятором мощности дозы и возраста как 920 ± 50 лет, что соответствует возрасту этой области, оцененному историками.

Ключевые слова: *замок Баллабур, термолюминесцентное датирование, годовая мощность дозы, Кварц*

UDC: 532.517.4
ORCID: 0000-0002-7084-3404 (Karimli)
ORCID: 0000-0003-2686-3659 (Shikhieva)

DEPENDENCE OF WATER DROP SETTLING SPEED ON TURBULENT DIFFUSION COEFFICIENT IN OIL AND MODELING OF PHYSICAL PROCESSES

Vafa Imran Karimli, Fatma Rashid Shikhieva
Academician M.Nagiev named Catalysis and Inorganic Chemistry Institute of the Ministry of Science and Education
E-mail: miracle1990@list.ru
Received: 02.02.2023
Accepted: 27.07.2023

Oil emulsions are a component of oil raw material extraction and refining processes. The presence of dispersed water, mineral salts and solid phase particles, as well as asphalt-resin and paraffin substances dissolved in it, significantly changes the physical properties and structure of the oil emulsion. As a rule, oil emulsion separation is carried out in two stages. First, large drops are quickly deposited (surfaced) and undergo coalescence. Very small drops remain in the form of "fog" and are deposited for a long time by forming an intermediate layer in the apparatus. The rate of stratification in most cases determines the productivity of the extraction process.

The emulsion formed when oil is mixed with reservoir water should be considered as a mechanical mixture of two insoluble liquids (oil and water). At this time, one of the liquids is distributed in the form of drops of different sizes in the volume of the other.

Due to the presence of water in the oil, the increase in the volume and viscosity of the transported liquid, the transportation cost becomes more expensive. Water solutions containing mineral salts cause wear and tear of oil-transporting devices and oil-refining equipment. The presence of even 0.1% water in the oil causes intense foaming of the oil in the rectification cylinders of oil refineries, which causes a violation of the processing regime and, in addition, contamination of condensation devices.

Keywords: *oil drops, coalescence, destruction of drops, turbulent diffusion coefficient, turbulent flow*

DOI: 10.59849/2409-4838.2023.3.13

INTRODUCTION

Oil freed from gases are kept in special tanks for a certain period of time to separate it from mechanical mixtures [1-3]. Under these conditions, those mixtures sink to the bottom of the tanks and are separated from the oil. At this time, most of the water in the crude oil gradually separates by itself. However, oil often contains a certain amount of small microscopic water droplets, which are difficult to separate. When water and oil are in the form of an emulsion, they are relatively difficult to separate. Water remains suspended inside the oil in the form of small droplets. In this work, we have analyzed the effect of the turbulent diffusion coefficient of these droplets on oil deposition [4-6].

In practice, centrifugal forces are used to intensify phase separation, and various structures and fillings placed in precipitators are applied. In some cases, the electric field of the high-voltage direct current created inside the device also enables stratification [7]. The structure of the pulsating interlayer is determined by the density and size of the droplets, which obey the dynamic equilibrium conditions and ensure the continuity of precipitation, as well as the velocity of the main flow [8-11].

According to its structure, the intermediate layer formed in precipitation devices is compressed, expanded, stratified according to its size and height, densified, moved, etc. It is

analogous to the "hot layer" of drops with its properties. Let us assume the following conditions to describe the motion of the droplets [12]:

a) drops are only spherical and this is determined by the small value of the Weber number: $W_e \ll 1$; $W_e=\rho_m U^2 a/\sigma_m$;

b) the washing of drops in the intermediate layer has a viscous character and is obtained from the condition of a small value of the Reynolds number:

$$Re_d = \frac{\Delta U a}{\nu_m} < 1, \left(\Delta U = \left|U - V_p\right|\right), \quad (1)$$

Here U - flow rate, V_p - velocity of drops in turbulent flow, a- the size of the drop, ν_m - kinematic viscosity of the medium.

c) There are no electrostatic, thermo- and diffusiophoretic and non-hydrodynamic effects in the flow. Droplet transfer by efficient diffusion and deposition is an exception. In this case, deposition effects for Stokes drops $\tau_r = \frac{1}{18}\frac{\rho_d a^2}{\eta_m}$, for large size drops $\tau_r = \frac{\rho_d a^2}{18\eta_c\left(1+Re_d^{2/3}/6\right)}$ is expressed. Here, ρ_d is the density of the drops, η_m is the dynamic viscosity of the medium, τ_r is the relaxation time of the drop, and a is the size of the drop[13, 14].

It should be noted that the turbulent diffusion coefficient plays an important role in the processes of droplet coalescence and destruction in isotropic turbulent flow, and its value is determined according to (2.) for the range of different values of the turbulent pulsation scale λ.

$$\lambda>\lambda_0\,,\ D_T = \alpha_0(\varepsilon_R\lambda)^{1/3}\,\lambda \ (2)$$

$$\lambda<\lambda_0\,,\ D_T = \alpha_0(\varepsilon_R\lambda)^{1/2}\,\lambda^2$$

MATERIAL AND METHODS

The movement of suspended particles in a turbulent flow of a liquid differs in complexity and intensity in all directions compared to laminar flows. In dispersed systems, small-sized particles will be completely involved in turbulent pulsations and will move along complex trajectories in fluids. With the increase in the size of the particles, they will lag behind the fluid movement, and in this case, the turbulent pulsation of the particles will decrease. It should be noted that the turbulent diffusion coefficient for large particles in a turbulent flow will be determined not only by the flow speed, but also by the precipitation speed of the particles. The turbulent diffusion coefficient of particles during the turbulent flow of dispersed systems is calculated as follows [15].

$D_{TR} \approx \mu^2 D_T$, where D_{TR} is the turbulent diffusion coefficient of particles, D_T is the turbulent diffusion coefficient of the liquid, μ^2 is the degree of attraction of particles by the pulsating medium, which depends on the size of the particles. In a broader sense, empirical formulas were proposed for determining the diffusion coefficients of particles depending on the dynamic speed of the flow, settling speed, etc.

$$\mu^2 = \frac{1}{1+\omega^2\tau_R^2} \ (3)$$

Here ω- turbulent pulsation frequency, τ_R- is the relaxation time of the particles. The value of μ varies between $0 \le \mu \le 1$. For small-sized particles, the value of μ is zero, and for large-sized particles, μ approaches unity.

For the degree of attraction of finely dispersed particles

$$\mu = \frac{1}{\left[1+\left(\frac{\rho_d a^2 \omega}{18\eta_c}\right)\right]^{1/2}} \quad (4)$$

RESULTS AND DISCUSSION

To estimate the turbulent diffusion coefficient in turbulent flow, a number of empirical dependences for vertical and horizontal channels can be obtained using various experimental studies, e.g.

$$D_{TR}/D_T = \mu^2 = 0{,}023\Psi\,(U_D)\left(\frac{U_D^2}{V_S}\right)^{1/4} \quad (5)$$

$$Re_d = \frac{V_S a}{\nu} \leq 5$$

Here V_S - droplet settling velocity, $\Psi\,(U_D) = 1 + 0{,}786 \cdot 10^{-6} U_D^4$, $U_D = \frac{0{,}2U_s}{Re^{1/8}}$ - dynamic flow rate, U_s - is the mean velocity of the turbulent flow. If $Re_d > 5$, then we get the following expression

$$D_{TR}/D_T = \mu^2 = 0{,}054\left(\frac{U_D^2}{V_S}\right)^{1/4} \quad (6)$$

From these equations, it can be seen that the turbulent diffusion coefficient of particles when flowing through vertical channels is directly proportional to the dynamic speed of the flow and inversely proportional to the precipitation speed of the particles. The following table 1 shows the comparison of the calculated and experimental values of the turbulent diffusion coefficient of particles.

Table 1.

Turbulent diffusion coefficient of particles during liquid flow in a vertical channel [16]

U_s, m/sec	U_d, sm/sec	a, mkm	V_S , sm/sec	D_T, sm^2/ sec	D_{TR}, sm^2/ sec	D_{TR}/D_T	μ^2	Re_d
1,55	9,0	80	17	6,3	0,370	0,059	0,059	< 5
3,44	18,0	80	17	12,6	1,35	0,107	0,107	< 5
7,60	36,0	80	17	25,2	10,1	0,400	0,386	< 5
1,55	9,0	150	50	6,3	0,26	0,042	0,045	$= 5$
3,44	18,0	150	50	12,6	1,05	0,083	0,082	$= 5$
7,60	36,0	150	50	25,2	6,20	0,246	0,295	$= 5$
1,55	9,0	200	69	6,3	0,20	0,032	0,032	> 5
3,44	18,0	200	69	12,6	0,44	0,035	0,038	> 5
7,60	36,0	200	69	25,2	1,22	0,048	0,046	> 5

For horizontal ducts, the following corrections for the turbulent diffusion coefficient were obtained using experimental evidence of the movement of solid particles and oil droplets in the air flow.

$$\frac{D_{TR}}{D_T} = \mu^2 = 0{,}24\left(\frac{V_s}{U_D^s}\right)^{1/4}, Re_d \geq 2{,}5 \quad (7)$$

$$\frac{D_{TR}}{D_T} = \mu^2 = k(V_S)\left(\frac{V_S}{U_D}\right)^{1/4}, Re_d < 2 \quad (8.)$$

Here $k(V_S)$ is a parameter whose value is $k(V_S) = \frac{2{,}16}{V_S^{1/8}}$. As can be seen from the expression, in contrast to vertical channels, the turbulent diffusion coefficient in horizontal channels is directly proportional to the settling velocity and inversely proportional to the dynamic velocity. Thus, the diffusion coefficient for both horizontal and vertical channels depends on the settling velocity, and this dependence increases as the particle size increases. The dependence of the turbulent diffusion coefficient of particles on the precipitation rate shows the influence of the particle mass on the diffusion coefficient. If the increase in the mass of particles in vertical channels mainly causes the particle to lag behind the speed of the main medium, then the increase in the mass of particles in horizontal channels directly affects their diffusion coefficient. The following table 3 show the comparison of the calculation and experimental values of the turbulent diffusion coefficient (Figure 1) in horizontal channels.

Table 2.

Experimental evidence and calculated values of the turbulent diffusion coefficient of solid particles in air (a=100-200 mm, Red>2.5) in a square channel with a cross section of 76x76mm [17]

U_s, m/san	U_D, sm/san	V_S, sm/san	D_T, sm^2/san	D_{TR}, sm^2/san	D_{TR}/D_T	μ^2
7,6	40,7	41	23,5	0,9	0,038	0,038
16,7	81,0	41	63,7	1,5	0,024	0,023
25,9	119,0	41	103,0	1,8	0,017	0,017
7,6	40,7	104	23,5	1,36	0,056	0,048

Based on the indicators shown in Table 2, the dependence between the calculated values of the turbulent diffusion coefficient and the experimental indicators was obtained:

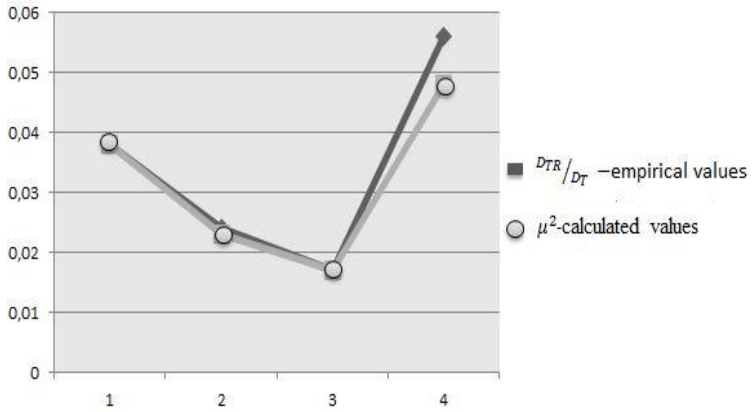


Fig. 1. Calculated and experimental values of the turbulent diffusion coefficient

Table 3.

Experimental evidence and calculated values of the turbulent diffusion coefficient for oil drops (a=45μm, Red>2.5) in a horizontal pipe (D=152mm, Vs= 3.5cm/sec**)** [18]

U_s, m/sec	U_D, sm/sec	D_T, sm^2/sec	D_{TR}, sm^2/sec	D_{TR}/D_T	μ^2
58	241	358	229	0,640	0,641
87,2	344	511	298	0,583	0,585
122	461	686	386	0,563	0,545
148	546	812	460	0,566	0,522

Despite the fact that dispersed systems (emulsions, suspensions) are characterized by polydispersity of particles, the sizes of which vary mainly in the wide range of 1-200 μm, there are larger colloidal particles in the flow [19]. In general, the state of dispersed flow, which determines the structure of the dispersion spectrum, its aggregative resistance to size change and precipitation resistance to precipitation, is characterized by the minimum and maximum particle sizes. It should be noted that the processes occurring in dispersed systems are accompanied not only by collisions and the enlargement of colliding drops, but also by the opposite phenomena - fragmentation, which is the division of particles in a mixed effect or the ability to maintain a continuous state, as well as spontaneously or their external accompanied by disintegration under any impact on the surface. Thus, in dispersed systems, there is such a size of the drop, amax, that the drop is unstable, deformed and quickly disintegrated at sizes higher than this; and the minimum amino size indicates the lowest droplet durability limit, or rather, drops that have reached this size under certain flow conditions cannot be crushed any more. The maximum size of the particles characterizes the discontinuity of the droplets, and this dispersed environment depends on the hydrodynamic conditions of the flow, so that the turbulent flow is accompanied by a tendency to break up and break up individual drops under certain conditions.

CONCLUSION

Expressions for the turbulent diffusion coefficient are given using experimental studies to explain the movement of solid particles and oil droplets in vertical and horizontal channels. As can be seen from the expressions, in contrast to vertical channels, the turbulent diffusion coefficient in horizontal channels is directly proportional to the settling velocity and inversely proportional to the dynamic velocity. Thus, the diffusion coefficient for both horizontal and vertical channels depends on the settling velocity, and this dependence increases as the particle size increases. The dependence of the turbulent diffusion coefficient of particles on the precipitation rate shows the influence of the particle mass on the diffusion coefficient. If the increase in the mass of particles in vertical channels mainly causes the particle to lag behind the speed of the main medium, then the increase in the mass of particles in horizontal channels directly affects their diffusion coefficient.

ACKNOWLEDGEMENTS

The authors are grateful to prof. G.I. Kelbaliev and associated M.R.Manafov (M.Nagiyev Institute of Catalysis and Inorganic Chemistry) for censorious remarks.

REFERENCES

1. Kelbaliev, G.I. Osobennosti zhidkofaznogo jekstrakcionnogo processa i ih ispol'zovanie dlja razrabotki tehnologii ochistki stochnyh vod / G.I.Kelbaliev, G.Z.Sulejmanov, F.I.Shekiliev [et al.] // Azerbaijan Chemical Jurnal, – 2017. №3, – p-45-54.
2. Kelbaliyev, G.I. "Transport Phenomena in Dispersed Media"/ G.I.Kelbaliyev, L.B.Tagiyev, S.R.Rasulov – Taylor and Francis Group, CRC Press Boca Raton-London-New York, – 2019. – 434 p.
3. Yuri, A.W. Shardt Statictics for Chemical and Process egineers / Springer International Publishing, – 2018. – p. 414.
4. Xinyuan, Li. Asphaltene Inhibition and Flow Improvement of Crude Oil with a High Content of Asphaltene and Wax by Polymers Bearing Ultra-Long Side Chain / Xinyuan Li, Shu Lu, Meifei Niu – 2021. – p. 8243.
5. Tian, Liang. Molecular Simulation of Resin and the Calculation of Molecular Bond Energy / Liang Tian, Zhao-Wen Zhan, Yan-Rong Zou // ACS Omega, – 2021, 6 (42), – p. 28254-28262.
6. Y.Sun. Experimental study on the falling and coalescence characteristics of droplets under alternating electric fields / Sun, Y., Yang, D., Sun, H // Colloids and Surfaces A: Physicochemical and Engineering Aspects, – 2020. – p. 125-136.
7. Silva, C.A. Impact of Crude Oil Emulsion on Pipeline Corrosion / C.A. Silva, D.N. Filho, M.A. Zanin // Journal of Petrochemical Engineering, – 2021. – p. 11-19.
8. Qingzhi, Lai Multiband directional reflectance properties of oil-in-water emulsion: application for identification of oil spill types / Lai Qingzhi, Yinmo Xie, Chengan Wang [et al.] // Optica Publishing Group, – 2021, 23 (60), – p .6902-6909.
9. Patel, H. Treatment of textile waster water by adsorption and coagulation / H.Patel, P.Vashi // Journal of Chemistry, – 2010, 7 (4), – p. 1483-1487.
10. Parimal, P. Industrial Water Treatment Process Technology / P.Parimal. Elsevier Science, – 2017. – 614 p.
11. Nico, L. Oil Droplet Coalescence in W/O/W Double Emulsions Examined in Models from Micrometer-to Millimeter-Sized Droplets / Leister Nico, Chenhui Yan [et al.] // Karbstein Colloids Interfaces, – 2022, 6 (12), – p. 1-17.
12. Mhunir, B. Investigation of Periodic Structures in Gas-Liquid Flow // The University of Nottingham School of Chemical & Environmental Engineering, – 2010. – 225 p.
13. Mazouzi, Ridha. Experimental Study of the Rheological Behaviour of Water-in-crude Oil Emulsions Recueil de Mecanique / Ridha.Mazouzi. – 2021. – 9 p.
14. Manafov, M.R. Analysis of the current state of researches of the deposition of asphalt-resinous substances, paraffin, and modeling methods / M.R. Manafov, G.S. Aliyev [et al.] // Azerbaijan Chemical Journal, – 2021. № 2, – p. 13-23.
15. Ismail, T. Fundamental mass transfer concepts in engineering applications / T.Ismail. – CRC press, – 2019. – p. 434.
16. Isah, M. Impact of asphaltene precipitation and deposition on wettability and permeability / M.Isah, M.Mahmoud [et al.] // ACS Omega, – 2021. – p. 432-444.
17. Manafov, M.R. Study of the effect of asphaltene-resinous compounds on the separation of oil emulsions / M.R.Manafov, F.R.Shikhieva [et al.] // Azerbaijan Chemical Journal, – 2022. №2, – p. 18-27.
18. Manafov, M.R. Analysis of deposition models of asphaltene-resin-paraffin deposits in vertical transport pipes / M.R.Manafov, G.I.Kelbaliev [et al.] // Journal Of Azerbaijan Oil Industry, – 2021. №12, – p. 33-37.
19. Shikhieva, F.R. "Modeling of heavy component deposition of oil in horizontal and vertical pipes" // Scientific works, – 2021. №1, – p. 142-148.

NEFTDƏ SU DAMLALARININ ÇÖKMƏ SÜRƏTİNİN TURBULENT DİFFUZİYA ƏMSALINDAN ASILILIĞI VƏ FİZİKİ PROSESLƏRİN MODELLƏŞDİRİLMƏSİ

V.İ. Kərimli, F.R. Şıxıyeva

Neft emulsiyaları neft xammalının çıxarılması və emalı proseslərinin tərkib hissəsidir. Tərkibində dispers su, mineral duzlar və bərk faza hissəcikləri, eləcə də orada həll olunan asfalt-qətranlı və parafin maddələrinin olması, neft emulsiyasının fiziki xassələrini və strukturunu əhəmiyyətli dərəcədə dəyişir. Neft emulsiyanın ayrılması bir qayda olaraq iki mərhələdə həyata keçirilir. Əvvəlcə iri damlalar tez çökdürülür (üzə çıxır) və koalessensiyaya məruz qalır. Çox kiçik damlalar "duman" şəklində qalır və aparatda aralıq təbəqə əmələ gətirməklə uzun müddət çökdürülür. Təbəqələnmə sürəti əksər hallarda ekstraksiya prosesinin məhsuldarlığını müəyyən edir.

Neft lay suları ilə qarışığını çıxaran zaman yaranan emulsiya iki bir-birində həll olmayan mayenin (neft və su) mexaniki qarışığı kimi baxılmalıdır. Bu zaman mayelərdən biri digərinin digərinin həcmində müxtəlif ölçülü damlalar şəklində paylanılır.

Neftin tərkibində suyun olması, nəql olunan mayenin həcminin və özlülüyünün artması səbəbindən nəql posesi bahalaşır. Tərkibində mineral duzların olduğu su məhlulları, nefti nəql edən qurğların və neft emalı avadanlıqlarının aşınmasına, tez sırada çıxmaına səbəb olur. Neftin tərkibində hətta 0,1 % suyun olması, neft emalı zavodlarının rektifikasiya kalonlarında, neftin intensiv köpüklənməsinə səbəb olur ki, bu da emal rejiminin pozulmasına və əlavə olaraq kondensasiya cihazlarının çirklənməsinə səbəb olur.

Açar sözlər: *neft damlaları, koalessensiya, damlaların parçalanması, turbulent diffuziya əmsalı, turbulent axın*

ЗАВИСИМОСТЬ СКОРОСТИ ОСЕДАНИЯ КАПЕЛЬ ВОДЫ ОТ КОЭФФИЦИЕНТА ТУРБУЛЕНТНОЙ ДИФФУЗИИ В НЕФТИ И МОДЕЛИРОВАНИЕ ФИЗИЧЕСКИХ ПРОЦЕССОВ

В.И. Керимли, Ф.Р. Шихиева

Нефтяные эмульсии являются составной частью процессов добычи и переработки нефтяного сырья. Наличие диспергированной воды, минеральных солей и частиц твердой фазы, а также растворенных в ней асфальтосмолистых и парафиновых веществ существенно изменяет физические свойства и структуру нефтяной эмульсии. Как правило, разделение масляной эмульсии проводят в две стадии. Во-первых, крупные капли быстро осаждаются (всплывают) и подвергаются слиянию. Очень мелкие капли остаются в виде «тумана» и длительное время оседают, образуя в аппарате промежуточный слой. Скорость расслоения в большинстве случаев определяет производительность экстракционного процесса.

Эмульсию, образующуюся при смешении нефти с пластовой водой, следует рассматривать как механическую смесь двух нерастворимых жидкостей (нефти и воды). В это время одна из жидкостей распределяется в виде капель разного размера в объеме другой.

Из-за наличия воды в масле, увеличения объема и вязкости транспортируемой жидкости стоимость транспортировки удорожается. Водные растворы, содержащие минеральные соли, вызывают износ нефтетранспортирующих устройств и нефтеперерабаты-вающего оборудования. Наличие даже 0,1 % воды в масле вызывает интенсивное вспенивание масла в ректификационных цилиндрах нефтеперерабатывающих заводов, что вызывает нарушение режима обработки и, кроме того, загрязнение конденсационных устройств.

Ключевые слова: *капли нефти, коалесценция, разрушение капель, коэффициент турбулентной диффузии, турбулентное течение*

UDC: 628.546.541.18
ORCID: 0000-0003-2686-3659 (Shikhieva)
ORCID: 0000-0002-7084-3404 (Karimli)
ORCID: 0000-0002-9965-4850 (Manafov)

RHEOLOGY OF A HEAVY CRUDE OIL

Fatma Rashid Shikhieva, Vafa Imran Karimli, Manaf Rizvan Manafov
Academician M.Nagiev named Catalysis and Inorganic Chemistry Institute of the Ministry of Science and Education
E-mail: fatmashikhieva9981@gmail.com
Received: 01.03.2023
Accepted: 26.07.2023

The growing demand for oil is encouraging the development of heavy oil and bitumen, the world's huge energy reserves. However, their high viscosity is a big problem in their use, because they cannot be transported without a proper method. A number of methods have been developed to transport heavy oil, including diluents, heated pipelines, emulsions, and crude oil upgrades.

It is known that the common characteristics of heavy oil are high viscosity, high specific gravity, high molecular content and low hydrogen-to-carbon ratio, high carbon residues, and high content of asphaltenes, heavy metals, sulfur, and nitrogen. Heavy oils are a strategic source of hydrocarbons because their reserves are on the same scale as those of conventional oils. The production of these raw materials remains low, especially due to their very high viscosities.

Heavy oil rheology problems caused by the hydrodynamic interaction of heavy particles in oil (asphaltenes, paraffin, resins, and solid phase particles) were considered in the research work. Transporting heavy crude oil requires the viscosity to be low enough so that pipeline size and pumping requirements are economically optimal. There are several methods to achieve these properties, some of which have been validated in the field and are currently in use, while others are under development.

In our current research work, we have analyzed some of these methods and given our recommendations for improving the rheology of heavy oils for the future.

Keywords: *rheology, heavy crude oil, oil emulsions, viscosity, oil-in-water emulsions, water-in-oil emulsions.*

DOI: 10.59849/2409-4838.2023.3.20

INTRODUCTION

There are more than 150 different types of crude oil in the world. Heavy crude oils are less expensive for a refinery to purchase but more expensive to refine since they have greater costs from higher energy inputs and additional processing to meet environmental requirements.

Refineries process crude oil into a wide variety of refined products. The refining process separates, breaks down, reformates, and recombines the molecules of crude oil into refined products [1].

Each type of crude oil yields different types of refined products. Light crude oil is primarily used to create fuels such as gasoline, diesel, and jet fuel. Heavy crude oil provides feedstock for petrochemicals, other fuels, and road surfaces. Heavy oil can also be converted into transportation fuel.

Crude oil plays a very important role in countries that are in dire need of fuel, be it for industrial consumption, electricity, or transportation mobilization. Economic development and spectacular population growth in recent decades have led to increased demand for fossil fuels, which has resulted in the gradual depletion of conventional oil reserves, including light and medium crude oil reserves, which have become scarce and insufficient to meet ever-increasing oil reserves. Unconventional oil resources, including heavy oil, extra-heavy oil, shale, oil sands, tar sands, and bitumen, are

alternative resources to fossil fuels [2]. However, unlike conventional oil, which is characterized by low production costs, unconventional oil cannot be recovered and then transported in its natural state by conventional production and transportation methods, generally requiring additional requirements to ensure its flow at acceptable flow rates. In the future, heavy and extra-heavy oils are expected to be an excellent alternative to conventional oil, but the complexity of their composition makes their flow extremely difficult under natural conditions without the problem of flow assurance.

Crude oil with API specific gravity below 20^0 is called heavy oil, and those below 10^0 are called extra heavy oil. Heavy oil cannot flow due to its high viscosity. Some researchers have explained the possible reason for the high viscosity of heavy oil. According to them, oil has evolved from natural source materials and has become heavier as a result of the elimination of lighter fractions through natural processes. A high proportion of asphaltene molecules that replace hetero-atoms in the carbon network, such as nitrogen, sulfur, and oxygen, also plays an important role in oil hardening. Therefore, heavy oil, regardless of its source, always contains heavy fractions of asphaltenes, heavy metals, sulfur, and nitrogen. Large asphaltene molecules determine the increase or decrease in density and viscosity of the oil. Removal or reduction of asphaltene dramatically affects the rheological properties of a particular oil [3].

Heavy oil/bitumen is characterized in terms of SARA fractions and divided into four different pseudo-components such as saturates, aromatics, resins and asphaltenes. A four-parameter equation of state developed by Adachi et al is used to calculate the values of solubility parameters, molar volume, and density of each SARA fraction [4-8].

Asphaltenes are defined as the heaviest compounds in crude oil that are completely soluble in aromatic solvents such as toluene and precipitate when paraffinic solvents such as n-alkanes are added.

Asphaltenes constitute the most refractory, polar, and heaviest component in crude oil [9]. Because of these distinctive characteristics, asphaltene is considered a prime factor that causes difficulties in many petroleum operations such as production, transportation, refining, even wax crystallization, crude oil emulsification, and de-emulsification. Any thermodynamic changes in pressure, temperature, or oil composition can cause asphaltene deposits, which result in many problems in transmission, production, and processing facilities in the oil industry.

The problems caused by the presence of asphaltene do not depend only on the amount of asphaltene in the oil. What is important is the stability of those asphaltenes, and stability depends on how well the rest of the oil is a solvent for the asphaltenes [10].

Many experimental methods are available to detect asphaltene precipitation, such as gravimetric, acoustic resonance IFT measurement, dynamic method, high-pressure microscopy, and infrared spectroscopy. In addition to experimental measurements, a large number of thermodynamic models have been used to model asphaltene precipitation and predict its onset point, including the solid model, micellization model, colloid model, solubility model, and equation of state models [11-13]. The solid model is the simplest model for predicting asphaltene precipitation, which treats asphaltenes as a single solid component and evaluates the behavior of other phases with an equation of state. However, the problem with this model is that it requires a lot of empirical parameters and experimental data. The colloidal model presented by Leontaritis [14] uses VLE calculation and EOS to estimate fluid composition. In this model, asphaltenes are treated with solid colloidal particles surrounded by large resin molecules and suspended in crude oil. On the other hand, in the dissolution model, asphaltenes are dissolved in the solvent liquid state and form a uniform solution [15]. Among the many thermodynamic approaches used to predict asphaltene precipitation, regular solution theory along with the equation of state models are the most common methods [16, 17].

METHODS FOR RECOVERING HEAVY CRUDE OILS

Oil is kept in the reservoir mainly due to capillary, gravity and viscous forces. It was determined in the research that the interaction between these forces during oil flow in a porous medium can

be measured by capillary number and mobility ratio [18]. Capillary number (Ca) is defined as follows:

$$Ca = \frac{\eta v}{\gamma} \quad (1)$$

Here, η - is the viscosity of the liquid, ν - is the flow rate through the pores, and γ - is the interfacial tension between the liquids.

Fluid mobility in porous media is determined based on the Darcy equation.

$$u = \frac{k}{\mu}\frac{dP}{dx} \quad (2)$$

u - Darcy surface velocity of liquid, k - conductivity, μ - viscosity, P - pressure, x - length.

For 1 phase, k represents the absolute conductivity, and for multiphase flow, the effective conductivity. The mobility of the liquid phase is defined as follows:

$$\lambda = \frac{k}{\mu} \quad (3)$$

Then the mobility speed

$$M = \frac{\lambda_2}{\lambda_1} \quad (4)$$

M-is an important parameter in displacement processes, it expresses the dimensionless viscosity ratio given by parameters λ_1 and λ_2 [19].

Transportation of heavy crude oil and natural bitumen requires viscosity to be low enough for pipeline size and pumping requirements to be economically optimal.

There are several methods to achieve these properties, some of which have been validated in the field and are currently in use, while others are under development. These methods are:

Effect of heat
Effects of diluents
With O/W emulsions
Core annular flow
Partial field upgrading

RHEOLOGICAL BEHAVIOR OF HEAVY CRUDE OIL BY HEAT TREATMENT

The thermal impact is a widely used method to reduce the high viscosity of heavy crude oil and improve flow in pipelines. Pipeline heating (ie, raising the temperature) results in a rapid reduction in viscosity to reduce the oil's resistance to flow. Figure 1 shows the viscosity response in the heat treatment temperature range of 30–60° for heavy crude oil at different shear rates. The fan-shaped rheogram shows the effectiveness of the method in improving flow characteristics, since the viscosity between the flowing feedstock and the pipe wall, and therefore the shear stress, decreases by several orders of magnitude with increasing temperature. When the raw material is heated to a temperature above 40°C, the rheological properties remain practically unchanged at higher shear rates and the slopes of the plots begin to decrease, indicating good flow behavior. The unique behavior of crude oil can be explained by the high paraffin content and the average paraffin-to-resin

ratio, which indicates the change in structural properties and destruction of the chemical structure of heavy components of crude oil [20].

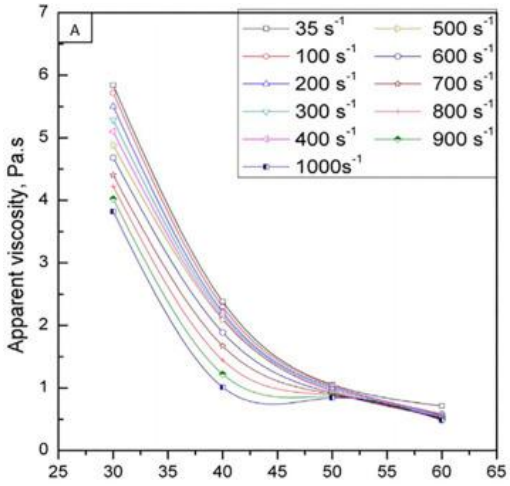


Fig. 1. Viscosity response of heavy oil in the heat treatment temperature range of 30–60° [21]

Figure 2 shows the effect of temperature on the typical flow behavior of heavy crude oil in terms of viscosity-shear rate. The figure clearly demonstrates the non-Newtonian shear thinning behavior in the range of shear rates where the apparent viscosity decreases significantly with temperature. This also shows that the differences in viscosity are greater at low shear rates than at high shear rates. This can be attributed to the strong effect of temperature on the viscosity and chemical structure of heavy crude oil components such as wax and asphaltene [12]. In addition, the viscosity of heavy crude oil is shear rate dependent, meaning that flow encounters less resistance at higher shear rates. As the shear rate increases, the chain-like molecule unwinds and reorients parallel to the driving force, reducing the viscosity of heavy crude oil. Therefore, the apparent viscosity depends on the shear rate at constant temperature and decreases with increasing temperature [23].

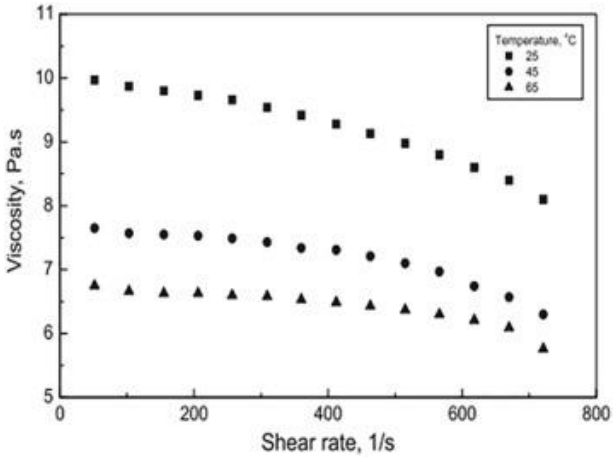


Fig. 2. Apparent viscosity as a function of shear rate of heavy crude oil at different temperatures [22]

In research studies [24-32], heating to raise the temperature of crude oil requires a considerable amount of energy and cost. Other problems include higher temperatures, greater internal corrosion due to the large number of heating stations required, and heat losses along the pipeline due to the low flow of heavy oil. However, in most cases, the pipeline is insulated to maintain high temperatures and reduce heat loss to the environment. In addition, sudden expansion and contraction along the pipeline can cause difficult problems. As a result, the cost of operating heating and pumping systems over long distances between the oil field and the final storage or processing plant is high [33]. This may not be a viable method for transporting crude oil through subsea pipelines. Finally, the cooling effect of the surrounding water, as well as the soil, reduces the efficiency of the method.

RHEOLOGICAL BEHAVIOR OF HEAVY CRUDE OIL IN WATER EMULSION

One of the effective ways to reduce the viscosity of heavy oil is the formation of oil-in-water emulsions with the help of surfactants.

Emulsions consist of a dispersion of an immiscible liquid (dispersed phase) in another liquid (continuous phase), usually with a drop size in the micrometer range. They generally fall into three categories (Figure 3): oil-in-water (O/W), water-in-oil (W/O), and complex or multiple emulsions. Many emulsions have continuous-phase droplets within dispersed phase droplets such as oil in water (W/O/W). In the emulsification method, droplets from the oil phase are dispersed into the water phase using suitable surfactants to form a stable oil-water emulsion. Thus, the formation of an emulsion significantly reduces the pour point as well as the viscosity of crude oil. Since water is a stable phase, the risks of wax deposits on the pipe surface, clogging of pipelines and corrosion are avoided. Optimizing the economics of the transportation process is always a priority for the oil industry. For maximum efficiency and economy, it is important to keep the oil content as high as possible while minimizing the viscosity of the crude oil. For efficient transportation of heavy crude oil, a stable oil-water emulsion must be prepared so that the water does not separate until it reaches the desired destination. Techniques used to create oil droplets to form emulsions include the use of devices such as dispersers, rotor-stator mixing, colloid mills, high-pressure homogenizers that apply high shear stresses, membrane emulsification, and ultrasonic waves.

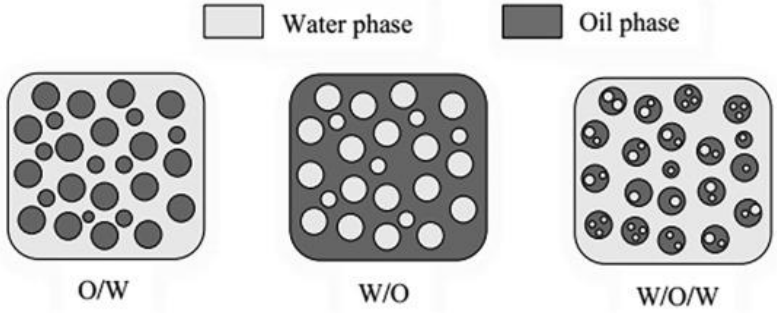


Fig. 3. Classification of oil emulsions [32]

CORE ANNULAR FLOW METHOD

The core annular mode flow is another method used to increase the transport of viscous crude oil. This method is based on the development of a core annular flow (CAF) to reduce pressure loss caused by friction in the pipeline. In this method, a less viscous fluid, such as water, is introduced into the flow to act as a lubricant that absorbs the shear stress that exists between the pipe walls and the fluid, thus reducing the resistance to flow and creating an overall pressure drop [33].

This method can be problematic because the crude oil tends to stick to the walls of the pipeline, thereby restricting and eventually clogging the flow system. Such problems are exacerbated where the flow has to be stopped for a period of time, allowing oil and water phases to stratify and increase oil adhesion. Restarting flow in such a stopped system may require a large pressure, pos-

sibly exceeding the pressure rating of some or all components of the flow system. In such a problem, it is also mandatory to flush the flow system to remove the adhering oil, which leads to additional costs and the failure of the flow system. A lot of work has been done in this direction to solve the problem.

PARTIAL UPGRADING METHOD

Another method of transporting heavy oil is to change it before it is transported. Partial upgrading is the process of changing the composition of crude oil by making it less viscous, without significantly changing its processing characteristics. Full upgrading completely changes the crude composition, turning it into a light synthetic crude oil that is more convenient to transport and more valuable [34].

The main advantage of this technique is that crude oil can be transported without any changes in the pipeline system.

Another advantage of this process is that it does not accumulate large volumes of coke by-product that must be stored or transported offsite. The produced coke is consumed by the process itself and converted into energy on the spot.

CONCLUSION

Despite the recent discoveries of huge oil fields consisting of conventional oils, heavy oil and bitumen still constitute a large part of the world's oil reserves. If the price of oil is favorable and suitable technology is available to produce and transport these oils, heavy oil reserves can be essential to meet the global energy demand for fuels and oil derivatives. The transportation strategy of these oils depends on the oil properties such as viscosity, API weight and asphaltene content and the potential to obtain high value products after the distillation process.

In this research work, several factors influencing the rheology of heavy oil raw materials were analyzed and various models were considered. At the same time, transportation of viscous oils, various methods of reducing their viscosity were considered. Many methods have been proposed to transport heavy oils; however, many of them fail in terms of commercial application either as a recovery method or as a pipeline flow improvement method.

An increase in temperature significantly reduces the viscosity of the raw material, which indicates a change in the rheological behavior. As the temperature increases, the viscosity of the heavy crude oil decreases, reducing the shear stress between the circulating crude oil and the pipe wall, thereby reducing the pressure drop and ultimately improving transportability. However, it has disadvantages such as high capital cost and fuel consumption, as well as difficulty in restarting after shutdown. In addition, special design, insulation, and welding technology degrees are required to manage the transportation of this type of pipeline.

REFERENCES

1. Manafov, M.R. Study of the effect of asphaltene-resinous compounds on the separation of oil emulsions / M.R. Manafov, F.R. Shikhieva, K.I. Matiyev [et al.] // Azerbaijan Chemical Journal, – 2022. №2, – p. 18-27.
2. Ibrahim, R.I. An overview on the recent techniques for improving the flowability of crude oil in pipelines / R.I. Ibrahim, M.K. Odah, A. Al-Mufti // IOP conference series: materials science and engineering, – 2019. – p. 1-9.
3. Meyer, R.F. Heavy Oil and Natural Bitumen Resources In Geological Basins Of The World / R.F. Meyer, E.D. Attanasi, P.A. Freeman // Open File-Report, – 2007. – p. 1-36.

4. Manafov, M.R. Analysis of the modern state of researches on deposition of asphalt-resin substances, paraffin and modeling methods review / M.R. Manafov, G.I. Kelbaliev // Azerbaijan Chemical Journal, – 2020. №2, – p. 6-19.
5. Manafov, M.R. Analysis of the current state of researches of the deposition of asphalt-resinous substances, paraffin, and modeling methods. Review part II: wax deposition / M.R. Manafov, G.S. Aliyev, A.I. Rustamova [et.al] // Azerbaijan Chemical Journal, – 2021. №2, – p. 13-23.
6. Manafov, M.R. Study of the effect of asphaltene-resinous compounds on the separation of oil emulsions / M.R. Manafov, F.R. Shikhieva, K.I. Matiyev [et al.] // Azerbaijan Chemical Journal, – 2022. №2, – p. 18-27.
7. Wenjie Dong. Evolution of the Properties and Composition of Heavy Oil by Injecting Dry Boiler Flue Gas / Dong Wenjie, Yanmin Ji, Jian Wang [et al.] // ACS Omega, – 2021, 6 (50), – p. 34675-34686.
8. Lei, J. A simple and effective strategy to enhance the stability and solid-liquid interfacial interaction of an emulsion by the interfacial dilational rheological properties / J. Lei, Y. Gao, X. Hou [et al.] // Soft Matter, – 2020, 16 (24), p. 5650-5658.
9. Garibotti, C. Upscaling non-Darcy low. / C. Garibotti, M. Peszynska // Transport in porous Media, –2009. №3, – p. 401-430.
10. Kelbaliev, G.I. Rheology of a viscous-plastic liquid in a porous medium / G.I. Kelbaliev, M.R. Manafov, F.R. Shikhieva // Open Journal of Fluid Dynamics, – 2023. – p. 16-31.
11. Ali, L.H. Investigations into asphaltenes in heavy crude oils. I. Effect of temperature on precipitation by alkane solvents / L.H. Ali, K.A. Al-Ghannam // Fuel, – 1981, 60 (11), – p. 1043-1046.
12. Balho, M. Polynomial iteration laws for low Reynolds number oils through porous media / M. Balho, A. Mikeelic, M.F. Wheeler // Transport in Porous Media, – 2009. №8, – p. 35-60.
13. Andrzej Anderko. Phase equilibria in aqueous systems from an equation of state based on the chemical approach // Fluid Phase Equilibria, – 1991. – p. 89-110.
14. Mansoori, Ali G. Descriptive Accounts of Thermodynamic and Colloidal Models of Asphaltene Flocculation / Ali G. Mansoori, Kosta Leontaritis, Seido Kawanaka // AIChE Spring National Meeting and Petrochemicals Expo conference, – 2018. – p. 1-16.
15. Santoso, R.K. Study of Non-Newtonian fluid flow in porous media at core scale using analytical approach / R.K. Santoso, I. Fauzi [et al.] // Geosystem Engineering, – 2018, 21 (1), – p. 21-30.
16. Andersen, S.I. Thermodynamic models for asphaltene solubility and precipitation / S.I. Andersen, J.G. Speight // Journal of Petroleum Science and Engineering, – 1999, 22 (1-3), – p. 53-66.
17. Yarranton, H.W. Molar mass distribution and solubility modeling of asphaltenes / H.W. Yarranton, J.H. Masliyah // AlChE Journal, – 1996, 42 (12), – p. 3533-3543.
18. Akbari, S. Emulsion types, stability mechanisms and rheology: A review / S. Akbari, A.H. Nour // International Journal of Innovative Research and Scientific Studies, – 2018, 1 (1), – p. 11–17.
19. Guohua Chen. Separation of Water and Oil From Water-in-Oil Emulsion by Freeze/Thaw Method / Guohua Chen, Gaohong He // April Separation and Purification Technology, – 2003, 31 (1), – p. 83-89.
20. Naiya, T.K. Heavy crude oil rheology improvement using naturally extracted surfactant SPE Oil & Gas India Conference and Exhibition / T.K. Naiya, S.Banerjee, R.Kumar [et al.] // Society of Petroleum Engineers, – 2015. – p. 1-17.
21. Kumar, R. Flow improvement of heavy crude oil through pipelines using surfactant extracted from soapnuts / R. Kumar, S.Banerjee, A.Mandal [et al.] // Journal of Petroleum Science Engineering, – 2017. – p. 353-360.
22. Ghannam, M.T. Rheological properties of heavy & light crude oil mixtures for improving flowability / M.T. Ghannam, S.W. Hasan, B. Abu-Jdayil [et al.] // Journal of Petroleum Science Engineering, – 2012. – p. 122-128.

23. Kumar, R. Application of naturally extracted surfactant from Madhuca longifolia to improve the flow properties of heavy crude oil through horizontal pipeline / R. Kumar, G.S. Bora, S. Banerjee [et al.] // Journal of Petroleum Science Engineering, – 2018. – p. 178-189.
24. Martínez-Palou, R. Transportation of heavy and extra-heavy crude oil by pipeline: a review / R. Martínez-Palou, M. de Lourdes Mosqueira, B. Zapata-Rendón [et al.] // Journal of Petroleum Science Engineering, – 2011, 75 (3–4), – p. 274-282.
25. Hart, A. A review of technologies for transporting heavy crude oil and bitumen via pipelines // Journal Petrol Exploration Productivity Technology, – 2014, 4 (3), – p. 327-336.
26. Saniere, A. Pipeline transportation of heavy oils, a strategic, economic and technological challenge / A. Saniere, I. Hénaut, J.F. Argillier // Oil Gas Science Technology, – 2004, 59 (5), – p. 455-466.
27. Homayuni, F. The viscosity reduction of heavy and extra heavy crude oils by a pulsed magnetic field / F. Homayuni, A.A. Hamidi, A. Vatani [et al.] // Petroleum Science Technology, – 2011, 29 (23), – p. 2407-2415.
28. Santos, R.G. An overview of heavy oil properties and its recovery and transportation methods / R.G. Santos, W. Loh, A.C. Bannwart [et al.] // Brazilian Journal of Chemical Engineering, – 2014, 31 (3), – p. 571-590.
29. Sivakumar, P. Flow improvers for assured flow of crude oil in midstream pipeline-A review / P. Sivakumar, A. Sircar, B. Deka [et al.] // Journal of Petroleum Science Engineering, – 2018, – p. 24-30.
30. Hasan, S.W. Heavy crude oil viscosity reduction and rheology for pipeline transportation / S.W. Hasan, M.T. Ghannam, N. Esmail // Fuel, – 2010, 89 (5), – p. 1095-1100.
31. Santos, I.C. Factors that affect crude oil viscosity and techniques to reduce it: a review / I.C. Santos, P.F. Oliveira, C.R.E. Mansur // Brazilian Journal of Petroleum Gas, – 2017, 11 (2), – p. 115-130.
32. Sweeta Akbari. Emulsion Types. Stability Mechanisms and Rheology: A Review / Sweeta Akbari, Abdurahman Hamid Nour // International Journal of Innovative Research and Scientific Studies, – 2018, 1 (1), – p. 11-17.
33. Kokal, S.L. Crude Oil Emulsions: A State-Of-The-Art Review // SPE Production & Facilities, – 2005, 20 (1), – p. 5-13.
34. Ursica, L. Particle size analysis of some water/oil/water multiple emulsions / L. Ursica, D. Tita, I. Palici // Journal of Pharmaceutical and Biomedical Analysis, – 2005, 37 (5), – p. 931-936.

AĞIR XAM NEFTİN REOLOGİYASI

F.R. Şıxıyeva, V.İ. Kərimli, M.R. Manafov

Artan neft tələbatı dünyanın nəhəng enerji ehtiyatları olan ağır neft və bitumun inkişafını təşviq edir. Lakin onların yüksək özlülüyü onların istifadəsində böyük problemdir, çünki lazımi üsul olmadan nəql edilə bilməz. Ağır neftin daşınması üçün bir sıra üsullar işlənib hazırlanmışdır ki, bunlara durulducuların, qızdırılan boru kəmərlərinin, emulsiyaların və xam neftin təkmilləşdirilməsi daxildir.

Məlumdur ki, ağır neftin ümumi xarakterik xüsusiyyətləri yüksək özlülük, yüksək xüsusi çəkisi, yüksək molekulyar tərkibi və aşağı hidrogenin karbona nisbəti, yüksək karbon qalıqları və asfaltenlərin, ağır metalların, kükürdün və azotun yüksək tərkibidir. Ağır neftlər karbohidrogenlərin strateji mənbəyidir, çünki onların ehtiyatları adi neftlərin ehtiyatları ilə eyni miqyasdadır. Bu xammalların istehsalı, xüsusən onların çox yüksək özlülüklərinə görə aşağı olaraq qalır.

Tədqiqat işində neftin tərkibindəki ağır hissəciklərin (asfaltenlər, parafinlər, qatranlar və bərk faza hissəcikləri) hidrodinamik qarşılıqlı təsiri nəticəsində əmələ gələn ağır neft reologiyası prob-

lemlərinə baxılmışdır. Ağır xam neftin daşınması özlülüyün kifayət qədər aşağı olmasını tələb edir ki, boru kəmərinin ölçüsü və nasos tələbləri iqtisadi cəhətdən optimal olsun. Bu xüsusiyyətlərə nail olmaq üçün bir neçə üsul var ki, onlardan bəziləri sahədə təsdiqlənib və hazırda istifadə olunur, digərləri isə inkişaf mərhələsindədir.

Hazırki tədqiqat işimizdə biz bu üsullardan bəzilərinin analizini aparmış və gələcək perspektiv üçün ağır neftlərin reologiyasının yaxşılaşdırılmasına dair öz tövsiyələrimizi vermişik.

Açar sözlər: *reologiya, ağır xam neft, neft emulsiyaları, özlülük, suda neft emulsiyası, neftdə suda emulsiyası*

РЕОЛОГИЯ ТЯЖЕЛОЙ НЕФТИ

Ф.Р. Шихиева, В.И. Керимли, М.Р. Манафов

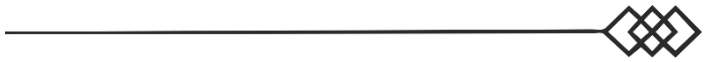
Растущий спрос на нефть стимулирует разработку тяжелой нефти и битума, огромных мировых запасов энергии. Однако их высокая вязкость является большой проблемой при их использовании, поскольку их нельзя транспортировать без надлежащего метода. Был разработан ряд методов транспортировки тяжелой нефти, включая разбавители, обогреваемые трубопроводы, эмульсии и обогащение сырой нефти.

Известно, что общими характеристиками тяжелой нефти являются высокая вязкость, высокий удельный вес, высокое молекулярное содержание и низкое отношение водорода к углероду, высокое содержание углеродистых остатков и высокое содержание асфальтенов, тяжелых металлов, серы и азота. Тяжелые нефти являются стратегическим источником углеводородов, поскольку их запасы не уступают запасам обычных нефтей. Производство этого сырья остается низким, особенно из-за его очень высокой вязкости.

В работе рассмотрены проблемы реологии тяжелой нефти, обусловленные гидродинамическим взаимодействием тяжелых частиц в нефти (асфальтены, парафины, смолы, частицы твердой фазы). Транспортировка тяжелой сырой нефти требует, чтобы вязкость была достаточно низкой, чтобы размер трубопровода и требования к перекачиванию были оптимальными с экономической точки зрения. Существует несколько методов достижения этих свойств, некоторые из которых были проверены в полевых условиях и используются в настоящее время, а другие находятся в стадии разработки.

В нашей текущей исследовательской работе мы проанализировали некоторые из этих методов и дали свои рекомендации по улучшению реологии тяжелых нефтей на будущее.

Ключевые слова: *реология, тяжелая нефть, нефтяные эмульсии, вязкость, эмульсии масло-в-воде, эмульсии вода-в-масле*



CHEMICAL SCIENCES

UDC: 543.5; 544; 544.03; 504
ORCID: 0000-0003-4160-1956 (Mirzazada)
ORCID: 0009-0001-6482-0441 (Valimatova)
ORCID: 0000-0001-6842-4975 (Guliyeva)
ORCID: 0000-0003-3321-1026 (Gurbanov)

STUDY OF THE PYROLYSIS PROCESS OF PLASTIC WASTE BY DERIVATOGRAPHIC ANALYSIS METHOD

Elshan Valeh Mirzazada[1,2], Naida Iskandar Valimatova[2], Ulviyya Aydin Guliyeva[1], Muslum Ahmed Gurbanov[1]
[1]Institute of Radiation Problems of the Ministry of Science and Education
[2]Institute of Geology and Geophysics of the Ministry of Science and Education
E-mail: el.mirzazada@gmail.com
Received: 27.01.2023
Accepted: 15.08.2023

The dependance of temperature and time on mass loss, mass loss rate and intensity of endothermic peaks during the pyrolysis process of polyethylene terephthalate (PET-1) polymer at various heating rate (10, 50 ^{0}C/min) was studied by derivatography methods. The parameters, as temperature (T) and time (t) of the beginning of destruction, temperature (T) and time (t) of half destruction, mass destruction time (min) at 510^{0}C and energy activation of the destruction process were estimated. Furthermore, the melting parameters as ΔH, square peak (mJ) and mass loss rate (Δmdt) are calculated. The obtained results show that as the heating rate increases, the destruction process occurs at higher temperatures, the initiation time of the destruction process decreases, and the activation energy of the decomposition is approximately equal to 58-60 kcal/mol. Two stages of exothermic nature were observed. The first occurs in the temperature range from 377,0 °C to 410.4°C, and the other in the range of 430.0°C to 475.7°C.

Keywords: *pyrolysis, mass loss, plastic, thermogravimetric analysis.*
DOI: 10.59849/2409-4838.2023.3.30

INTRODUCTION

The generation of plastic waste and its negative effects on the environment are increasing. It is known that there is about one ton of plastic waste in every three tons of fish [1]. The analysis conducted in 2017 showed that by 2050, the amount of primary plastic waste, untreated and treated may increase dramatically [2]. Hence, research on the neutralization and recycling of these wastes is a significant scientific and practical issue [3-6]. Currently, despite the development of various methods (mechanical, landfill placement, chemical plasma method) in this field, the pyrolysis method is more promising. Solid residues, liquid compounds and gas products can be obtained, in the pyrolysis method [7-9]. The speed of the process is related to the composition of pyrolyzed plastic masses as well as the temperature. One of the investigation methods of plastic wastes degradation processes is application of thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC), that gives the information of kinetics and thermal properties of wastes under the effect of heat energy. Despite some research work on thermogravimetric study, there is need to continue the work on pyrolysis processes of plastic waste. Purpose of this work is the study of the thermal conversion process of PET-1 plastic wastes with TGA and DSC analysis methods.

MATERIAL AND METHODS

The Perkin Elmer Simultaneous Thermal Analyzer STA 6000 (USA) was used. The PET samples (5.66-11.76 mg) with dimensions of 0.03-0.06 cm^2 were taken for analysis. In the device, these samples were heated up to a temperature of 700ºC in a nitrogen atmosphere, and appropriate parameters were set. The activation energy was calculated according to Arrhenius equation [10]:

$$ln\Delta t = -\frac{E}{RT} + C$$

where Δt is the depth of the peak of the DTA curve, which is proportional to the rate constant of the phase transformation at the temperature T. From the dependence ln Δt -1/T. The tangent of the slope of which will be expressed:

$$tg\ \varphi = -\ E/R$$

To graphically determine the activation energy on the initial branch of the peak of the DTA curve, 8-9 points are randomly selected, as shown in Figure 1.

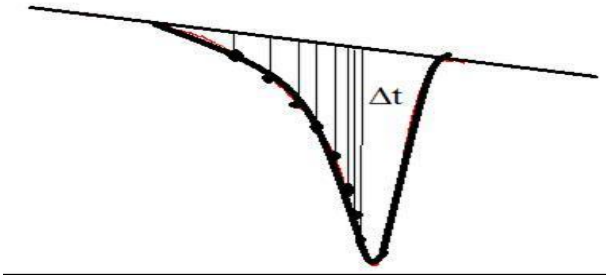
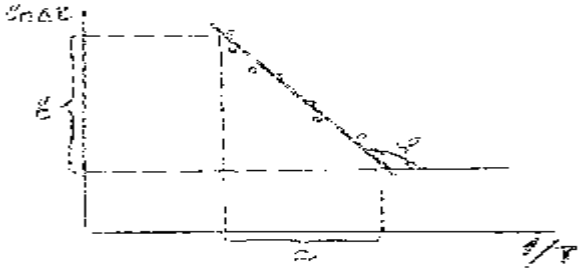


Fig. 1. Initial branch of the peak of the DTA curve

For each of them, using a ruler, measure the distance to the baseline (Δt, mm). For each of them, the temperature (t, ºC) is determined by projecting onto the T curve. The data obtained are applied in the form of dots to the figure and an averaged line is drawn in the coordinates ln Δt - 1 / T, as shown in Figure 2 the tangent of the slope angle of which is used to calculate the activation energy E, kJ / mol.



$$E = -R * tg\varphi;\ -tg\varphi = \frac{b}{a};$$

Fig. 2. Dependence ln Δt on 1 / T

The structural formula (Figure 3) and physicochemical properties of PET-1 brand polyethylene terephthalate polymer for research are given in the table 1.

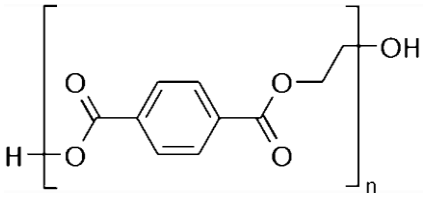


Fig. 3. The structural formula of polyethylene terephthalate polymer PET-1 brand

Table 1.

Physico-chemical properties of polyethylene terephthalate polymer PET-1 brand [11]

Molar mass	10–50 kg/mol, varies
Density	1.38 g/cm^3, 20 °C 1.370 g/cm^3, amorphous 1.455 g/cm^3 single crystal
Melting point	> 250 °C -260 °C (280 °C-320 °C)
Boiling point	> 350 °C (decomposes)
Solubility in water	Practically insoluble
log P	0.94540
Thermal conductivity	0.15 to 0.24 W/(m·K)
Refractive index (nD)	1.57–1.58, 1.5750
Heat capacity (C)	1.0 kJ/(kg·K)
Young's modulus, E	2800–3100 MPa
Tensile strength, σt	55–75 MPa
Elastic limit	50–150 %
Notch test	3.6 kJ/m^2
Glass transition temperature, Tg	67–81 °C
Vicat B	82 °C
Linear expansion coefficient, α	7×10^{-5} K^{-1}
Water absorption (ASTM)	0.16

Apparently, the melting temperature of the polymer is (280°C-320°C) according to some data, and the pyrolysis process of polymers usually occurs around 500°C. As a result of the pyrolysis process, fractions of gas products, liquid products and solid residual products are obtained.

RESULTS AND DISCUSSION

Polymer materials used for water packaging (bottles) were divided into parts with an area of approximately 0.03-0.06 cm^2 and placed in glass ampoules and pyrolyzed in the range of 20^0C-700 ^{0}C in a nitrogen flow in a brand derivatograph device using standard methodology. The quantity of the substance taken for pyrolysis was in the range of 5-12 mg and prepared samples were pyrolyzed at the rates of 10, 50^0 C/min, respectively. As a result of the study, polymer mass loss, mass loss rate and endothermic peaks characteristic of thermal transformations were measured in the considered temperature range. The results obtained at different heating rates are given in the following figures (Figure 2 a-b, Figure 3 a-b).

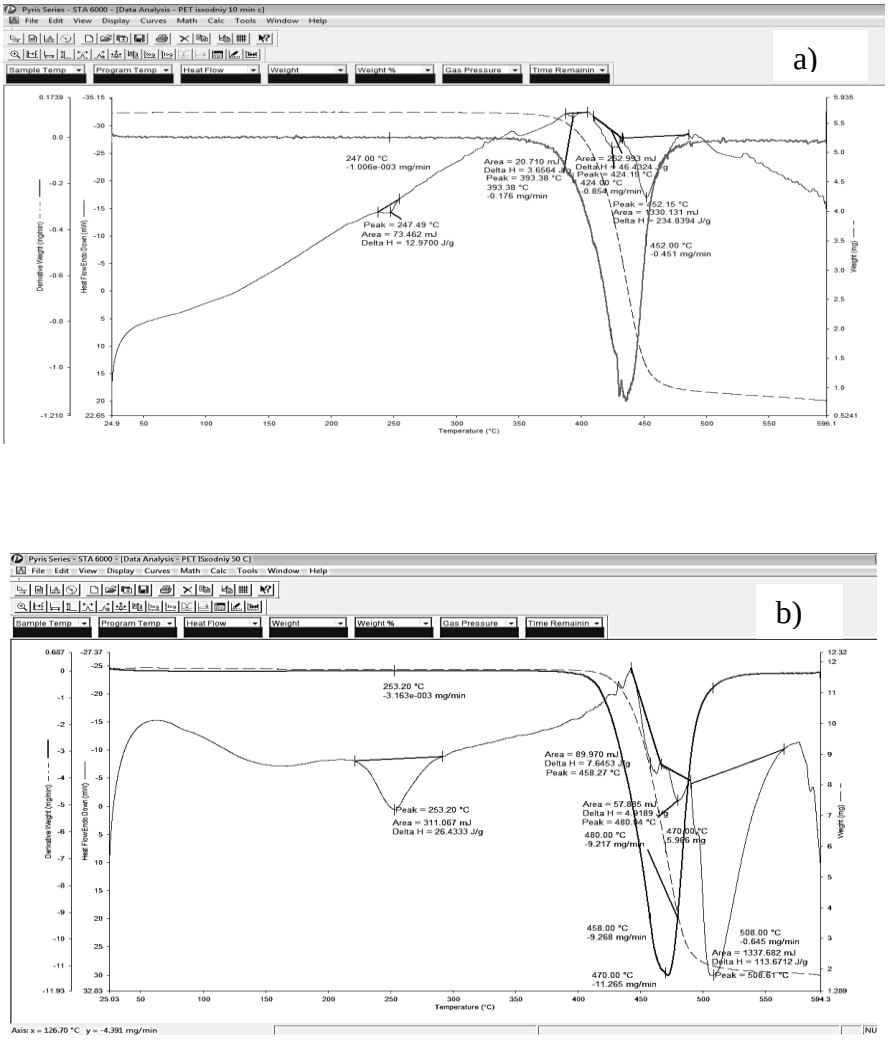
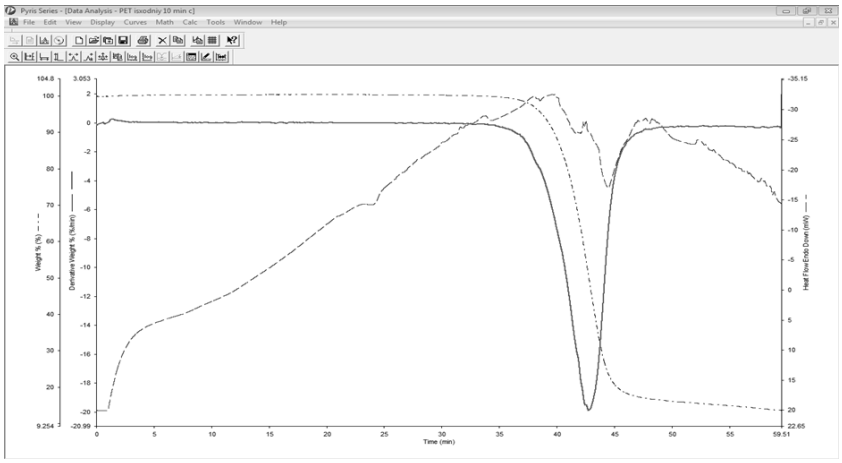
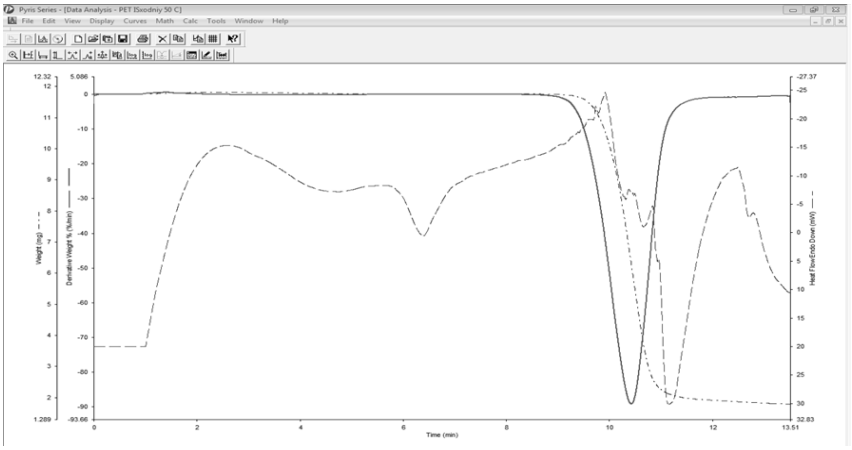


Fig. 2. Temperature dependence of mass loss, mass loss rate and intensity of endothermic peaks during the pyrolysis process of PET 1 polymer, a-10^0 C/min, b-50 ^{0}C/min



a)



b)

Fig. 3. Time dependence of mass loss, mass loss rate and intensity of peaks during the pyrolysis process of PET 1 polymer. a-10 ^{0}C/min, b-50 ^{0}C/min.

Table 2 a.

Values of parameters calculated from derivatographic dependencies

Heat rate, ^{0}C/min	Initial mass, mg	Left mass, mg	Conversion, %
10	5,66	4.892	86,36
50	11,76	9,97	84,77

Table 2 b.

Values of parameters calculated from derivatographic dependencies (continuation)

Heat rate ^{0}C/min	10	50
Temperature of beginning of destruction, ^{0}C	395,5	416,58
Time of beginning of destruction, min	38,731	9,43
Temperature of half destruction, ^{0}C	435,52	470.3
Time of half destruction, min	42,7	10,4
Destruction at 510 ^{0}C, %	16	17,6
Mass destruction time at 510 ^{0}C, min	49,3	11,21
E_a kkal/mol	58,1	59,8

As can be seen from the table (2 a, 2 b), the temperature of the start of destruction changes from 395^{0}C to 416^{0}C as the heating rate increases. As the heating rate increases, the decomposition process takes less time. Thus, the decomposition time at the heating rate of 10 ^{0}C/min is 38,7 min, but at 50 ^{0}C/min. 9,43 min at the heating rate. The half-destruction temperature also increases from 435^{0}C to 470^{0}C as the heating rate increases. Time of half destruction decreases from 42,7 min to 10,4 min as the heating rate increases. Destruction time at 510^{0}C is 49,3 min at 10^{0}C/min, that decreases up to 11,2 min at 50 ^{0}C/min. The activation energy values were calculated from the mass reduction curve at both heating rates based on the Arrhenius equation, and these values were 58,1 kcal/mol at a heating rate of 10 ^{0}C/min, and 59,8 kcal/mol at a heating rate of 50^{0}C/min. The melting and destruction processes are listed in the table 3.

Table 3.

Melting and destruction processes

	Melting, Peak 1				Destruction, Peak 1				Destruction, Peak 2				Destruction, Peak 3			
ΔT Δt	dm/dt, mg/sec	T, °C	Area ,mJ	H, J/gr	dm/dt, mg/sec	T, °C	Area, mJ	ΔH, J/gr	dm/dt, mg/sec	T, °C	Area, mJ	ΔH, J/gr	dm/dt, mg/sec	T, °C	Area, mJ	ΔH, J/gr
10 °C / min	1,97 E-03	247,0	73,4	13,0	0,2	393,4	20.7	3,7	0,85	424	252,9	46,4	0,5	452.2	1330.1	234.8
50 °C / min	3,16 E-003	253,0	311,0	26,0	9,3	458,0	90	7,6	9,217	480	57,9	4,9	0,6	508	1227,7	113,7

The obtained results show that as the heating rate increases, the decomposition process occurs at higher temperatures, the initiation time of the decomposition process decreases, and the activation energy of the decomposition is approximately equal to 58-60 kcal/mol. Melting temperature is 249-253 C, enthalpy (ΔH) is about 28-30 J/gr. The area of the peak corresponding to the melting process increases as the heating rate increases. At a heating rate of 50 C/min, the melting peak area is 358.4 mJ. Two stages of exothermic nature were observed. The first occurs in the temperature range from 377.0 °C to 410.4°C, and the other in the range of 430.0°C to 475.7 °C. Initial decomposition can be broadly seen as a two-stage thermal degradation process consisting of primary decomposition and secondary reactions. During the primary steps of decomposition weak aliphatic bonds (non-aromatics) are broken. The secondary phase of pyrolytic, thermal decomposition results in CH_4 and other n-alkanes.

REFERENCES

1. Donoso, D., Andreas, M. By 2025, our seas may be filled with one ton of plastic for every three tons of fish: [Electronic resource] / The Guardian-2015. URL: https://www.theguardian.com/sustainable-business/sep/30/dow-chemical-the-ocean-conservancy-ocean-plastics-pollution.
2. Geyer, R., Jambeck, J.R., Law, K.L. Production, Use, and Fate of All Plastics Ever Made // Science Advances Research Article, – 2017. №7, – p. 1-5.
3. Das, P., Tiwari, P. Thermal degradation study of waste polyethylene terephthalate (PET) under inert and oxidative environments // Thermochimica Acta, – 2019. – p. 178340.
4. Rostec, E. Thermogravimetry as a Research Method in the Transformation Processes of Waste Rubber and Plastic Products for Energy Carriers (Wte and WtL Processes) / E.Rostec, K.J.Bierant [et al.] // Sustain Development of Energy, Water and Environmental System, – 2013, 1 (2), – p. 163-171.
5. Giorgia, M. Primary thermal degradation mechanisms of PET and PBT / Montaudo Giorgia, Concetto Puglisi, Filippo Samperi [et al.] // Polymer Degradation and Stability, – 1993. – p. 13-28.
6. https://www.preprints.org/manuscript/201608.0099/v1.-Preprints 2016/
7. Martyna, S., Semida, S. Technologies for chemical recycling of household plastics – A technical review and TRL assessment // Waste Management, – 2020. – p. 128-138.
8. Kim, R., Laurens, D., Kevin Van, G. Mechanical and chemical recycling of solid plastic waste // Waste Management, – 2017. – p. 24-58.
9. Zocalya, N.Z., Nusatio, E.W., Felicia, Sh. Processing of Jakartas Plastic Waste to Gasoline with Catalytic Fluidized Bed Pyrolysis // Proceeding Book 7th Asian Society International Conference, – 2019, – p. 602-603.
10. https://studopedia.net/17_10974_analiz-poluchennoy-derivatogrammi-.html
11. Van der Vegt, A.K. Govaert, L.E. The Netherlands / A.K.Van der Vegt, L.E.Govaert. – 2005. – 2079 p.

PLASTİK TULLANTILARIN PİROLİZ PROSESİNİN DERİVATOQRAFİK ANALİZ ÜSULU İLƏ ÖYRƏNİLMƏSİ

E.V. Mirzəzadə, N.İ. Vəlimatova, Ü.A. Quliyeva, M.Ə. Qurbanov

Polietilentereftalat (PET-1) polimerinin müxtəlif qızdırma sürətlərində (10, 50 °C/dəq) piroliz prosesi zamanı temperatur və vaxt kütlə itkisindən, kütlə itkisi sürətindən və endotermik piklərin intensivliyindən asılı olaraq derivatoqrafiya üsulları ilə tədqiq edilmişdir. Parametrlər, temperatur (T) və destruksiyanın başlama vaxtı (t), yarımdestruksiya temperaturu (T) və vaxt (t), 510°C-də kütlənin destruksiya vaxtı (dəq) və destruksiya prosesinin aktivasiya enerjisi hesablanmışdır. Bundan əlavə, ΔH, kvadrat pik (mJ) və kütlə itkisi dərəcəsi (Δm/dt) kimi ərimə parametrləri hesablanır. Alınan nəticələr göstərir ki, qızdırma sürəti artdıqca, daha yüksək temperaturda destruksiya prosesi baş verir, destruksiya prosesinin başlama vaxtı azalır və parçalanmanın aktivləşmə enerjisi təxminən 58-60 kkal/mol-a bərabər olur. İki ekzotermik təbiətli mərhələ müşahidə edilmişdir. Birincisi 377,0°C ilə 410,4°C arasında, digəri isə 430,0 °C ilə 475,7°C arasında olan temperatur intervalında baş verir.

Açar sözlər: *piroliz, kütlə itkisi, plastik, termoqravimetrik analiz.*

ИССЛЕДОВАНИЕ ПРОЦЕССА ПИРОЛИЗА ПЛАСТИКОВЫХ ОТХОДОВ МЕТОДОМ ДЕРИВАТОГРАФИЧЕСКОГО АНАЛИЗА

Э.В. Мирзазада, Н.И. Валиматова, У.А. Кулиева, М.А. Курбанов

Методами дериватографии исследована зависимость температуры и времени от потери массы, скорость потери массы и интенсивность эндотермических пиков в процессе пиролиза полимера полиэтилентерефталата (ПЭТФ-1) при различной скорости нагрева (10, 50 ℃/мин). Оценивались такие параметры, как температура (T) и время (t) начала деструкции, температура (T) и время полудеструкции (t), время массовой деструкции (мин) при 510°C и энергия активации процесса деструкции. Кроме того, рассчитываются такие параметры плавления, как ΔH, квадрат пика (мДж) и скорость потери массы (Δm/dt). Полученные результаты показывают, что с увеличением скорости нагрева процесс деструкции протекает при более высоких температурах, время инициации процесса деструкции уменьшается, а энергия активации распада примерно равна 58-60 ккал/моль. Наблюдались две стадии экзотермического характера. Первый происходит в интервале температур от 377,0°C до 410,4°C, а другой - в интервале от 430,0°C до 475,7°C.

Ключевые слова: *пиролиз, потеря массы, пластик, термогравиметрический анализ.*

UDC: 541.123.3:546.289′22
ORCID: 0000-0003-1564-8080 (Suleymanova)

PRODUCTION OF NANOPARTICLES OF $AgAsS_2$ AND Ag_3AsS_3 COMPOUNDS

Turaj Ibrahim Suleymanova
Y.H. Mamedaliyev's Institute of Petrochemical Processes of the Ministry Science and Education
E-mail: teimxkl@gmail.com
Received: 19.03.2023
Accepted: 24.08.2023

Synthesis of ternary sulfides $AgAsS_2$ and Ag_3AsS_3 from systems $AgNO_3 - As_2S_3$, $AgNO_3 - NaAsO_2 - Na_2S$ and $AgNO_3 - As_2S_3 - HNO_3$ in ethylene glycol medium, obtained nano- and microparticles of compounds, their physicochemical properties studied. The solution stirred for 30 minutes, poured into an experimental bowl, placed in a Teflon cuvette, sealed and placed in a microwave electric heater and heated for a day at a temperature of 373-453 K. After synthesis, the precipitate filtered. For extraction, excess of arsenic washed with 0.1 M nitric acid solution, distilled water and ethanol. The purified precipitate dried at 353 K for 1 hour. It has been established that at pH = 4-6 and molar ratios of the initial components $AgNO_3 : As_2S_3 = 3:2$ and $AgNO_3 : As_2S_3 = 3:1$, $AgAsS_2$ and Ag_3AsS_3 compounds, respectively, are obtained. At 373-453 K, nanoparticles formed, the size of which varies depending on the temperature and duration of heat treatment. The individuality of the synthesized compounds controlled by differential thermal and X-ray diffraction methods of analysis. According to the DTA results, the $AgAsS_2$ and Ag_3AsS_3 compounds revealed two endothermic effects. The endothermic effect observed at 695 ± 2 K and 763 ± 2 K corresponds to the melting temperature of the $AgAsS_2$ and Ag_3AsS_3 compounds, respectively. The endothermic effect observed at 594 K and 465 K corresponds to a polymorphic transition. According to SEM data, it found that the synthesized compound has nano- and microsizes at 413-433 K. The sizes and shapes of nanoparticles and microparticles vary depending on conditions, temperature and pH.

Keywords: *organic solvent, silver (I) nitrate, nanoparticles, thioarsenites, sediment.*
DOI: 10.59849/2409-4838.2023.3.38

INTRODUCTION

The continuous search and study of new nanoscale materials is an important factor in the development of modern science and technology. Silver (I) thioarsenites ($AgAsS_2$ and Ag_3AsS_3) are among the important functional materials of modern technology. Most compounds of this class widely used and considered promising materials with valuable semiconductor, photo-, ferroelectric-, and thermoelectric properties [1, 2].

Synthesis of silver nanoparticles briefly, 5 mL of sodium citrate 0.05 M (TSC, Sigma-Aldrich CAS 6132-04-3) and 5 mL of silver nitrate 0.05 M ($AgNO_3$, PANREAC CAS 7761-88-8) added to 185 mL of water type 1 in a cold bath between 6°C to 10°C. The solution stirred for 3 min at 3000 RPM. Subsequently, 5 mL of sodium borohydride 0.05 M ($NaBH_4$, Sigma-Aldrich CAS 16940-66-2) dripped slowly. The pH adjusted to 10 with sodium hydroxide 1.25 M (NaOH, PANREAC CAS 1310-73-2). The nanoparticles obtained were stored in amber bottles at 4°C. These nanoparticles were the reference AgNPs (Ref-AgNPs) for the study [3-9].

In the $Ag_2S - As_2S_3$ system known compounds with compositions of $AgAsS_2$ and Ag_3AsS_3. These compounds possess unique semiconductor properties [10, 11]. $AgAsS_2$ compound melts at 696 K, polymorphic transformation occurs at 594 K, and according to [10], at the low-temperature modifi-

cation (trechmannite) (T < 594 K) crystallizes in the orthorhombic (sp. gr. $R\bar{3}$: a = 1.398, c = 0.912 nm), and at the high-temperature modification (smithite) – in the hexagonal (sp. gr. $A2/a$: a = 1.723, b = 0.778, c = 1.519 nm; β = 101,2^o) structures [12, 13, 14]. This compound decomposes at a temperature above 773 K.

The compound of Ag_3AsS_3 melts at 764 K, its polymorphic transformation occurs at 468 K. The low-temperature modification (xanthoconite) (T < 468 K) crystallizes in the orthorhombic (sp. gr. $C2/c$: a = 1.200, b = 0.626, c = 1.708 nm; β = 110^o), and the high temperature modification (proustite) – in the hexagonal (sp. gr. $R3c$: a = 1.083, c = 0.865 nm; β = 103.52^o) structures [12, 13].

From the literature [10, 11] it is known that silver thioarsenites are synthesized at high temperatures (700-800 K) in deaerated (~10^{-2} Pa) quartz ampoules by melting the elemental components or silver (I) sulfide with arsenic (III) sulfide. To homogenize these compounds is required high temperature and too much time. In this regard, the production of silver (I) thioarsenites in solution at low temperatures is one of the most urgent matters. It known that the production of d-metal chalcogenides in polar and low-polarity organic solvents is of great practical importance recently, since impurities are less in composition of the compounds obtained in an organic solvent medium. Furthermore, the formation of nanoparticles and microparticles is very easy. Information on the production of silver (I) thioarsenites in ethylene glycol medium is almost absent in the literature. Ethylene glycol is a colorless, viscous, hygroscopic, odorless liquid with sweetish taste. Its boiling point is 470.6 K, melting temperature 287.5 K, density 1.1132 g/cm^3. It is soluble in water, alcohols, and ketones, et al., mildly soluble in benzene, toluene, and diethyl ether. Aqueous solutions of ethylene glycol freeze at low temperatures (down to -343 K). It forms partial and full ethers with monobasic acids. Ethylene glycol used in many industries: chemical, motorcar, aerospace, electrical, textile, oil and gas and others. One of ethylene glycol main applications is the production of nonfreezable fluids, cooling, and heat-transfer agents. Ethylene glycol is use as solvent, as starting reagent in the chemical industry for the production of many inorganic compounds, synthetic resins, and polymers, in the manufacturing of polyurethanes, explosive, and odoriferous substances. The dielectric constant at 293 K is equal to 37.0 [3, 6, 15, 16]. Consider this, in the synthesis of Ag_3AsS_3 and $AgAsS_2$ compounds we used ethylene glycol as the solvent.

The study results of $AgAsS_2$ and Ag_3AsS_3 compounds nanoparticles obtaining conditions in ethylene glycol medium are cite in this paper.

MATERIAL AND METHODS

To obtain $AgAsS_2$ and Ag_3AsS_3 compounds nanoparticles in ethylene glycol medium are investigated physical and chemical interactions within the system of the $AgNO_3 - As_2S_3$, $AgNO_3 - NaAsO_2 - Na_2S$ and $AgNO_3 - As_2S_3 - HNO_3$.

As starting components in the $AgNO_3 - As_2S_3$ system were used $AgNO_3$ and As_2S_3. As_2S_3 and $AgNO_3$ were taken in a molar ratio, according to the reaction equation, mixed, and 20 ml of ethylene glycol were added to this mixture. The solution was stirred for 30 minutes, and then each sample was transferred to 2 autoclaves and heated for 24 hours at temperatures of 373-453 K. After synthesis, the precipitate filtered. For extraction, the excess of arsenic washed with 0.1 M of nitric acid solution, distilled water and ethanol. The purified precipitate dried at 353 K for 1 hour. The composition of the obtained compounds determined by NETZSCH STA 449F349F3 derivatograph (Germany) and chemical analysis. Differential thermal analysis (DTA) carried out in an HTP-70 pyrometer, Thermoscan-2 device, in an inert atmosphere. The phase analysis of $AgAsS_2$ and Ag_3AsS_3 nano- and microparticles was studied using a Bruker D8 ADVANCE X-ray diffractometer (CuKα, λ = 1.5406 Å, 0 < 2θ < 80º). Morphological studies performed using scanning electron microscopy

TM3000 (Hitachi, Japan), also studied the influence of pH medium (pH METER-pH410 "AKVILON").

RESULTS AND DISCUSSION

The resulting precipitate investigated by microstructure analysis. It ascertained that the nanoparticles (Figure 1) formed at 373-453 K. In practice, it ascertained that sizes of nanoparticles vary depending on the temperature and heat treatment time.

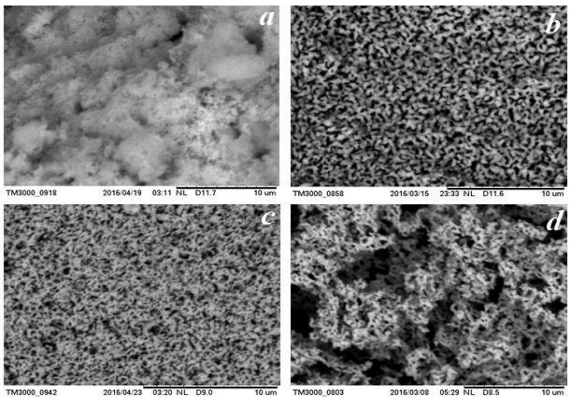


Fig. 1. The photomicrograph of nanoparticles of $AgAsS_2$ (*a* – at 373 K; *b* – at 453 K) and Ag_3AsS_3 (*c* – at 373 K; *d* – at 453 K) compounds.

The individuality of the synthesized compounds monitored by methods of differential thermal analysis (Figure 2).

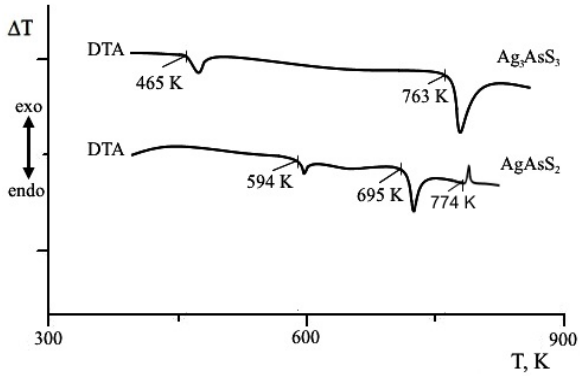


Fig. 2. The DTA curve of Ag_3AsS_3 and $AgAsS_2$ compounds.

In the DTA curve (Figure 2) of $AgAsS_2$ and Ag_3AsS_3 compounds found two endothermic effects. The endothermic effect observed at 695 ± 2 K and 763±2 K corresponds to the melting point of $AgAsS_2$ and Ag_3AsS_3 compounds, respectively. The endothermic effect observed at 594 K and 465 K corresponds to the polymorphic transition of $AgAsS_2$ and Ag_3AsS_3 compounds that agrees well with the published data, presented above. In this paper has been studied also the influence of pH medium and temperature on total precipitation of $AgAsS_2$ and Ag_3AsS_3 compounds. For production in an acid medium solution, we used hydrochloric acid and monitored product yield at different pH values of medium in the temperature range of 353-453 K. It has been ascertained that the maximum yield of $AgAsS_2$ and Ag_3AsS_3 compounds is observed at pH = 4 and at the temperature of 393 K. According to XRD data it has been found that at pH >7 a mixture of products: Ag_3AsO_3, H_3AsO_3, Ag_2S

и $AgAsS_2$ (Ag_3AsS_3) is formed in the system. $AgAsS_2$ and Ag_3AsS_3 compounds decompose at pH < 2. Effect of medium pH and temperature on complete precipitation of $AgAsS_2$ and Ag_3AsS_3 compounds represented in the following table 1.

Table 1.

The study results of medium pH and temperature effect on the yield of $AgAsS_2$ and Ag_3AsS_3 compounds.

The temperature, K	pH	Compound yield, %	
		$AgAsS_2$	Ag_3AsS_3
343	3.5	93.31	92.59
373	3.8	94.67	95.52
393	4	96.94	97.68
435	5	96.64	95.49
453	6	95.32	95.13

In the $AgNO_3 - NaAsO_2 - Na_2S$ system at the synthesis of $AgAsS_2$ and Ag_3AsS_3 compounds in ethylene glycol medium we used $AgNO_3$, $NaAsO_2$ and Na_2S as starting components. According to the reaction equation:

$$AgNO_3 + NaAsO_2 + 2Na_2S + 4HNO_3 \rightarrow AgAsS_2 + 5NaNO_3 + 2H_2O;$$
$$3AgNO_3 + NaAsO_2 + 3Na_2S + 4HNO_3 \rightarrow Ag_3AsS_3 + 7NaNO_3 + 2H_2O$$

We mixed $NaAsO_2$ and $AgNO_3$ with Na_2S in ethylene glycol medium in molar ratios of $AgNO_3 : NaAsO_2 : Na_2S = 1:1:2$ and $AgNO_3 : NaAsO_2 : Na_2S = 3:1:3$, respectively. Synthesis carried out in the temperature range of 413-433 K for 24 hours. According to SEM HITACHI TM3000 data it is ascertained that the synthesized compound is nano- and micro-sized at 413-433 K. Sizes and shapes of nano- and microparticles vary depending on the conditions, temperature and pH = 4-5 (Figure 4.).

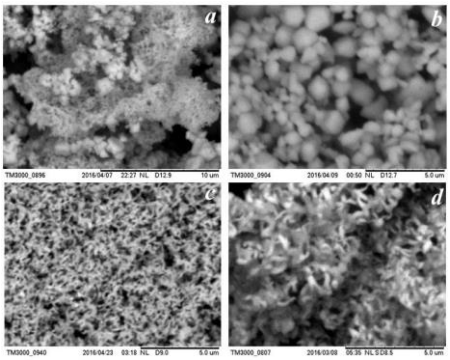
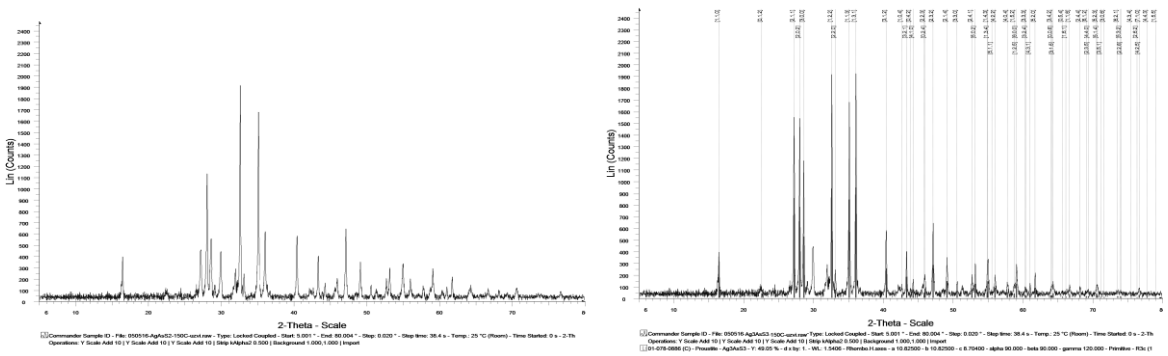


Fig. 4. The photomicrograph of nanoparticles of $AgAsS_2$ (*a* – at 413 K; *b* – at 433 K) and Ag_3AsS_3 (*c* – at 413 K; *d* – at 433 K) compounds

Based on the XRD data, it determined that at 453 K $AgAsS_2$ (a) and Ag_3AsS_3 (b) compounds obtained in the system (Figure 5 a, b).



a) b)

Fig. 5. The diffraction pattern of $AgAsS_2$ (a) and Ag_3AsS_3 (b) compounds obtained at 453 K (a).

In the $AgNO_3 - As_2S_3 - HNO_3$ system depending on molar ratios of $AgNO_3$, As_2S_3 and HNO_3 are obtained Ag_3AsS_3 and $AgAsS_2$ compounds in ethylene glycol medium. Practically it found that in ethylene glycol medium, in molar ratios of $AgNO_3 : As_2S_3 : HNO_3 = 1:1:7$ obtained $AgAsS_2$ compound, and in $AgNO_3 : As_2S_3 : HNO_3 = 5:12:18$ – Ag_3AsS_3 compound.

$$As_2S_3 + AgNO_3 + 7HNO_3 \rightarrow AgAsS_2 + H_3AsO_4 + 8NO_2 + SO_2 + 2H_2O$$
$$5As_2S_3 + 12AgNO_3 + 18HNO_3 \rightarrow 4Ag_3AsS_3 + 6H_3AsO_4 + 30NO_2 + 3SO_2$$

CONCLUSION

Very simple synthetic methods developed for the preparation of $AgAsS_2$ and Ag_3AsS_3 chalcogenides in ethylene glycol medium without polluting the environment. Nanoparticles of $AgAsS_2$ and Ag_3AsS_3 compounds have been obtained in the systems of $AgNO_3 - As_2S_3$, $AgNO_3 - NaAsO_2 - Na_2S$ and $AgNO_3 - As_2S_3 - HNO_3$ The effect of temperature, time and pH on the complete formation of nanoparticles of these compounds studied. During the conducted research, it was determined that nanoparticles are obtained in the system of $AgNO_3 - NaAsO_2 - Na_2S$ at a temperature range of 453 K within 24 hours (pH = 4-5)

ACKNOWLEDGEMENTS

Based on the presentation at the 7th International Conference "Nanoparticles, Nanostructured coatings and microcontainers: technology, properties, applications".

REFERENCES

1. Saniger, J.M. Silver nanoparticles synthesized by direct photoreduction of metal salts. Application in surface-enhanced Raman spectroscopy / J.M. Saniger, R. Sato-Berr´u, R. Redo´n [et al.] // Journal of Raman Spectroscopy, – 2009, 40 (4), – p. 376–380.
2. Remita, S. X-ray radiolysis induced formation of silver nano-particles: a SAXS and UV-visible absorption spectroscopy study / S. Remita, P. Fontaine, E. Lacaze [et al.] // Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, – 2007. – p. 436-440.

3. Lim, P.Y. Synthesis of Ag nanospheres particles in ethylene glycol by electrochemical-assisted polyol process / P.Y. Lim, R.S. Liu, P.L. She [et al.] // Chemical Physical Letters, – 2006. – p. 304-308.
4. Ashkarran, A.A. A novel method for synthesis of colloidal silver nanoparticles by arc discharge in liquid // Current Applied Physics, – 2010. – p. 1442-1447.
5. Gu, X. Synthesis of silver nanorods and nanowires by tartrate-reduced route in aqueous solutions / X. Gu, C. Nie, Y. Lai [et al.] // Materials Chemical Physical, – 2006. – p. 217-222.
6. Sun, Y. Uniform silver nanowires synthesis by reducing $AgNO_3$ with ethyleneglycol in the presence of seeds and poly (vinyl pyrrolidone) / Y. Sun, Y. Yin, B. Mayers [et al.] // Chemical Materials, – 2002. – p. 4736-4745.
7. Nghia, N.K. Synthesis of nanowire-shaped silver by polyol process of sodium chloride / N.K. Nghia, N.M. Thong, N.P. Hung [et al.] // International Journal of Materials Chemical, – 2012, 2 (2), – p. 75-78.
8. Wiley, B.J. Synthesis and optical properties of silver nanobars and nanorice / B.J. Wiley, Y. Chen, J.M. McLellan [et.al] // Nanomaterial Letters, – 2007, 7 (4), – p. 1032-1036.
9. Darmanin, T. Microwave-assisted synthesis of silver nanoprisms / nanoplates using a “modified polyol process” / T. Darmanin, P. Nativo, D. Gilliland [et.al] // Colloids Surface, – 2012. – p. 145-151.
10. Chaus, I.S. The Ag_3AsS_3-Ag system / I.S. Chaus, N.M. Kompanichenko, V.G. Andreichenko // Inorganic Materials, – 1981, 17 (12), – p. 2146-2149.
11. Federova, Zh.N. Determination of the saturated vapor pressure over $AgAsS_2$ melt, / Zh.N. Federova, V.V. Gurov, B.G. Nenashev // Inorganic Materials, – 1985. – p. 9-11.
12. Schmid-Fetzer, R. Ternary Alloys-a Comprehensive Compendium of Evaluated Constitutional Data and Phase Diagrams // Ternary Silver Alloys, – 1988, 1 (2), – p. 612-624.
13. Schoenau, K.A. High-temperature phase transitions, dielectric relaxation, and ionic mobility of proustite, Ag_3AsS_3 and pyrargyrite, Ag_3SbS_3 / K.A. Schoenau, S.A.T. Redfern // Journal of Applied Physics, – 2002. – p. 7415-7424.
14. Zlokazov, V.B. The Electroconductivity of the Ag_3AsS_3 proustit under 260-760 K Temperature / V.B. Zlokazov, L.Ya. Kabelev, S.V. Karpachev // Experimental, Transport Phenomena, – 1983, 268 (6), – p. 1380-1384.
15. Oudhoff, K.A. Characterization of polyethylene glycols and polypropylene glycols by capillary zone electrophoresis and micellar electrokinetic chromatography / K.A. Oudhoff, P.J. Schoenmakers, Kok W.T. // Journal Chromatography A, – 2003. – p. 479-491.
16. Szymanski, A. Determination of short-chained polyethylene glycols and ethylene glycol in environmental samples / A. Szymanski, B. Wyrwas, M. Szymanowska [et al.] // Water Resources, – 2001, 35 (15), – p. 3599-3604.

$AgAsS_2$ VƏ Ag_3AsS_3 BİRLƏŞMƏLƏRİNİN NANOHİSSƏCİKLƏRİNİN ALINMASI

T.İ. Süleymanova

$AgAsS_2$ və Ag_3AsS_3 üçlü sulfidlərin $AgNO_3 - As_2S_3$, $AgNO_3 - NaAsO_2 - Na_2S$ və $AgNO_3 - As_2S_3 - HNO_3$ sistemlərindən etilenqlikol mühitində sintezi, alınan birləşmələrin nano- və mikrohissəcikləri, onların fiziki-kimyəvi xassələri tədqiq edilmişdir. Məhlul 30 dəqiqə qarışdırılır, təcrübə qabına tökülür, teflon kyuvetə yerləşdirilir, ağzı kip bağlanır və mikrodalğalı elektrik qızdırıcısına qoyulur. Bir gün ərzində 373-453 K temperaturda qızdırılır. Sintezdən sonra çöküntü süzülür, ekstraksiya üçün artıq arsen 0,1 M azot turşusu məhlulu, distillə edilmiş su və etanol ilə yuyulur. Təmizlənmiş çöküntü 1 saat ərzində 353 K-də qurudulur. Müəyyən edilmişdir ki, , ilkin komponentlərin $AgNO_3 : As_2S_3 = 3:2$ və $AgNO_3 : As_2S_3 = 3:1$ mol nisbətində və pH = 4-6 qiymətlərində müvafiq olaraq birləşmələr əldə edi-

lir. 373–453 K-da nanohissəciklər əmələ gəlir, hissəciklərin ölçüləri temperaturdan asılı olaraq dəyişir. Sintez edilmiş birləşmələrin fərdiliyi diferensial istilik və rentgen şüalanma analiz üsulları ilə müəyyən olunmuşdur. DTA nəticələrinə görə birləşmələrin iki endotermik təsiri aşkar edilmişdir. 695 ± 2 K və 763 ± 2 K-də müşahidə olunan endotermik təsir müvafiq olaraq birləşmələrin ərimə nöqtəsinə uyğundur. 594 K və 465 K-də müşahidə edilən endotermik təsir polimorfik keçidə uyğundur. SEM məlumatlarına əsasən, sintez edilmiş birləşmənin 413–433 K-də nano- və mikroölçülərə malik olduğu aşkar edilmişdir. Nanohissəciklərin və mikrohissəciklərin ölçüləri və formaları şəraitdən, temperaturdan və pH-dan asılı olaraq dəyişir.

Açar sözlər: *üzvi həlledici, gümüş (I) nitrat, nanohissəciklər, tioarsenitlər, çöküntü.*

ПОЛУЧЕНИЕ НАНОЧАСТИЦ СОЕДИНЕНИЙ $AgAsS_2$ И Ag_3AsS_3

Т.И. Сулейманова

Синтез тройных сульфидов $AgAsS_2$ и Ag_3AsS_3 из систем $AgNO_3 - As_2S_3$, $AgNO_3 - NaAsO_2 - Na_2S$ и $AgNO_3 - As_2S_3 - HNO_3$ в среде этиленгликоля, полученные нано- и микрочастицы соединений, изучены их физико-химические свойства. Раствор перемешивали в течение 30 минут и переливали в экспериментальную чашу, помещали на тефлоновую кювету, герметизировали и помещали в микроволновый электронагреватель и нагревали в течение суток при температуре 373-453 К. После синтеза осадок фильтруют. Для экстракции избыток мышьяка промывают 0,1 М раствором азотной кислоты, дистиллированной водой и этанолом. Очищенный осадок сушили при 353 К в течение 1 часа. Установлено, что при pH = 4-6 и мольных соотношениях исходных компонентов $AgNO_3 : As_2S_3 = 3:2$ и $AgNO_3 : As_2S_3 = 3:1$ соответственно получаются соединения $AgAsS_2$ и Ag_3AsS_3. При 373-453 К образуются наночастицы, размер которых меняется в зависимости от температуры и продолжительности термообработки. Индивидуальность синтезированных соединений контролируют дифференциально-термическим и рентгеноструктурным методами анализа. По результатам ДТА соединения $AgAsS_2$ и Ag_3AsS_3 выявили два эндотермических эффекта. Эндотермический эффект, наблюдаемый при 695 ± 2 К и 763 ± 2 К, соответствует температуре плавления соединений $AgAsS_2$ и Ag_3AsS_3 соответственно. Эндотермический эффект, наблюдаемый при 594 К и 465 К, соответствует полиморфному переходу. По данным СЭМ установлено, что синтезированное соединение имеет нано- и микроразмеры при 413-433 К. Размеры и формы наночастиц и микрочастиц варьируются в зависимости от условий, температуры и pH.

Ключевые слова: *органический растворитель, нитрат серебра (I), наночастицы, тиоарсениты, осадок.*

UDC: 536:546.231
ORCID: 0000-0001-5050-9858 (Ashirov)
ORCID: 0000-0002-3275-5833 (Babanly)
ORCID: 0000-0003-2357-6195 (Mashadiyeva)

THERMODYNAMIC STUDY OF SILVER-SILICON SELENIDES (TELLURIDES) BY THE EMF METHOD WITH AG_4RBI_5 SOLID ELECTROLYTE

Garay Mikayil Ashirov, Kamala Nagı Babanly, Leyla Farhad Mashadiyeva
Academician M.Nagiev named Catalysis and Inorganic Chemistry Institute of the Ministry of Science and Education
E-mail: garayasirov@gmail.com
Received: 04.04.2023
Accepted: 31.08.2023

The Ag_2Se-$SiSe_2$-Se subsystem of the Ag-Si-Se system was studied in the 360-450 K temperature range, while the Ag_2Te-Si_2Te_3-Te subsystem of the Ag-Si-Te system was studied in the 300-450 K temperature range by the EMF (Electromotive Force) method with Ag_4RbI_5 solid electrolyte. It was observed that the dependence of EMF on temperature was linear in the samples prepared for both systems. Partial thermodynamic functions of silver in alloys of Ag-Si-Se(Te) systems, as well as standard integral thermodynamic functions of ternary compounds Ag_8SiSe_6 and Ag_8SiTe_6 were calculated based on the results of EMF measurements. Besides, standard integral thermodynamic functions of β-Ag_8SiSe_6 were calculated both under standard conditions and at 400 K.

Keywords: *silver-silicon selenides, tellurides, phase transition, thermodynamic functions, EMF method, Ag_4RbI_5 solid electrolyte.*
DOI: 10.59849/2409-4838.2023.3.45

INTRODUCTION

Silver-containing ternary chalcogenides are considered valuable functional materials [1-3]. These compounds exhibit high photoelectric, optical, and thermoelectric properties and therefore are considered promising for use in alternative energy devices and various fields of modern electronics [4-17]. In addition, some of these compounds show ionic conductivity due to the mobility of Ag^+ cations and thus, can be used as electrochemical sensors, electrode materials, and batteries as well [18-21]. It is known that the search and study of new multicomponent materials are based on information about the phase equilibria and the thermodynamic properties of the corresponding systems [22-25]. The study of thermodynamic functions using EMF measurements is well-known and proven method. The discovery of unipolar superionic conductors with Ag^+ conductivity makes it possible to use these materials as solid electrolytes in electrochemical cells. Such electrochemical cells have already been successfully used in many works during thermodynamic studies of silver-based complex systems [26-35]. In this work, we report the results of a thermodynamic study of Ag_2Se-$SiSe_2$-Se and Ag_2Te-Si_2Te_3-Te subsystems using the EMF method with Ag_4RbI_5 solid electrolyte in the temperature range of 360-450 K and 300-450 K, respectively. Both Ag-Si-Se and Ag-Si-Te systems have been described in literature quite well. The T-x-y diagram of the Ag-Si-Se system is given in [36] and shows that the Ag_8SiSe_6 ternary compound forms in the system, which melts congruently. However, different authors report sharply different values of its melting point. It was shown that it melts at 1203 K in [36, 37], 1258 K in [38], and 1268 K in [39]. The polymorphic transition temperatures of this compound are 315 and 354 K [40]. The low-temperature modificati-

on has tetragonal (Sp.gr. I-4m2, a = 0.7706, b =1.10141 nm) [36, 37], the medium-temperature modification has simple cubic (Sp.gr. P4232, a = 1.087 nm) [41] and high-temperature modification has a face-centered cubic structure (F-43m, a = 1.09413 nm) [36, 37]. The T-x-y diagram of the Ag-Si-Te system shows the formation of Ag_8SiTe_6 ternary compound in the system [37]. This compound has phase transitions at lower temperatures which are 195 K and 263 K[42]. The γ-Ag_8SiTe_6 modification is stable from room temperature to melting temperature and melts congruently at 1143 K [42]. The Ag_8SiTe_6 compound has a cubic structure (Sp.gr.F43m) and the crystal lattice parameter are a =11.5225(7) Å [42], 11.538 Å [43].

MATERIAL AND METHODS

For the thermodynamic study of silver-silicon selenide (telluride), we assembled concentration cell

$$(–)\ Ag\ (s)/Ag_4RbI_5(s)/(Ag\ in\ melt)\ (s)\ (+) \qquad (1)$$

Here, the solid superionic conductor Ag_4RbI_5, which has high ionic conductivity at room temperature, was taken as the electrolyte. In addition, the electron conductivity of this electrolyte is negligible: 10^{-9} S cm^{-1} [44]. Ag_4RbI_5 solid electrolyte was synthesized by the methods described in [45, 46]. During the synthesis, chemically pure AgJ and RbJ compounds were taken and melted in a quartz ampoule under vacuum (10^{-2} Pa) conditions. The alloy was rapidly cooled to room temperature to obtain fine-grained and microscopically homogeneous crystals. Then it was annealed at 400 K temperature for 200 hours to get homogenized ingot. The synthesized compound Ag_4RbI_5 was checked by DTA and XRD methods. During the analysis of this compound, it was observed that it melts with decomposition according to the peritectic reaction at 505 K and crystallizes in the cubic lattice (space group $P4_132$, a = 1.1238 nm), which agreed well with the literature data [44]. Pellets with a diameter of ~1 cm and a thickness of 4-6 mm were cut from the obtained cylindrical ingot and used as a solid electrolyte in cell of type (1). Ag_4RbI_5 solid electrolyte samples prepared by this method were previously successfully used in thermodynamic studies by the EMF method [26-35]. For EMF measurements, silver metal was selected as the left electrode in the solid-state electrochemical cell, and alloys from the Ag_2Se-$SiSe_2$-Se and Ag_2Te-Si_2Te_3-Te composition ranges of the Ag-Si-Se(Te) system were selected as the right electrode (Figure 1). The XRD results of some of the points shown in Figure 1 are shown in Figure 2. As can be seen, in the diffraction pattern of alloy #1, the diffraction lines of Ag_8SiSe_6, $SiSe_2$, and elemental selenium are observed. The diffraction pattern of alloy #3 consists of the sum of the diffraction lines of Ag_8SiTe_6, Si_2Te_3, and elemental tellurium. The composition, synthesis, and thermal annealing conditions of the electrodes taken for both systems are based on the information about the Ag-Si-Se(Te) phase diagrams [36, 37]. The synthesis was carried out by melting stoichiometric mixtures of the corresponding elements with high purity in quartz ampoules under vacuum conditions (10^{-2}Pa). Since the saturated vapor pressure of selenium (T_{boil}=958 K) at the melting temperature of the compounds is high, their synthesis was carried out in a two-zone inclined furnace. The temperature of the furnace was gradually heated to a temperature of 40-50 K above the melting point of the synthesized compound. The obtained melted non-homogenized samples were subjected to prolonged stepwise thermal annealing at 800 K (500 h) and 450 K (200 h).To prepare proper electrodes, the annealed alloys were first powdered and then molded into pellets of 0.5-1 g mass and used as anodes in the solidification cycle.

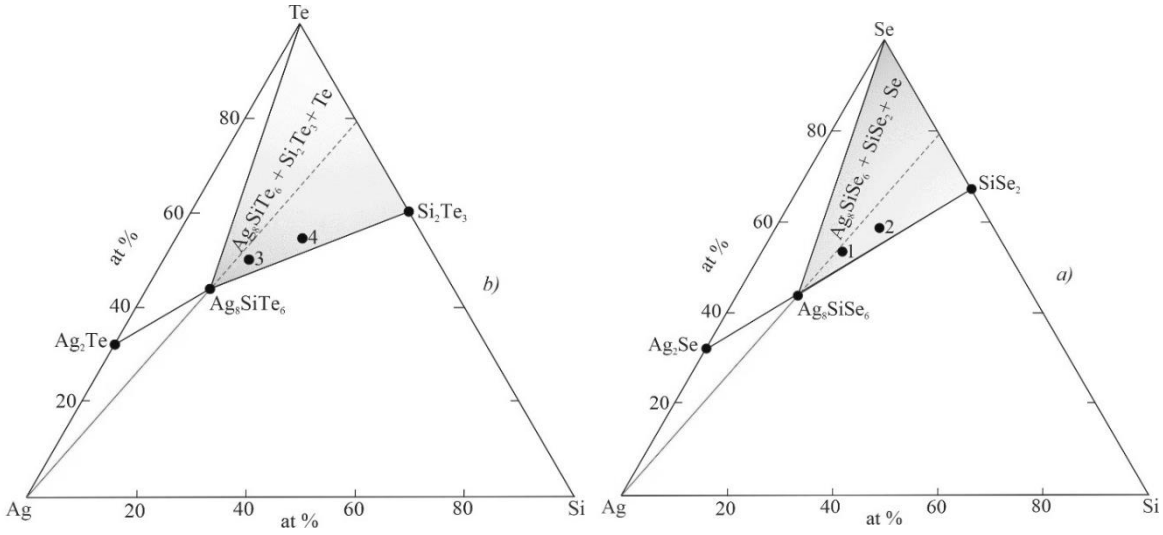


Fig. 1. Solid phase equilibrium diagram at 300 K of the (a) Ag_2Se-$SiSe_2$-Se composition area in the Ag-Si-Se system and (b) Ag_2Te-Si_2Te_3-Te composition area of the Ag-Si-Te system.

A vacuum was created in the concentration cell prepared as given in [45, 46], and it was filled with argon and placed in a specially prepared tube. Here it was kept under thermal control at ~380 K for 40-50 hours. The temperature of the cell was measured with an accuracy of ±0.5°C using chromel-alumel thermocouples and a mercury thermometer. EMF values were measured using a high-resistance digital voltmeter (V7-34A) in the range 360-450K and 300-450 K for both selenide and telluride systems, respectively. After the keeping cell under the conditions mentioned above, the first equilibrium values were recorded and subsequent values were obtained every 3 hours after a given temperature. Equilibrium values were calculated as EMF did not differ by more than 0.5 mV during several measurements at a certain temperature, regardless of the direction of temperature change.

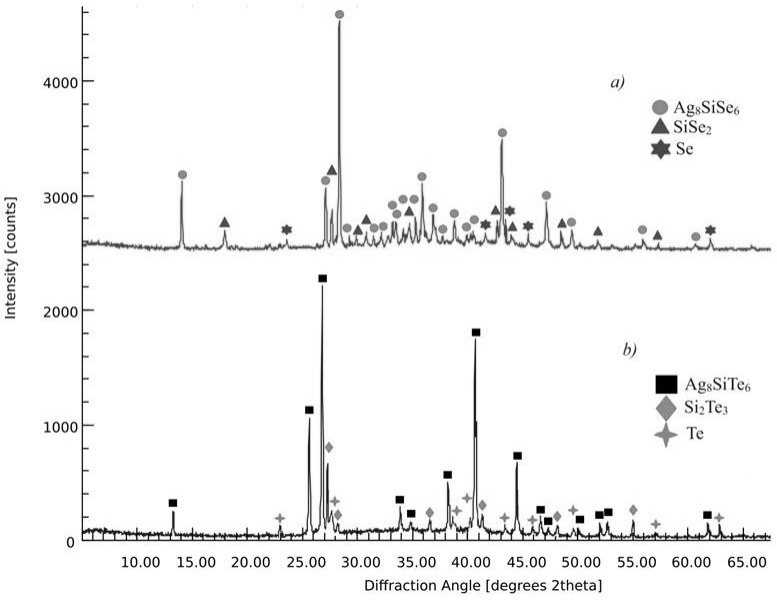


Fig. 2. Powder diffraction patterns of the Ag_2Se-$SiSe_2$-Se and Ag_2Te-Si_2Te_3-Te alloys which shown in Figure 1: (a) alloy #1, (b) alloy #3

RESULTS AND DISCUSSION

Temperature dependences of EMF of type (1) cell are given in Fig. 3. As can be seen, this dependence is linear in the entire temperature range during the measurements for electrode alloys taken from Ag_8SiTe_6+Si_2Te_3+Te phase field. Similarly, a linear dependence was observed in the temperature range of 360-450 K for alloys from the Ag_8SiSe_6+$GeSe_2$+Se phase field. The reproducibility of EMF values in the temperature range of 300-355 K was very low. This can be explained by the fact that the Ag_8SiSe_6 compound undergoes 2 polymorphic phase transitions in that temperature range [40] that are 315 and 354 K. It is possible that there may be kinetic inhibition in these transitions and the samples may not reach equilibrium during the measurements. At 360 K and higher temperatures, the Ag_8SiSe_6 compound is in the high-temperature cubic modification (HT), and the measurements correctly reflect the equilibrium.

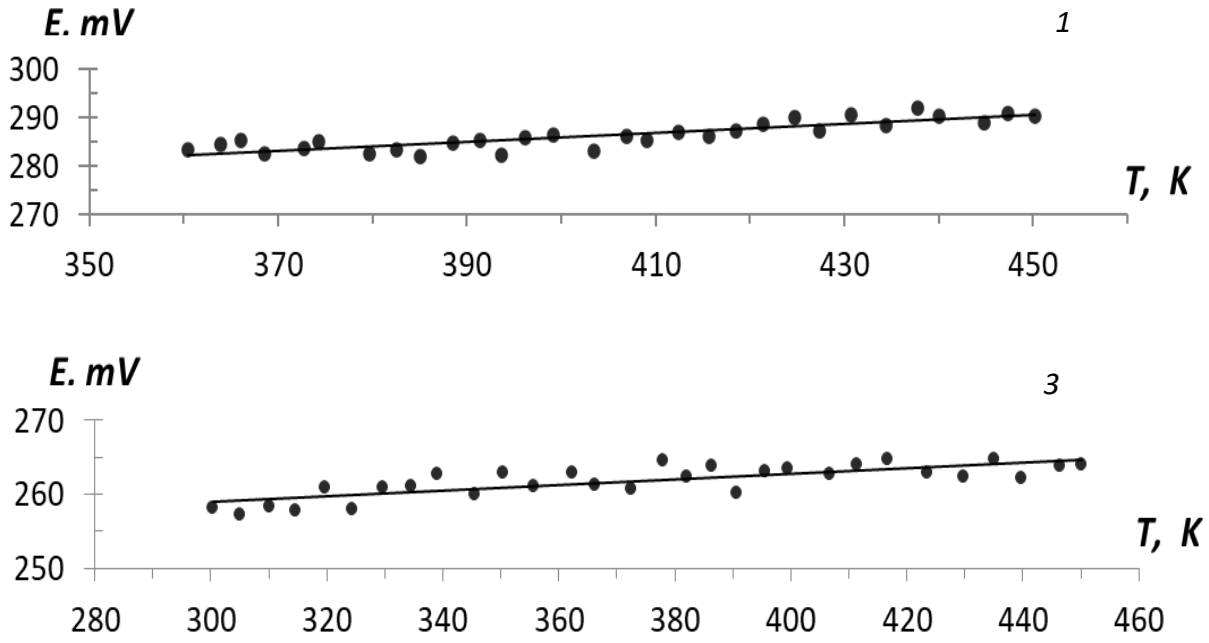


Fig. 3. Temperature dependence of the EMF of concentration cell (1) in the composition area of Ag_2Se-$SiSe_2$-Se(alloy (1) in fig.1) and Ag_2Te-Si_2Te_3-Te(alloy (3) in figure 1), respectively.

Taking into account the mentioned, the results of EMF measurements were processed in the temperature range of 300-450 K for the telluride system and 360-450 K for the selenide system using the least squares method based on a special computer program and linear equations of type (2) were obtained.

$$E = a + bT \pm t\left[\frac{S_E^2}{n} + \frac{S_E^2(T-\bar{T})^2}{\sum(T_i-\bar{T})^2}\right]^{\frac{1}{2}} \quad (2)$$

The results of calculations for HT-Ag_8SiSe_6 is shown in Table 1, and for Ag_8SiTe_6 in Table 2. The obtained equations (2) are presented in Table 3.

Table 1.

Experimentally obtained data for temperature (T_i,), EMF (E_i) and data associated with the calculation steps for the HT-Ag_8SiSe_6.

T_i, K	E_i, mV	$T_i - \bar{T}$	$E_i (T_i - \bar{T})$	$(T_i - \bar{T})^2$	$\tilde{E}$	$E_i - \tilde{E}$	$(E_i - \tilde{E})^2$
360.4	283.29	-44.49	-12603.57	1979.36	282.20	1.09	1.18
363.9	284.55	-40.99	-11663.70	1680.18	282.52	2.03	4.11
366.5	285.21	-38.89	-11091.82	1512.43	282.72	2.49	6.22
368.6	282.59	-36.29	-10255.19	1316.96	282.95	-0.36	0.13
372.7	283.6	-32.19	-9129.08	1036.20	283.33	0.27	0.07
374.3	284.87	-30.59	-8714.17	935.75	283.48	1.39	1.94
379.7	282.49	-25.19	-7115.92	634.54	283.97	-1.48	2.20
382.6	283.33	-22.29	-6315.43	496.84	284.24	-0.91	0.83
385.1	281.84	-19.79	-5577.61	391.64	284.47	-2.63	6.91
388.5	284.68	-16.39	-4665.91	268.63	284.78	-0.10	0.01
391.4	285.36	-13.49	-3849.51	181.98	285.05	0.31	0.10
393.7	282.15	-11.19	-3157.26	125.22	285.26	-3.11	9.66
396.2	285.97	-8.69	-2485.08	75.52	285.49	0.48	0.23
399.1	286.52	-5.79	-1658.95	33.52	285.75	0.77	0.59
403.4	283.11	-1.49	-421.83	2.22	286.15	-3.04	9.23
406.9	286.03	2.01	574.92	4.04	286.47	-0.44	0.19
409.1	285.38	4.21	1201.45	17.72	286.67	-1.29	1.66
412.4	286.99	7.51	2155.29	56.40	286.97	0.02	0.00
415.6	286.05	10.71	3063.60	114.70	287.27	-1.22	1.48
418.5	287.37	13.61	3911.11	185.23	287.53	-0.16	0.03
421.4	288.63	16.51	4765.28	272.58	287.80	0.83	0.69
424.7	289.99	19.81	5744.70	392.44	288.10	1.89	3.57
427.3	287.36	22.41	6439.74	502.21	288.34	-0.98	0.96
430.7	290.67	25.81	7502.19	666.16	288.65	2.02	4.07
434.4	288.39	29.51	8510.39	870.84	288.99	-0.60	0.36
437.8	292.03	32.91	9610.71	1083.07	289.30	2.73	7.44
440.3	290.23	35.11	10189.98	1232.71	289.50	0.73	0.53
444.8	288.83	39.91	11527.21	1592.81	289.95	-1.12	1.24
447.3	290.84	42.41	12334.52	1798.61	290.17	0.67	0.44
450.2	290.17	45.31	13147.60	2053.00	290.44	-0.27	0.07
$\bar{T}$=404,89	$\bar{E}$=286,284		Σ=1973,65	Σ=21513,51			Σ=66,14

As it is known, the linearity of the dependence of E~f(T) makes it possible to calculate thermodynamic functions using below given expressions below.

$$\Delta\bar{G}_{Ag} = -zFE, \tag{3}$$

$$\Delta\bar{H}_{Ag} = -Z\left[E - T\left(\frac{\partial E}{\partial T}\right)_p\right] = -zFa, \tag{4}$$

$$\Delta\bar{S}_{Ag} = zF\left(\frac{\partial E}{\partial T}\right)_p = zFb \tag{5}$$

Table 2.

Experimentally obtained data for temperature (T_i,), EMF (E_i) and data associated with the calculation steps for the Ag_8SiSe_6.

T_i, K	E_i, mV	$T_i - \bar{T}$	$E_i (T_i - \bar{T})$	$(T_i - \bar{T})^2$	$\tilde{E}$	$E_i - \tilde{E}$	$(E_i - \tilde{E})^2$
300.4	240.29	-73.62	-17690.15	5419.90	239.34	0.95	0.90
304.9	239.55	-69.12	-16557.70	4777.57	239.72	-0.17	0.03
310	238.21	-64.02	-15250.20	4098.56	240.14	-1.93	3.73
314.6	239.59	-59.42	-14236.44	3530.74	240.53	-0.94	0.88
319.7	241.6	-54.32	-13123.71	2950.66	240.95	0.65	0.42
324.3	242.87	-49.72	-12075.50	2472.08	241.34	1.53	2.36
329.7	239.49	-44.32	-10614.20	1964.26	241.79	-2.30	5.27
334.6	242.33	-39.42	-9552.65	1553.94	242.19	0.14	0.02
339.1	243.84	-34.92	-8514.89	1219.41	242.57	1.27	1.61
345.5	244.68	-28.52	-6978.27	813.39	243.10	1.58	2.48
350.4	245.36	-23.62	-5795.40	557.90	243.51	1.85	3.41
355.7	242.15	-18.32	-4436.19	335.62	243.96	-1.81	3.26
362.2	245.97	-11.82	-2907.37	139.71	244.50	1.47	2.17
366.1	246.52	-7.92	-1952.44	62.73	244.82	1.70	2.88
372.4	243.11	-1.62	-393.84	2.62	245.35	-2.24	5.01
377.9	242.03	3.88	939.08	15.05	245.81	-3.78	14.27
382.1	245.38	8.08	1982.67	65.29	246.16	-0.78	0.61
386.4	246.99	12.38	3057.74	153.26	246.52	0.47	0.22
390.6	246.05	16.58	4079.51	274.90	246.87	-0.82	0.67
395.5	247.37	21.48	5313.51	461.39	247.28	0.09	0.01
399.4	248.63	25.38	6310.23	644.14	247.60	1.03	1.06
406.7	249.99	32.68	8169.67	1067.98	248.21	1.78	3.17
411.3	247.36	37.28	9221.58	1389.80	248.59	-1.23	1.52
416.7	250.67	42.68	10698.60	1821.58	249.05	1.62	2.64
423.4	251.39	49.38	12413.64	2438.38	249.60	1.79	3.19
429.8	252.03	55.78	14058.23	3111.41	250.14	1.89	3.58
435	249.23	60.98	15198.05	3718.56	250.57	-1.34	1.80
439.8	248.83	65.78	16368.04	4327.01	250.97	-2.14	4.59
446.3	252.84	72.28	18275.28	5224.40	251.52	1.32	1.76
450.1	250.17	76.08	19032.93	5788.17	251.83	-1.66	2.76
$\bar{T}$=374,02	$\bar{E}$=261,796		Σ=2296,53	Σ=60400,43			Σ=55,63

Partial molar thermodynamic functions of silver in alloys were calculated based on equations (3)-(5) (Table 4). Since the HT-Ag_8SiSe_6 phase is not stable under standard conditions, its partial Gibbs free energy was also calculated for 400 K temperature.

Table 3.

Equations of the temperature dependence of EMF of type (1) cell in some phase fields of Ag-Si-Se(Te) systems

Phase field	E, mV = a+bt±tS_E(T)
β-Ag_8SiSe_6 + $SiSe_2$ + Se	$249{,}14 + 0{,}0917T \pm 2\left[\frac{2{,}2}{30} + 1{,}1 \cdot 10^{-4}(T - 404{,}9)^2\right]^{\frac{1}{2}}$
Ag_8SiTe_6 + Si_2Te_3 + Te	$247{,}58 + 0{,}0380T \pm 2\left[\frac{1{,}9}{30} + 3{,}1 \cdot 10^{-5}(T - 374{,}0)^2\right]^{\frac{1}{2}}$

As can be seen from the fragments of the solid phase equilibrium diagrams of Ag-Si-Se(Te) systems (Figure 1), the tie-lines starting from the Ag corner of Gibbs triangle and passing through the stoichiometric compositions of Ag_8SiSe_6 and Ag_8SiTe_6 compounds, respectively and enters Ag_8SiSe_6 + $SiSe_2$ + Se and Ag_8SiTe_6 + Si_2Te_3 + Te three-phase fields. That is, the phase diagrams show that under equilibrium conditions (imaginary) Ag removal from the compound Ag_8SiSe_6 would lead to $SiSe_2$ and elemental Se. Similarly, when Ag was removed from Ag_8SiTe_6, a mixture of Si_2Te_3 + Te would be obtained. It is seen that according to the solid-phase equilibrium diagram (Fig. 1), the values of the relative partial molar functions are a response to the following virtual-cell reactions:

$$8Ag + SiSe_2 + 4Se = Ag_8SiSe_6 \quad (6)$$

$$8Ag + 0{,}5Si_2Te_3 + 4{,}5Te = Ag_8SiTe_6 \quad (7)$$

Therefore, the integral thermodynamic functions of ternary compounds were calculated from the expressions given below: (Δ Z≡ Δ G, Δ H)

$$\Delta_fZ^o(Ag_8SiSe_6) = 8\Delta\bar{z}_{Ag} + \Delta_fZ^o(SiSe_2) \quad (8)$$

$$\Delta_fZ^o(Ag_8SiTe_6) = 8\Delta\bar{z}_{Ag} + 0{,}5\Delta_fZ^o(Si_2Te_3) \quad (9)$$

Absolute entropies can be calculated based on the expressions:

$$S^o(Ag_8SiSe_6) = 8[\Delta\bar{S}_{Ag} + S^o(Ag)] + S^o(SiSe_2) + 4S^o(Se) \quad (10)$$

$$S^o(Ag_8SiTe_6) = 8[\Delta\bar{S}_{Ag} + S^o(Ag)] + 0{,}5S^o(Si_2Te_3) + 4{,}5S^o(Te) \quad (11)$$

The results of calculations according to equations (8)-(11) are given in Table 5. The errors were calculated by the error accumulation method. During the calculation of integral thermodynamic functions, in addition to the quantities obtained by the EMF method (Table 4), the standard entropies of the elementary components involved in reactions (6) and (7) taken from the database (Ag-42.55±0.13 J(K) ·mol)), as well as the thermodynamic functions of $SiSe_2$ and Si_2Te_3 compounds were used. Literature data on the thermodynamic properties of both compounds are contradictory.

Table 4.

Partial thermodynamic functions of silver in alloys of Ag-Si-Se(Te) systems (T=298.15K)

Phase field	$-\Delta\bar{G}_{Ag}$	$-\Delta\bar{H}_{Ag}$	$-\Delta\bar{S}_{Ag}$, $J\cdot mol^{-1}\cdot K^{-1}$
	$kJ\cdot mol^{-1}$		
β-Ag_8SiSe_6 + $SiSe_2$ + Se	26,68±0,11 *27,58±0,11	24,04±0,40	8,85±0,98
Ag_8SiTe_6 + Si_2Te_3 + Te	24,98±0,05	23,89±0,20	3,67±0,53

Comparative analysis of the obtained values for enthalpy of formation of $SiSe_2$ compound in different works [47, 49-52] are discussed in [48] and values very close to the calorimetric results obtained by O'Hare et al. [49] were recommended (Table 5). The results given in different sources [48-51] for the Si_2Te_3 compound are also quite different. We used the values of melting enthalpies and absolute entropies of these compounds given in [46, 50], as well as the calculated standard Gibbs energies of formation using these quantities (Table 5).

Table 5.

Integral thermodynamic functions of HT-Ag_8SiSe_6 and Ag_8SiTe_6 compounds with some relevant literature data for $SiSe_2$ and Si_2Te_3 compounds

Compound	$-\Delta_fG^o$	$-\Delta_fH^o$	Δ_fS^o	S^o
	$kJ\cdot mol^{-1}$		$kJ\cdot mol^{-1}\cdot K^{-1}$	
SiSe2	175,3±3,5 - -	177,6±3,2[46] 178,4±3,1[47] 208±57[48]	- - -	95,2±2.0[52] - -
Si2Te3	70,9±10	65±10[48] 76,6±10[50] 71±10[51] 80±15[49]		167,0±3,0[52]
β-Ag8SiSe6	388,7±4,4	369,9±6,4	63,1±9,8	675±12
Ag8SiTe6	235,3±5,4	229,4±6,6	19,8±9,2	676±11

CONCLUSION

In the present paper, we report the results of a thermodynamic study of the Ag_2Se-$SiSe_2$-Se and Ag_2Te-Si_2Te_3-Te subsystem using the EMF method with an Ag_4RbI_5 solid electrolyte in a temperature range from 360 to 450 K and from 300 to 450, respectively. According to the EMF measurements, the partial molar functions of silver in two-phase regions, β-Ag_8SiSe_6 + $SiSe_2$ + Se and Ag_8SiTe_6 + Si_2Te_3 + Te at 298 K, as well as the standard thermodynamic functions of the formation and standard entropies of β-Ag_8SiSe_6 and Ag_8SiTe_6, were calculated. Since the HT-

Ag_8SiSe_6 phase is not stable under standard conditions, its partial Gibbs free energy was also calculated for 400 K temperature.

REFERENCES

1. Babanly, M.B. Ternary Chalcogenides Based on Copper and Silver (Тройные халькогениды на основе серебра и меди) / M.B.Babanly, Y.A.Yusibov, V.T. Abishev – Russia: BSU Publisher, – 1993. – 342 p.
2. Chalcogenides: From 3D to 2D and Beyond / X.L.Sanghoon, L.J.Tengfei, L.Y. Zhang [et al.] – Elsevier, – 2019. – 398 p.
3. Ahluwalia, G.K. Applications of Chalcogenides: S, Se, and Te / G.K. Ahluwalia. – Springer, – 2016. – 461 p.
4. Schwarzmüller, S. Argyrodite-Type Cu_8GeSe_6-xTex($0 \leq x \leq 2$): Temperature-Dependent Crystal Structure and Thermoelectric Properties // Zeitschrift Für Anorganische Und Allgemeine Chemie, – 2018. №24, – p. 1915-1922.
5. Acharya, S. High thermoelectric power factor in p-type Cu_8GeSe_6 // Solid-state physics symposium, – 2019. – p. 1-3.
6. Li, W. Low Sound Velocity Contributing to the High Thermoelectric Performance of Ag_8SnSe_6 / W. Li, S. Lin, B. Ge [et al.] // Advanced Science, – 2016. №11, – p. 1600196-1600201.
7. Ghrib, T. High Thermoelectric Figure of Merit of Ag_8SnS_6 Component Prepared by Electrodeposition Technique / T. Ghrib, A.L. Otaibi, A. Almessiere [et al.] // Chinese Physics Letters, – 2015. №12, – p. 127402-127409.
8. Jin, M. Fabrication and Thermoelectric Properties of Single-Crystal Argyrodite Ag_8SnSe_6 / M. Jin, S. Lin, W. Li [et al.] // Chemistry of Materials, – 2019. №7, – p. 2603-2610.
9. Shen, X. High-Temperature Structural and Thermoelectric Study of Argyrodite Ag_8GeSe_6 / X. Shen, C. Yang, Y. Liu [et al.] // ACS Applied Materials and Interfaces, – 2019. №2, – p. 2168-2176.
10. Charoenphakdee, A. Ag_8SiTe_6: A New Thermoelectric Material with Low Thermal Conductivity // A. Charoenphakdee, K. Kurosaki, H. Muta [et al.] // Japanese Journal of Applied Physics, – 2009. №1, – p. 01160-01169.
11. Qinghui, J. Eco-friendly Highly Robust Ag_8SiSe_6-Based Thermoelectric Composites with Excellent Performance Near Room Temperature / J. Qinghui, L.Suwei, L.Yubo [et al.] // ACS publications, – 2020. №49, – p. 54653-54661.
12. Masaki, F. Thermoelectric properties of Ag_8GeTe_6 / F. Masaki, K. Ken, M. Hiroaki [et al.] // Journal of Alloys and Compounds, – 2005. №1, – p. 280-282.
13. Semkiv, I. Ag_8SnSe_6 argyrodite synthesis and optical properties / I. Semkiv, H. Ilchuk, M. Pawlowski [et al.] // Opto-Electronics Review, – 2017. №1, – p. 37-40.
14. Lu, C.L. Electronic, optical properties, surface energies and work functions of Ag_8SnS_6: First-principles method / C.L. Lu, L. Zhang, Y.W. Zhang [et al.] // Chinese Physics B, – 2015. №1, – p. 1-7.
15. Boon-on, P. Ag_8SnS_6: a new IR solar absorber material with a near -optimal bandgap / P. Boon-on, B. A. Aragaw, C.Y. Shi [et al.] // Royal Society of chemistry Advances, – 2018. №8, – p.39470-39476.
16. Brammertz, G. Fabrication and characterization of ternary Cu_8SiS_6 and Cu_8SiSe_6 thin film layers for optoelectronic applications / G. Brammertz, B.Vermang, H. ElAnzeery [et al.] // Thin Solid Films, – 2016. №616, – p. 649-654.
17. Somnath, A. Enhancement of Power Factor for Inherently Poor Thermal Conductor Ag_8GeSe_6 by Replacing Ge with Sn / A. Somnath, J. Pandey, A. Soni [et al.] // American Chemical Society Applied Energy Materials, – 2019. №2, – p. 654-660.
18. Hull, S. Ag^+ diffusion within the rock-salt structured superionic conductor $Ag_4Sn_3S_8$ // Journal

of Physics Condensed Matter, – 2005. №7, – p. 1067-1084.
19. Barbara, K.H. High Electron Mobility and Disorder Induced by Silver Ion Migration Lead to Good Thermoelectric Performance in the Argyrodite Ag_8SiSe_6 / K.H. Barbara, W. Kai, K.Yasar [et al.] // Materials Science and Engineering, – 2017. – p. 4833-4839.
20. Boucher, F. Distribution and Ionic Diffusion Path of Silver in γ-Ag_8GeTe_6: A Temperature Dependent Anharmonic Single Crystal Structure Study / F. Boucher, M. Evain, R. Brec // Journal of Solid State Chemistry, – 1993. №2, – p. 332-346.
21. Ashirov, G.M. Ionic conductivity of the Ag_8GeSe_6 compound / G.M. Ashirov, R.M. Sardarly, L.F. Mashadiyeva [et al.] // Modern Physics Letters B, – 2023. – p. 32-34.
22. West, D.R. Ternary Phase Diagrams in Materials Science / D.R.West. CRC Press, – 2019. – 236 p.
23. Hiroyasu, S. Introduction To Phase Diagrams In Materials Science And Engineering / S. Hiroyasu. World Scientific Publishing Company, – 2020. – 188 p.
24. Babanly, M.B. Some issues of complex investigation of the phase equilibria and thermodynamic properties of the ternary chalcogenide systems by the EMF method / M.B. Babanly, L.F. Mashadiyeva, D.M. Babanly [et al.] // Russian Journal of Inorganic Chemistry, – 2019. №13, – p. 1649-1671.
25. Imamaliyeva, S.Z. Physicochemical Aspects of Development of Multicomponent Chalcogenide Phases Having the Tl_5Te_3 Structure: A Review / S.Z. Imamaliyeva, D.M. Babanly, D.B. Tagiev [et al.] // Russian Journal of Inorganic Chemistry, – 2018. №13, – p.1703-1730.
26. Aspiala, M. Thermodynamic study in the Ag–Sb–S system by the EMF method / M. Aspiala, F. Tesfaye, and P. Taskinen [et al.] // The Journal of Chemical Thermodynamics, – 2016. – p. 361-368.
27. Babanly, N.B. Thermodynamic investigation of silver-thallium tellurides by EMF method with solid electrolyte Ag_4RbI_5 / N.B. Babanly, E.N. Orujlu, S.Z. Imamaliyeva [et al.] // The Journal of Chemical Thermodynamics, – 2019. – p. 78-88.
28. Babanly, N.B. Thermodynamic study of the Ag–Tl–Se system using the EMF method with Ag_4RbI_5 as a solid electrolyte / N.B. Babanly, S.Z. Imamaliyeva, Y.A. Yusibov [et al.] // Journal of solid state electrochemistry, – 2018. – p. 1143-1149.
29. Mashadieva, L.F. Thermodynamic study of the 2PbTe–$AgSbTe_2$ system using EMF technique with the Ag_4RbI_5 solid electrolyte / L.F. Mashadieva, S.G. Mansimova, Y.A. Yusibov [et al.] // Russian Journal of Electrochemistry, – 2018. – p. 106-112.
30. Babanly, M.B. Phase diagram and thermodynamic properties of compounds of the AgI–TlI–I system / M.B. Babanly, L.F. Mashadieva, Z.S.Aliev [et al.] // Journal of Alloys Compound, – 2012. – p. 38-48.
31. Mashadieva, L.F. Experimental investigation of the Ag–Bi–I ternary system and thermodynamic properties of the ternary phases / L.F. Mashadieva, Z.S. Aliev, A.V. Shevelkov [et al.] // Journal of Alloys Compound, – 2013. – p. 512-518.
32. Mashadiyeva, L.F. The Ag_2Te–SnTe–Bi_2Te_3 system and thermodynamic properties of the $(2SnTe)_1 – x(AgBiTe_2)_x$ solid solutions series / L.F. Mashadiyeva, J.O. Kevser, I.I. Aliev [et al.] // Journal of Alloys Compound, – 2017. – p. 641-648.
33. Mashadiyeva, L.F. Phase Equilibria in the Ag_2Te–SnTe–Sb_2Te_3 System and Thermodynamic Properties of the $(2SnTe)_{12x}(AgSbTe_2)_x$ Solid Solution/ L.F. Mashadiyeva, J.O. Kevser, I.I. Aliev [et al.] // Journal of Phase Equilibria and Diffusion, – 2017. – p. 603.
34. Alverdiev, I. Thermodynamic study of Ag_8GeSe_6 by EMF with an Ag_4RbI_5 solid electrolyte / I. Alverdiev , S.M. Bagkheri, S.Z. Imamalieva [et al.] // Russian Journal of Electrochemistry, – 2017. – p. 551.
35. Babanly, M.B. Thermodynamic study of the Ag–As–Se and Ag–S–I systems using the EMF method with a solid Ag_4RbI_5 electrolyte / M.B. Babanly, L.F. Mashadiyeva, G.M. Veliyeva, [et al.] // Russian Journal of Electrochemistry, – 2015. – p. 399.
36. Hofmann, A.M. Silver-Selenium-Silicon // Ternary Alloys, – 1988. – p. 559-560.

37. Gorochov, O. Les composés $A_{g8}MX_6$ (M= Si, Ge, Sn et X= S, Se, Te) // Bulletin de la Société Chimique de France, – 1968. №101, – p. 2263-2275.
38. Venkatraman, M. The phase diagrams of M_2X -SiX_2 (M is Cu, Ag; X is S, Se) / M. Venkatraman, R. Blachnik, A. Schlieper [et al.] // Thermochimica Acta, – 1995. №249, – p. 13-20.
39. Piskach, L.V. Interaction of argyrodite family compounds with the chalcogenides of II-b elements / L.V. Piskach, O.V. Parasyuk, I.D. Olekseyuk [et al.] // Journal of Alloys and Compounds, – 2006. №421, – p. 98-104.
40. Amiraslanova, A.J. Phase equilibria in the Ag_8SiSe_6- Ag_8SiTe_6 system and characterization of solid solutions $Ag_8SiSe_{6-x}Te_x$ / A.J. Amiraslanova, K.N. Babanly, S.Z. Imamaliyeva [et al.] // Applied Chemical Engineering, – 2023. – p. 48-53.
41. Heep, B.K. High electron mobility and disorder induced by silver ion migration lead to good thermoelectric performance in the argyrodite Ag_8SiSe_6 / B.K. Heep, K.S. Weldert, Y. Krysiak [et al.] // Chemistry of Materials, – 2017. №29, – p. 4833-4839.
42. Boucher, F. Single-crystal structure determination of γ-Ag_8SiTe_6 and powder X-ray study of low-temperature α and β phases / F. Boucher, M. Evain and R. Brec // Journal of Solid State Chemistry, – 1992. – p. 341-355.
43. Charoenphakdee, A. Ag_8SiTe_6: A New Thermoelectric Material with Low Thermal Conductivity / A. Charoenphakdee, K. Kurosaki, H. Muta [et al.] // Japanese Journal of Applied Physics, – 2009. – p. 011603.
44. Ivanov-Shchits, A.K., Murin I.V. Ionika tverdogo tela // Solid State Ionics, – 2000. – p. 462-466.
45. Babanly, M.B. Elektrokhimicheskie metody v termodinamike neorganicheskikh sistem (Electrochemical Methods in Thermodynamics of Inorganic Systems) / M.B. Babanly, Yu.A. Yusibov – Baku: Elm, – 2011.
46. Olin, A. Chemical thermodynamics of selenium / A. Olin, N.G. Evgeny – France: 2005, –851p.
47. Tomaszkiewicz, I. Fluorine-combustion calorimetric determinations of the standard molar enthalpy changes for the formation of $SiSe_2$(cr), $SiSe_{1.94}$(cr), and $SiSe_{1.94}$(vit), and for the transition: $SiSe_{1.94}$(vit) = $SiSe_{1.94}$(cr) at the temperature T = 298.15 K. Implications of the results for the enthalpies of dissociation Dom(Se–SiSe) and Dom(SiSe). Thermodynamic properties of SiSe(g) / I. Tomaszkiewicz, S. Susman, K. Volin [et al.] // The Journal of ChemicalThermodynamics,– 1994.№10,–p.1081-1093
48. Chandrasekharaiah, D.S. Continuum Mechanics / D.S. Chandrasekharaiah, L. Debnath – 1994. – 595p.
49. O'Hare, P.A.G. Termodynamic proporties of $SiSe_2$ // Journal of Chemistry Thermodynamics, – 1986.
50. Exsteen, G. Enthalpies of Formation of Solid Silicon Dichalcogenides / G. Exsteen, J. Drowart, A. Vander [et al.] // Journal of Physics and Chemistry, – 1966. №12, – p. 4130-4131.
51. Brebrick, R.F. Thermodynamic study of silicon sesquitelluride using a mass spectrometer / R.F.Brebrick,–1968.
52. Materials Thermochemistry / O.Kubaschewski [et al.]. – Oxford: Pergamon, – 1993. – 363 p.

GÜMÜŞ-SİLİSİUM SELENİDLƏRİN (TELLURİDLƏRİN) EMF METODU İLƏ AG_4RBI_5 BƏRK ELEKTROLİT İSTİFADƏSİ İLƏ TERMODİNAMİK TƏDQİQİ

G.M. Əşirov, K.N. Babanlı, L.F. Məşədiyeva

Ag-Si-Se sisteminin Ag_2Se-$SiSe_2$-Se altsistemi EHQ(elektrik hərəkət qüvvəsi) üsulu ilə 360-450K temperatur intervalında, Ag-Si-Te sisteminin Ag_2Te-Si_2Te_3-Te altsistemi isə 300-450K temperature intervalında Ag_4RbI_5 bərk elektroliti ilə öyrənilmişdir. Hər iki sistem üzrə hazırlanmış

nümunələrdə EHQ-nin temperaturdan asılılığının xətti olduğu müşahidə edilmişdir. Ag-Si-Se(Te) sistemlərinin xəlitələrində gümüşün parsial termodinamik funksiyaları hesablanmışdır. Eyni zamanda hər iki sistemdə yaranan üçlü birləşmələrin (Ag_8SiSe_6, Ag_8SiTe_6) standart inteqral termodinamik funsksiyaları hesablanmışdır. β-Ag_8SiSe_6 üçün Δ_fG dəyəri həm standart hal üçün həm də 400K- üçün hesablanmışdır.

Açar sözlər: *gümüş-silisum selenidləri,telluridləri, faza keçidləri, termodinamik funksiyalar, EHQ üsulu, Ag_4RbI_5 bərk elektrolidi*

ТЕРМОДИНАМИЧЕСКОЕ ИССЛЕДОВАНИЕ СИВЕР-СЕЛЕНИДОВ (ТЕЛЛУРИДОВ) КРЕМНИЯ МЕТОДОМ ЭДС С ТВЕРДЫМ ЭЛЕКТРОЛИТОМ AG_4RBI_5

Г.М. Аширов, К.Н. Бабанли, Л.Ф. Машадиева

Подсистема Ag_2Se-$SiSe_2$-Se системы Ag-Si-Se исследована в интервале температур 360-450 К, а подсистема Ag_2Te-Si_2Te_3-Te системы Ag-Si-Te - в диапазоне 300-450 К. температурный диапазон методом ЭДС (электродвижущей силы) с твердым электролитом Ag_4RbI_5. Было замечено, что зависимость ЭДС от температуры была линейной в образцах, приготовленных для обеих систем. По результатам измерений ЭДС рассчитаны парциальные термодинамические функции серебра в сплавах систем Ag-Si-Se(Te), а также стандартные интегральные термодинамические функции тройных соединений Ag_8SiSe_6 и Ag_8SiTe_6. Кроме того, были рассчитаны стандартные интегральные термодинамические функции β-Ag_8SiSe_6 как в стандартных условиях, так и при 400 К.

Ключевые слова: *селениды серебра–кремния, теллуриды, фазовый переход, термодинамические функции, метод ЭДС, твердый электролит Ag_4RbI_5*

EARTH SCIENCES

UDC: 581.5
ORCID: 0000-0001-7931-3082 (Togola)

CARTOGRAPHIC ANALYSIS OF ANTHROPOGENIC IMPACT ON THE FAYA FOREST IN MALI

Adama Togola
Baku State University
E-mail: togolaadama1987@gmail.com
Received: 09.02.2023
Accepted: 15.07.2023

Mali's forests have been subjected to extensive human pressures in recent decades. This Sahel country where 90% of the population lives on 30% of the territory is very dependent on forest resources through multiple activities. Malian forest resources are subject to several pressures, including: agricultural clearing, cumulative consumption of wood and charcoal, harvesting of wood and services, pastoralism, hunting, bush fires (early and late) which devastate more than 100 000 ha per year and also for reasons of traditional medicine. The protected forest of Faya, which covers an area of 80 000 ha, located 40 km from Bamako, has not escaped this destruction despite its status as a protected forest and the new management plan which only grants the right to use by residents of the Faya in terms of forest exploitation. The methodology was based on the realization of the collections and documentary analysis, the analyzes of cartographic and figure, the realization of the qualitative surveys, the treatment and the analysis of the data. The study revealed to us that the Faya forest has been under enormous pressure and that the gallery forests and wooded savannah are turning into shrub savannah. This article aims to analyze the pressures on plant formations of Faya in recent decades.

Keywords: *GIS maps, anthropogenic pressure, Faya, protection, forest management.*
DOI: 10.59849/2409-4838.2023.3.58

INTRODUCTION

From Stockholm in 1972 to Rio in 1992, considering the environment is a major concern of the community of nations, which is witnessing the effects of our devastating activities on our environment [4]. If the problems of pollution, nuisances, the combustion of fossil resources which affects biodiversity and worries the experts, the first to report on the disasters which generate, one of the cruellest major problems would be above all deforestation, the exploitation irrational use of our faunal and floristic resources [8].

In most countries, on all continents, this drama exists at worrying proportions. This is the case with industrial and mining exploitation, excessive logging, climate change, devastating natural fires, bush fires, developments, the expansion of agriculture, concessions crowned with incivility [17].

In Mali, the program for defining national land degradation neutrality objectives by makes extremely serious observations in terms of management. Forests and reforestation, forest resources are drastically decreasing due to the consumption of wood energy and agricultural desertification reinforced by economic growth [2, 6].

Malian forest resources are subject to several pressures, including: agricultural clearing, increased consumption of wood and charcoal, removal of timber and service timber, bush fires (early and late) which devastate more than 100 000 ha per year and harvesting for traditional medicine purposes [10].

Faced with the threats to these resources, the Malian authorities have increased the number of forests and protected areas, which currently number 113 and cover an area of 1338991 ha, or 1% of the country's area [1]. The Faya forest, the first protected forest by the authorities in history is the largest among many others; covering an area of nearly 80.000 ha, 40 km from the capital Bamako

on National Road N°6 does not resist degradation due to population explosion, large-scale urbanization and high demand for wood [7]. Forest products meet the basic needs of Malian communities. Among them the use of wood as energy (90% of needs), service wood, sawn wood, pharmacopoeia, socio-cultural needs. The Faya is now threatened with extinction by human activities [3, 17]. Nowadays it suffers from several causes of degradation such as:
Excessive and uncontrolled logging;
Strong pastoral pressure on natural formations;
The incivility of the actors in charge of protection;
Climate change;
Bush fires [19].

MATERIAL AND METHODS

The general pattern of research on the classified forests of Mali is based on methodological approaches proposed by scientists such as [14, 16, 18] and experts in the field in different organizations in Mali. The studies were conducted in 2 stages: documentary research and field research. Preparatory stage in the office. At this stage, information was collected on the vegetation and soil cover, topography and climatic conditions of the territories studied, the causes of deforestation in the research objects were identified, Landsat 8 images and a brief review of the research world scientists on forest management was carried out.

Field step.

Initially, field studies were carried out from June to September 2021 in the classified forest of Faya but also with the human resources of the various technical services which deal with Faya: Ministry of Sanitation, Environment and Sustainable Development, National Directorate of Water and Forests, Regional Directorate of Water and Forests, Cantonment of Water and Forests, Management of the Forest Information System, Water and Forest Post, Decentralized Forest Management Program and Institute of Rural Economy .Finally, some researchers at university level and research departments were consulted for further information and analysis.

RESULTS AND DISCUSSION

Here, we were able to have the maps of the year 1990 and the year 2020, i.e. a period of 30 years based on the Landsat 5 tool for the 1990 map and Landsat8 for that of 2020 which allowed us to know the state of forest formations during these two periods and to measure the state of their degradation or improvement in the face of natural phenomena and anthropogenic pressures that threaten its existence. the tables below taken from the information on the maps will allow us to have even more precision on the surface covered on each of these formations (Figure 1).

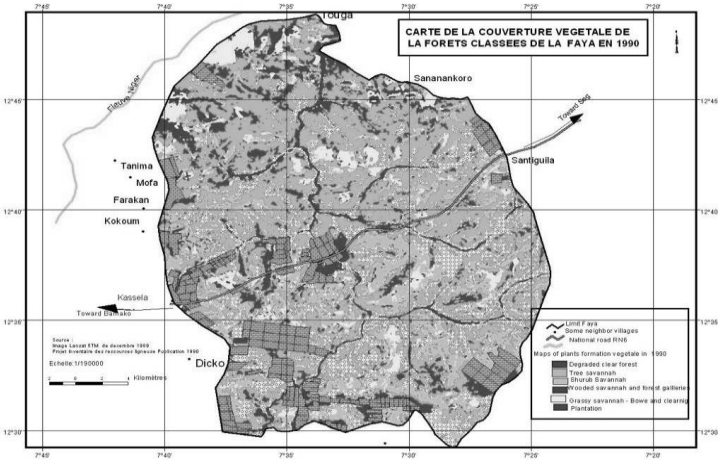


Fig.1. Maps of Faya plant formations in 1990

This table below is a complement to the map to see more details on the covered area of each forest formation (Table 1).

Table 1.

Areas of plant formations in the Faya forest 1990

Type of plant formations	Area in 1990	
	ha	%
Wooded savannahs and degraded galleries	12794	16%
Degraded clear forests	10058	13%
Tree Savannah	9954	12%
Wooded Savannah	16220	20%
Shrub savannas	21210	26.51%
Grassy savannah - Bowé and clearing	5197	6.49%
plantations	4 531.08	6%
Total	79964.08	100

With regard to this 1990 map, we see the predominance of shrub savannah over an area of 26.51% followed by wooded savannah with 20%. Regarding this map of the Faya of the year 1990, wooded on an area of 40% followed by shrubby savannah with 19%. This predominance also of the wooded savannah, which comes in second place, is explained by the non-exploitation or the controlled exploitation of the forest resources of the Faya at that time. It is followed by wooded savannah and gallery forests, which are bands of vegetation with more or less closed cover, located along certain watercourses and in depressions. They constitute an ecologically unstable and very fragile environment. These are the galleries which have undergone strong cutting pressure and whose regeneration has led to the formation of savanna along the main watercourses. It covers an area of 12794 ha or 16% of the massif.

Then is positioned the degraded clear forest on an area of 10058 hectares or 13% of the forest. This indicates the deterioration of forest resources. The tree savanna generally results from the permanent and continuous degradation of the vegetation under the combined effect of human action and successive droughts. It covers an area of 9954 or 12% of the massif.

The grassy savannah, bowe and glades occupies an area of 5197 or 6.49% of the forest. The total coverage of tree savannas, degraded clear forest, shrubby savannah and grassy savannah, bowe and clearing cover an area of 35267 ha or 58% of the entire forest, hence the need to adopt strategies for the conservation of this f forest hence the idea of planting. The latter covers an area of 4531.08 or 6% of the forest. It is safe to say that taking into account the preservation of forest biodiversity was a reality and a battle horse for the government after the droughts of the 1990s that hit the Sahel countries hard. Massive plantations have been carried out by importing exotic species to correct deforestation due to massive exploitation by communities and green forests in general have been well protected by effective protection mechanisms (Figure 2).

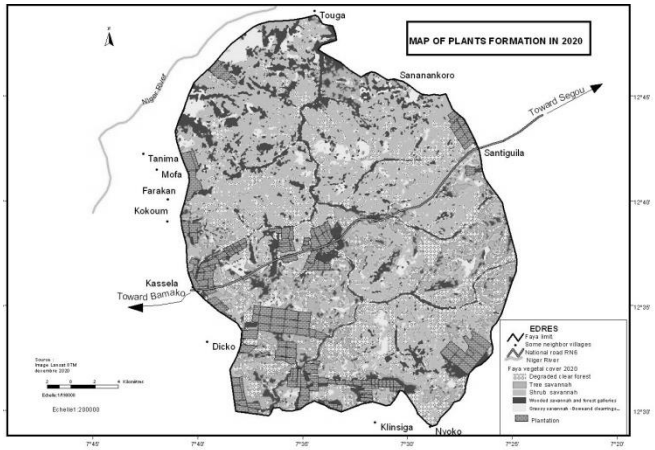


Fig.2. Maps of Faya plant formations in 2020

This 2020 map clearly shows us the natural and human factors of degradation that weigh on this massif. In view, we noted the predominance of shrubby savannah that covers an area of 37372 ha or 47% of the total area of the forest, followed by wooded savannah 9594 or 12%, grassy savannah, bowe and clearing 8770 or 11% (Table 2).

Table 2.

Areas of plant formations in the Faya classified forest 2020

Type of plant formations	Area in 2020	
	ha	%
Wooded savannahs and degraded galleries	5250	6%
Degraded clear forests	8195	10%
Tree Savannah	6250	8%
Wooded Savannah	9594	12%
Shrub savannas	37374	47%
Grassy savannah - Bowé and clearing	8770	11%
plantations	4 531.08	6%
Total	79964.08	100

The predominance of these savannas is striking proof of the degradation of forest resources in the Faya. These savannahs listed except the wooded savannah instead of the wooded savannah cover an area of 60589 ha or 76% of the protected forest of the Faya. The wooded savanna occupies 8% of an area of 6250 ha. In addition, finally the planting 6.0 % on an area of 4531.08 ha.

This detection of changes made by Landsat 5 for the year 1990 and Landsat 8 for 2020, i.e. an interval of 30 years, will allow us to observe the dynamics of change either the dynamics of change either in terms of degradation or improvement of forest management in this vast classified forest near the capital of Mali, Bamako.

In view of the Landsat 5 and 8 data on the state of the two maps of the Faya of 1990 and 2020, the detection of changes in the forest resources of the Faya is of great concern to us and challenges each of us for its protection. We are witnessing a serious degradation of almost all of its resources (Table 3).

Table 3.

Types of plant formations and its evolution of forest area from 1990-2020

Types of plant formations	Area in 1990	Area in 2020	Evolution of forested areas from 1990 - 2020
Wooded savannahs and degraded galleries	12794	5250	-7544
Degraded clear forests	10058	8195	-1863
Tree Savannah	9954	6250	-3704
Wooded Savannah	16220	9594	-6626
Shrub savannas	21210	37374	+16164
Grassy savannah - Bowé and clearing	5197	8770	+3573
plantations	4531.08	4531.08	0
Total	79964.08	79964.08	

During the last thirty years, the forest resources of Faya Forest have been under strong pressure, pressure due to the proximity of the city of Bamako which has an increasingly growing need for domestic energy; to this must be added the effects of drought relating to climate variability since the 1980s [15]. All this justifies the degradation of forest resources in this classified area. The potential of the various formations, especially around the villages and the Bamako-Ségou national road, has been strongly affected. It is thus in the various formations with high woody potential that it has been observed in:

Wooded savannah and gallery forest the cover is 12794 in 1990 against 5250 ha in 2020 a loss of 5250 ha;

Degraded open forest 10058 ha in 1990 against 8195 ha, i.e. a loss of 1863 ha:

Savannah 9954 ha in 1990 against 6250 ha in 2020, i.e. a loss of 3703 ha;

Wooded savannah 16220 ha in 1990 against 9594 in 2020, i.e. a loss of 6626 ha;

Shrubby savannah 21210 in 1990 against 37374 in 2020;

Grassy savannah – Bowé-and Clearing 5197 ha in 1990 against 8770 ha in 2020.

On analysis, it can be said that a large part of the area of this classified forest covered by the formations (wooded savannah, gallery forest, wooded savannah, tree savannah) has been transformed into shrub savannah or grassy savannah, Bowé and clearing [13]. This sufficiently demonstrates the strong degradation of resources in this period notwithstanding the concession of Faya in 2013 with a management plan, the degradation continues at a very worrying rate in the forest. This tendency to degradation is also stronger in gallery forests. In 1990, it covered an area of 12794 ha or 16% of the total area of forest resources of Faya, in 2020, it covers an area of 5250 ha, or only 6%. This can be explained by the effects of climate change, which dry up the rivers that water these gallery forests, or by anthropogenic pressures in the search for service timber that is abundant in this forest formation. In any case, the tendency to deterioration is present. Despite the awareness of the role that forests play, the consequences of deforestation and the vast reforestation campaigns or dare we say "reforestation propaganda" by the Malian authorities every year for decades, the detection of changes in the level of plantations assesses the inefficiency of reforestation campaigns by perhaps a lack of monitoring and/or exploitation of planted resources [9, 12]. From 1990 to 2020, the area of plantations has not changed. Most essences are exotic such as: Gmelina arborea, Tectona grandis, Eucalyptus sp, Azadirchta indica for utility purposes [5]. In fact, the inventories carried out in these forests over a time interval of about 10 years (1996 and 2005)

showed that the area of gallery forests has greatly decreased and that tree savannahs have receded to give way to shrubby savannahs and forest clear degraded [11].

CONCLUSION

This forest has been classified, that is to say protected since the colonial period in order to constitute a reserve of wood for the supply of Bamako and wooden rails attracts all the greed of the neighboring communities to the number of 17 villages but also of Bamako which is located 40 km from this forest. Faced with the dependence of communities (rural and urban) on timber, firewood, tree bark for traditional therapy, animal husbandry, intensive agriculture, the absence of other generative activities income, large-scale anarchic urbanization and finally the population explosion, all attempts, all efforts to restore the Faya by politicians have failed. Through the new public-private partnership contract tested several times for its preservation in the name of ecotourism and participation, without the implementation of a strategy of dependence on forest resources through a strong energy transition, nothing is not possible indicates the success of this strategy. The gigantic measure that must be implemented is the fencing of this forest, the endowment of forest services with modern technological tools such as the drone to facilitate its surveillance and rapid intervention actions, the creation of income-generating activities for local communities, awareness and ecotourism.

REFERENCES

1. AEDD/AGCC-Mali, Communication strategy in the field of climate change and forests / – 2019.
2. Achieving Land Degradation Neutrality in the Republic of Mali, Bamako / – 2020. – 41 p.
3. Essor, Regeneration of the Faya / – 2011.
4. FAO, The State of the World's Forests / – 2020. – 168 p.
5. FAO, PFN-info 2012, Mali, Political, legal and institutional framework of the forestry sector / – 2012. – 32 p.
6. FONABES, The management of Natural forest and the sustainable wood fuel supply of the cities of the Sahel / – 2017. – 225 p.
7. Mamadou, T. COP 25 is heating up: where are the classified forests in Mali? / T.Mamadou. – 2019.
8. Mbodj, F. Management of forest resources in Mali and territorial claims. The relationship with the native or the migrants of the wood of Mandé // Anthropologie and development, – 2014. – 37 p.
9. Development and Management Plan for the Development of Vision Tourism and Ecotourism in the La Faya Class Forest / – 2020.
10. National Forest Policy / – 2017.
11. Regional development plan for the Koulikoro region, Final report / – 2011.
12. Report of the National Directorate of Water and Forests / – 2016. – 83 p.
13. Sanogo, S. Anthropic influence of the city of Bamako and surrounding villages about functions and benefits from the Faya forest / S.Sanogo, A.Sissoko – 2017.
14. Thomas, I.S. Role of planted forests and trees outside forests in sustainable forest management: Republic of Mali country case study / I.S.Thomas, S.Samassekou – 2003. – 73 p.
15. Sow, Y. Inter de Bamako: the classified forest of Faya threatened with extinction / Y.Sow. – 2019.
16. Traore, M. The Co-Management System Approach, a Space for Citizen Participation or Control in the Management of Natural Resources in Mali / M.Traore. – 2010.
17. Tessogue, M., Coulibaly, O. Kledu farm and Faya classified forest near Bamako in Mali, opportunities and constraints for ecotourism // International Journal of Science and Technology, – 2021, 18 (6), – p. 117-131.

18. Tangara, N. Case studies on assessing forest degradation extract from the forest inventory of classified forests around Bamako, FAO / N.Tangara. – 2009.
19. Zenith, B. Fifteenth of the environment, visit to the Faya / B.Zenith. – 2014.

MALİNİN FAYA MEŞƏLƏRİNƏ ANTROPOGEN TƏSİRİN KARTOQRAFİK TƏHLİLİ

Adama Toqola

Son onilliklərdə Mali meşələri güclü antropogen təzyiqə məruz qalmışdır. Əhalinin 90%-nin ərazinin 30%-də yaşadığı bu Sahel ölkəsi müxtəlif fəaliyyətlər səbəbindən meşə ehtiyatlarından çox asılıdır. Malinin meşə ehtiyatları müxtəlif təzyiqlərə məruz qalır, o cümlədən: kənd təsərrüfatı üçün meşələrin qırılması, oduncaq və kömür istehlakı, oduncaq hazırlanması və ekosistem xidmətləri, heyvandarlığın inkişafı, ovçuluq, ildə 100000 hektardan çox ərazini məhv edən meşə yanğınları (erkən və gec), həmçinin xalq təbabəti üçün istifadə və s. Bamakodan 40 km məsafədə yerləşən 80000 hektarlıq Faya meşəsi qorunan meşə statusuna və yalnız Faya əhalisinə meşədən istifadə hüquqlarını verən yeni idarəetmə planına baxmayaraq, bu məhv olmadan xilas ola bilməmişdir. Metodologiya toplanmış materialların analizinə, kartoqrafik məlumatların və şəkillərin təhlilinə, keyfiyyət müşahidələrinin aparılmasına, məlumatların emalına və təhlilinə əsaslanmışdır. Tədqiqat bizə göstərdi ki, Faya meşələri böyük təzyiq altındadır, qalereya meşələri və meşəlikli savannalar getdikcə kol savannasına çevrilir. Bu məqalə son onilliklərdə Fayanın bitki formasiyalarına olan yüklənmələri təhlil etmək məqsədini daşıyır.

Açar sözlər: *CİS xəritələr, antropogen yüklənmə, Faya, mühafizə, meşələrin idarəedilməsi*

КАРТОГРАФИЧЕСКИЙ АНАЛИЗ АНТРОПОГЕННОГО ВОЗДЕЙСТВИЯ НА ЛЕСА ФАЯ В МАЛИ

Адама Тогола

В последние десятилетия леса Мали подвергались сильному антропогенному давлению. Эта страна Сахеля, где 90% населения проживает на 30% территории, очень зависит от лесных ресурсов благодаря множеству видов деятельности. Малийские лесные ресурсы подвергаются многочисленным нагрузкам, в том числе: вырубка лесов для сельскохозяйственных нужд, потребление древесины и древесного угля, заготовка древесины и оказание экосистемных услуг, пастбищное животноводство, охота, лесные пожары (ранние и поздние), которые опустошают более 100 000 га в год, а также использование в целях традиционной медицины. Охраняемые леса Фая площадью 80 000 га, расположенный в 40 км от Бамако, также не избежал этого уничтожения, несмотря на его статус охраняемого леса и новый план управления, который предоставляет право лесопользования только жителям Фаи. Методология основывалась на проведении анализа собранных материалов, анализе картографических материалов и рисунков, проведении качественных обзоров, обработке и анализе данных. Исследование показало нам, что леса Фая находится под огромным давлением и что галерейные леса и лесистая саванна постепенно превращаются в кустарниковую саванну. В данной статье ставится задача проанализировать нагрузки на растительные формации Фая в последние десятилетия.

Ключевые слова: *ГИС-карты, антропогенная нагрузка, Фая, охрана, управление лесами*

UDC: 631.6
ORCID: 0009-0008-0271-4118 (Mehdiyeva)

METHODS OF SOIL IMPROVEMENT IN SUMGAYIT-SIYAZAN MASSIVE

Nigar Zeydulla Mehdiyeva
Institute of Soil Science and Agrochemistry of the Ministry of Science and Education
E-mail: niqus598@gmail.com
Received: 01.03.2023
Accepted: 24.08.2023

The article describes a present state, salinization reasons, and location depth of the subsoil water and change of the salt quantity of the irrigated soil in the Siyazan-Sumqayit massive. The long researches carried out in the massive were compared with our investigations and it was determined that more salt gathered in the top and bottom layer of soil and this creates a condition for soil salinization. According to the results obtained that the salt quantity formed 0.22-3.11 % (for dry residue). As a result of the research, it was determined that the soils of the experimental site were unsalinized, poor, mean and strongly salinized.

Keywords: *irrigation, salinization, salt, fertility, ameliorative state.*
DOI: 10.59849/2409-4838.2023.3.65

INTRODUCTION

One of the actual problems of the modern period is increase of productivity of the agricultural plants. It is known that there is significant importance of correct management in terms of preserving the ameliorative state of soil because the plant crops are obtained from irrigated soil. At present the soil cover undergo to serious changes as a result of the continuing negative processes and this was reflected in loss of resourses and fertility of soil, in complicating of the structure of soil cover. A danger of the secondary salinization of the ameliorated soil occur in the condition with the incorrect irrigation. Salinization and solonetzification of the soil is a characteric indication for the plain soil.

Reduction of the soil fertility as a result salinization, solonetzification,eroding of soil in some agricultural zones of our republic caused decrease of productivity of the agricultural plants. Salinization and solonetzification - environmental problems associated with the ground water-soil- water-plant-atmosphere continuum associated with water potential in the growth medium, which causes decreased transpiration and net photosynthetic rates (the osmotic effect, salinity degree), reduced capacity of plants to transform energy to biomass, and accumulation of specific toxic ions (Cl^-, Na^+) to levels exceeding the tolerance limits of plants (salinity stress, specific ion effect); ionic disequilibrium and imbalance of nutrients in the plant, thus harming seed germination, plant stomatal conductance, density and growth, and biomass partitioning between shoots and roots; and deterioration of soil structure (soil disaggregation and clay dispersion) and hydraulic characteristics (solution and air flow) due to high content of exchangeable Na^+, Mg^{2+}, or K^+ when soil electrolyte concentration is below a ”threefold” level [4].

The ameliorative state of the soil strongly changed because of unfitness of some available irrigative systems including collector-drainage networks in the irrigatrd soil as a result of thriftlessness occured in agriculture until the implementation of agrarian reforms [5, p. 32-36]. From this point of view study of the present state of the soil in the Siyazan-Sumgayit massive and improvement ways of of the soil was an actual problem and it assumes a practical importance. Aim of the research was to improve an amoliaritive state of the soil of the experimental area selected in the Siyazan-Sumqayit massive.

MATERIAL AND METHODS

The salinized soils have been taken as a research object in the Siyazan-Sumgayit. For this purpose, three (3) soil sections have been applied in the character places of the virgin soils in the Shurabad village of the Khizi district. The soil samples have been taken indicating coordinates on genetic layers in order to study an ameliorative state of the same soils. The necessary chemical analyses have been realized according to the widely used method in the republic [18, p. 392-394].

The additional sections were applied to study a change of salt quantity in the experimental area and compile a zone map. During the research it was determined that the salt amount was various in the soils of the experimental area and the soils exposed to unsalinized, weak, moderate and strong degree according to the obtained consequences.

RESULTS AND DISCUSSION

The investigations indicate that the hydrogeological-amelioration state of the irrigated soil in our republic has improved noticeably in recent years, and this is a result of purposeful amelioration measures. The decisions in connection with the fight against degradation and desertification and improvement of the soil amelioration state which was added to" The measures Plan on provision of rational use of the water resources" approved by Decree No.2340 of the President of the Azerbaijan Republic dated December 2020 are accomplishing. Recently, conduction of the reforms show that attitude of the land users to soil is different and sometimes they do not use the soil properly for its intended purpose. The carried out researches indicate that some ecological changes happened in the soil as a result of the anthropogenic effects. The salt quantity, mineralization of the subsoil water, modern state of the collector-drainage systems must be firstly determined to study ameliorative state of the soil used under agricultural plants. The role of the chemical composition and the degree of mineralization of groundwater in the salinization of irrigated areas and the formation of soil types is great [13, 14].

As it is known that Siyazan-Sumqayit massive is included in plain zone of the republic. The heavy grey soil of the massive forms a large zone of the coastal region. A role of the climate is great in formation of the natural solonchaks. According to some researches' experiments the extramurally of the ameliorative state of the massive soil show itself in the low background of the natural water permeability of the heavy soil, and this makes impossible the soil desalination under natural climatic factors [17, p. 238]. The climate changes firstly affect agriculture that is one of the manufacturing areas. Climate change primarily affects agriculture, which is one of the manufacturing sectors [6, p. 139-142, 16, p. 45]. An area of the Siyazan-Sumgayit massive is nearly 60.000 hectares. The massive is a plain, which has a plane weak inclination stretching from north-west to south-east [15, p. 47-54]. The Caspian lowland where Siyazan-Sumgayit massif is located is 5-6 km wide in the southeast, and 13 km wide with the formation of the Gilazi in the northwest. Sumgayit that is located from low flow of the river to north and stretches from the coastal line to north is a valley-plain. According to the long information, an average annual quantity of the atmospheric precipitations is 160-353 mm. The snow cover is not observed in the massive. The atmospheric precipitations are unequal. According to the information of the meteorological stations, a quantity of the atmospheric precipitations in the Siyazan-Sumgait massif is maximum in autumn-winter, but minimum in summer [1, p. 16].

The soil cover of the Siyazan-Sumgayit massive is rather various and it is mainly grey-cinnamonic (*Calcic Gypsisols*), grey (*Haplic Calcisols*), takir and saline. A structure and characters of the grey-cinnamonic (*Calcic Cypsisols*) soil are defined with the soilforming features which deve-

lop in the condition of th strong drought climate and xerophylephemer plant cover. Here, the plant cover intensively develop in a short spring period. The plant residues are completely mineralized during a season. Therefore humus is less here. The weak structure is characteristic for grey-cinnamonic soil and the humidity supply is not great. The salinization indications are seen in the grey-cinnamonic soil beginning from 30-40 cm depth and salinization reflects itself from 50 m. This soil belongs to chloride-sulphatic type [7, p. 19].

It was determined on the basis of the researches that the groundwater widespread in the area. A chemical composition of the groundwater is sulphate-chlorine-natrium, chlorine-sulphate-natrium in the Khizi and Siyazan regions [3, p. 334-342]. The climate indications, plant cover, the zone relief, the different humid condition (surface water) affect the formation and distribution of the soil. The heavy granulometric structure on soil profile is observed.

A quantity of physical clay is 72-90% in the soil profile, and this indicates systematical collection of the small fractions brought by surface flows. Salinization of this soil is high. Great salt collection is observed on the top and low layer (1.3-2.6). The salinization process occurs as a result of development of the salt migration in different conditions, mainly, in the accumulative plains, debris cones of the rivers, in the deluvial foothill plains. The alluvial salinized soil is distinguished with the widespread of the great dynamicity of the water-salt regime and secondary salinization event [10]. Collection of the salt in the soil rises density of soil solution, decreases water-permeability of the soil and rises an osmotic pressure of solution. Consequently, provision of plants with water destroys, one part of the nutrient combinations become non-mastered state. The annual experiments show that productivity of the agricultural plants is 20% in the weak salinized soil, 50% in the average salinized soil, 70% in the strong salinized soil, 90% in the very strong salinized soil in connection with non-salinized soil [8, p. 151-167].

It is known that irrigations are quickly reflected in the water regime of the zone. Removing the salt from irrigation areas rises water mineralization and change their chemical composition. The salt entering the zone from the low layers by the irrigated water causes secondary salinization of soil in the non-drained area for a short time. Y.B.Cheshnokov and others note that the ameliorative drainage system was not realized in the zone without black soil in Russia Federation and the project norm and climate change weren’t paid attention during the covering drainage construction for last 30 years [2, p. 24].

The soil researches in the massive were performed by V.M.Smirnov-Loginov (Absheron, 1927, 1928, 1935, 1942), N.A.Kachinsky (Strait,1937), I.A.Shulga (Strait,1938), E.M.Salayev (along the Samur-Davachi canal ,1941), M.R.Abduyev (in the massive deluvial plain,1941), R.G.Mammadov (1965, 1969) and others. The researches indicated that a reason of the factors complicating amelioration work is weak development of the irrigation system, smoothing of the area, building of the channels in the soil conduit and open form, non- compliance of irrigation norm and technology, excessive flowing of irrigation water into depressions, negative effect of the economic factors on ameliorative condition [9, p. 221-222]. The last researches indicated that the soil degraded under the influence of salinity, irrigation erosion, and aridity and so on. An amount of the salt in the soil samples taken from the research zone was fixed and the consequences were given on the table.

Table 1.

Change of the salt quantity in the soil of the experimental area

	Depth, cm	Mg.ekv/%							Total of salt	Dry residue, %
		CO_3	HCO_3	Cl	SO_4	Ca	Mg	Na+k		
N1	"0-23	No	0,40	24,2	24,48	10,25	3,25	35,58	3,11	3,66
			0,024	0,847	1,176	0,205	0,039	0,818		
N $40^0$50.341"	23-61		0,40	11,2	5,996	2,00	3,25	12,34	1,07	1,07
E $049^0$20.411			0,024	0,392	0,288	0,040	0,039	0,284		
	61-112		0,60	3,80	1,998	4,50	0,25	1,648	0,39	1,31
			0,036	0,133	0,096	0,090	0,003	0,038		
	112-178		0,40	10,8	11,99	5,25	2,00	15,94	1,47	2,08
			0,024	0,378	0,576	0,105	0,024	0,366		
	"0-35		0,40	1,00	7,745	2,25	0,50	6,395	0,63	1,13
N2		No	0,024	0,035	0,372	0,045	0,006	0,147		
	35-68		0,40	23,4	21,74	7,75	0,25	37,54	2,86	2,84
N$40^0$50.430"			0,024	0,819	1,044	0,155	0,003	0,817		
E $049^0$20.127	68-91		0,40	31,2	10,49	6,00	2,75	33,34	2,54	2,75
			0,024	1,092	0,504	0,120	0,033	0,766		
	91-182		0,40	6,40	22,24	7,75	1,50	19,79	1,94	1,93
			0,024	0,224	1,068	0,155	0,018	0,455		
	0-30	No	0,80	1,40	5,246	2,00	2,25	3,196	0,49	0,41
N3			0,048	0,049	0,252	0,040	0,027	0,074		
	30-60		0,60	0,60	5,996	1,00	2,50	3,696	0,48	0,28
N $40^0$49.905"			0,036	0,021	0,288	0,020	0,030	0,085		
E$049^0$20.215"	60-90		0,80	0,60	1,998	1,25	2,00	0,148	0,22	0,21
			0,048	0,021	0,096	0,025	0,024	0,003		

As it is seen on the table, CO_3 ion wasn't observed in salt anion content in the soil of the experimental area, a quantity of HCO_3 was 0,024-0,048% on genetic layers, an amount of Cl ion was 0,021-0,847 %, but a quantity of SO_4 was 0,096-1,176 %. Ca quantity in cation content of the salt was 0,020-0,205 %, Mg was 0,018-0,039 %, but an amount of Na+k was 0,003-0,818. The salt quantity formed 0,22-3,11 % (for dry residue) (Table 1). This indicates that the soil in the experimental area was unsalinized, poor, mean and strongly salinized. Change of the salt quantity reflects on the diagram. pH was studied in the soil of the research zone and it was determined that its value was 7,8-8,8 in 2017, 7,4-8,8 in 2018, 7,5-8,8 in 2019. In addition, this approved that the soil is salinized to a weak, mean and strong degree [11, 12]. The soil type was determined in the soil of the research area and they were belonged to sulphate and chlorine-sulphate type.

CONCLUSION

1. The carried out researches indicated that a quantity of the salt in the grey-cinnamonic soil in the selected zone of the Siyazan-Sumqayit massif was 0,22-3,11%. This shows that the same soil is unsalinized, poor, mean and strong salinized.

2. It is important to fulfil agromeliorative measures for improvement of the ameliorative state of this soil (deep plough, to clean the soil from salt by applying showing water to the places where the saltness is higher (2500-3000m^3/ha), to dig temporary drains in the salinized places, applying mineral and organic fertilizers depending on plant kind, planting of salt-tolerant plants and so on). A condition is created for both fertility and improvement ameliorative state by applying all the mentioned to the same soil.

REFERENCES

1. Abduyev, M.R. Deluvial shaped salinized soil and their amelioration problems / M.R.Abduyev. – Baku: – 2012. – 179 p.
2. On some scientific and practical aspects of involving reclaimed agricultural lands into circulation. Efficient development of the reclamation complex. Land reclamation and water management / Yu.V.Chesnokov, G.G.Gulyuk, Yu.G.Yango [et al.] – 2022. – 24 p.
3. Ismailov, J.M., Pasayaev, N.E. Agricultural plants grown on irrigated lands of the Siyazan-Sumgayit massive and their productivity // Collection of works of the ATC, – 2019. – p. 334-342.
4. Ismayilov, A.I. Soil Salinity Type Effects on the Relationship between the Electrical Conductivity and Salt Content for 1:5 Soil-to-Water Extract / A.I.Ismayilov, A.I.Mamedov, H.Fujimaki [et al.] // Sustainability, – 2021. №6, – p. 3395-3405.
5. Jalilova, L.Z. Provision of soil fertility in the experimental area // – Ganja: ANAS news collection, – 2013. № 52, – p. 32-36.
6. Jalilova, L.Z., Mekhtieva, N.Z. Role of the climate change in soils salinizatization. Trends in the development of science and education // – Samara: Reviewed scientific journal, – 2021. №72, – p. 139-142.
7. Mammadov, G.Sh. Bases of Soil Science and Soil Geography / G.Sh.Mammadov. – Baku: – 2007. – 661 p.
8. Melioration: diagnostics and classification of saline and saline soils. Textbook / G.Sh.Mammadov, A.Ch.Gashimov, S.T.Gasanov [et al.] – Baku: – 2017. – 308 p.
9. Mehdiyeva, N.Z. Melorative state of soils in the territory of the Siyazan-Sumgait massive // International scientific conference of students, graduate students and young scientists. Moscow, – 2018.
10. Mehdiyeva, N.Z. Change of some indications of the soil in the research zone (on Siyazan-Sumqayit massive) // The topic devoted to the 110th anniversary of Volobuyev's birth is "Ecology, amelioration and energetic of the soil". Scientific-practical conference Materials. Baku, – 2020, – p. 70.
11. Mehdiyeva, N.Z. Changes in the amount of salts in the tropics at the experimental site // "Soil-ecological problems of agrocenoses and ways to solve them" movement international scientific-practical conference. Baku, – 2021, – p. 74-78.
12. Mehdiyeva, N.Z. Types of salts in soils on the territory in Siyazan-Sumgayit mountain massive // – Minsk: Scientific Journal «Land reclamation», – 2022. – p. 19-23.
13. Mustafayev, M.Q. Change of groundwater mineralizetion and location in irrigated soils in Mugan-Salyan massive // 10 th İnternational Congress on "The Soil Resources and Environment Conservation". Almaty, Kazakhstan, – 2018, – p. 93-94.
14. Mustafayev, M.G. Modern state of the soil in the Mughan-Salyan massive and scientific bases of their improvement. Monograph / M.G.Mustafayev. – Baku: – 2019. – 324 p.
15. Mustafayev, M.G., Mustafayeva, N.Z. Modern state of the Siyazan-Sumgayit massive soils // – Almaty: Soil Science and Agrochemistry, – 2018. – p. 47-54.
16. Rzaev, M.A. Azerbaijan: Irrigation Farming Reform and Environmental Sustainability / M.A.Rzaev. – Baku: "Science and Education", – 2019. – 369 p.
17. Suleimanov, N.R. Landscape-adapted soil-ecological method of development of natural solonchaks of the Siyazan-Sumgait massive. A collection of works on Soil science and agrochemistry. / N.R.Suleimanov, R.Ya.Abbasova – Baku: Elm, – 2009. – 238 p.
18. Arinushkina, E.V. Guidelines for chemical analysis of soils / E.V.Arinushkina. – M., izd, MGU, – 1970. – 487 p.

SİYƏZƏN-SUMQAYIT MASSİVİ TORPAQLARININ YAXŞILAŞDIRILMASI YOLLARI

N.Z. Mehdiyeva

Məqalədə Siyəzən-Sumqayıt massivində suvarılan torpraqların hazırkı vəziyyəti, onların şorlaşma səbəbləri, qrunt sularının yerləşmə dərinliyi və torpaqda olan duzların miqdarının dəyişməsi haqqında məlumat verilmişdir. Massivdə aparılan uzun müddətli tədqiqatlarla bizim tədqiqatlar müqayisə olunmuş və müəyyən edilmişdir ki, torpağın üst və alt qatlarında böyük miqdarda duz toplanır ki, bu da həmin torpaqların şorlamasına şərait yaradır. Əldə edilən nəticələrə əsasən duzların miqdarı 0,22-3,11% (quru qalığa görə) təşkil etmişdir. Aparılan tədqiqatlar nəticəsində təcrübə sahəsi torpaqlarının şorlaşmamış, zəif, orta və şiddətli dərəcədə şorlaşmaya məruz qaldığı müəyyən edilmişdir.

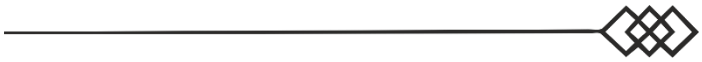
Açar sözlər: *suvarma,şorlaşma, duzlar, münbitlik, meliorativ vəziyyət*

МЕТОДЫ УЛУЧШЕНИЯ ПОЧВ СУМГАИТ-СИЯЗАНСКОГО МАССИВА

Н.З. Мехдиева

В статье описаны современное состояние, причины засоления, глубина залегания грунтовых вод и изменение количества солей орошаемой почвы в Сиязано-Сумгайытском массиве. Многолетные исследования, проведенные в массиве, сопоставили с нашими исследованиями и определили, что в верхнем и нижнем слое почвы скапливается больше солей, что создает условия для засоления почвы. По полученным результатам количество солей составило 0,22-3,11% (в пересчете на сухой остаток). В результате проведенных исследований установлено, что почвы опытного участка не засолены, слабо, средне и сильно подвержены засолению.

Ключевые слова: *орошение, засоление, соли, плодородие, мелиоративное состояние*



BIOLOGICAL AND MEDICAL SCIENCES

UDC: 162.57
ORCID: 0000-0002-7726-9396 (Aliyeva)

STUDY OF RABIES VIRUS IN AZERBAIJAN 2016-2017

Chichak Vali Aliyeva
Azerbaijan Food Safety Institute
E-mail: ciceksuleymanova3@gmail.com
Received: 01.04.2023
Accepted: 31.08.2023

Due to the fact that rabies causes 100% of deaths among humans and animals, it is still considered a particularly dangerous disease. Rabies is caused by an RNA-containing virus that affects nerve cells. In order to contract rabies, a person must be bitten by a sick animal. World Organization for Animal Health (WOAH-OIE) has mandated that member countries report on rabies. Hence, Azerbaijan submits rabies statistics to the OIE every year.

According to OIE data, rabies kills about 70,000 people worldwide every year. According to statistical data, rabies disease is registered in the country every year. The virus is widespread mainly among pets and stray dogs.

Azerbaijan is located in the South Caucasus, a region of geopolitical importance located at the gateway between Europe and Asia. This geographical location makes the region of central importance to epidemiological study and the control of transboundary infectious diseases such as rabies.

The purpose of the conducted research is to study the regions where the rabies virus spread in 2016-2017, the type of infected animals and laboratory diagnostics. As a result, in 2016-2017, the zone where the virus spread the most in the country was Zagatala-Sheki and Baku. The main advantage in laboratory diagnostics is given to the polymerase chain reaction. This method is used for early detection and is considered confirmatory.

Keywords: *Rabies, Azerbaijan, foci, PCR (polymerasa chain reaction), virus*
DOI: 10.59849/2409-4838.2023.3.72

INTRODUCTION

Rabies is present on all continents and this one is a vaccine-preventable, zoonotic, viral disease [1, 2]. Once clinical symptoms appear, rabies is virtually 100% fatal. In up to 99% of cases, domestic dogs are responsible for rabies virus transmission to humans [3]. Yet, rabies can affect both domestic and wild animals. It is spread to people and animals through bites or scratches, usually via saliva [5]. World Animal Health Organization (WOAH-OIE) estimates that rabies kills approximately 70,000 people each year. In European countries, red foxes (Vulpes vulpes) are the main reservoir and vector of rabies, while dogs (canis) are the most common cause of rabies cases in countries such as Ukraine, Belarus, and the Russian Federation, as well as Africa, Asia, and the Middle East. Dogs and foxes are both thought to act as reservoirs of rabies in Turkey, according to recent statistics.

The causative agent of rabies is a neurotropic RNA-containing virus belonging to the Lyssavirus genus of the Rabdoviridae family. It is shaped like a bullet, and its size is 90-170 nm, and 110-120 nm. Their reproduction (in vitro and in vivo) leads to the formation of Babesh-Negri bodies, special derivatives of various shapes (big, oval, thread) in the cytoplasm of neurons, 0.5-2.5 nm in size, stained red with acid dyes. Two variants of the virus are known: a) street or "wild" variant - which circulates among animals under natural conditions, b) Fixed variant-obtained by infecting rabbits by L. Pasteur. Since fixed viruses are not excreted in saliva, they cannot be transmitted during a bite. Neuronal proliferation is not accompanied by the formation of Babesh-Negri bodies. Fi-

xed viruses are used to obtain an antirabies vaccine and their administration forms permanent immunity against the street variant virus. This indicates that both variants have the same antigenic structure. Rabies viruses have two - S and V antigens. The S antigen is the same as for lyssaviruses and induces the formation of complement-binding and precipitating antibodies. V-antigen (surface antigen) causes the synthesis of neutralizing antibodies and participates in the formation of immunity. Wild viruses are pathogenic to humans, warm-blooded animals and birds. High sensitivity to the virus is noted in foxes and Siberian mountain mice.

Azerbaijan is located in the South Caucasus, a region of geopolitical importance located at the gateway between Europe and Asia. This geographical location makes the region of central importance to epidemiological study and the control of transboundary infectious diseases such as rabies. Throughout Azerbaijan, rabies is a reportable disease. There is little known about the characteristics (density, growth dynamics) of the dog population, which is thought to be the main source of rabies. Therefore, there is a need to conduct scientific and epidemiological studies in this regard. There is a large population of stray dogs in Azerbaijan. Current management of these animals consists of neutering and vaccination programs and culling is prohibited.

According to reports from the Azerbaijan State Veterinary Control Service rabies cases are observed among animals and fatal cases occur sporadically among people in Azerbaijan annually [4, 6, 7]. However, despite all the research conducted there is still a lack of information regarding the circulation of rabies in Azerbaijan. Therefore, the goal of this study is the continuing study of rabies positive samples for further identification of the circulation of the virus in Azerbaijan in order to plan a vaccination program.

MATERIAL AND METHODS

Research Area

The State Veterinary Service under the Ministry of Agriculture of the Republic of Azerbaijan carried out passive surveillance for Rabies from 2000 to 2017.

The statistical information regarding rabies cases in animals in 2016-2017 was collected from the Azerbaijan State Veterinary Control Service. The National Reference Laboratory under the Azerbaijan Food Safety Institute (AFSI) tested the collected samples.

This laboratory provided training on rabies diagnosis to the research team participants in 2017. All the samples were tested (from 2000 to 2018) by the National Reference Laboratory and PCR positive samples were sent to the Food Safety Institute (former Veterinary Scientific Research Institute) to assure virus vitality and for sequencing.

Laboratory examinations

All brain samples were stored at -80°C in the BSL-2 laboratory (AFSI).Stored samples were tested by FAT for identification of Babes-Negri bodies. The most widely used test for rabies diagnosis is the FAT, which is recommended by both the WHO and WOAH.

Due to using different diagnostic tests and comparing the results of these tests, we did PCR in parallel with FAT. Since the samples taken (2016-2017) were not fresh, we considered it appropriate to use PCR together with FAT.

First for identification of the agent, we used the fluorescent antibody test (FAT). PCR assays were conducted using Qiagen RNA mini kit (USA) and GENESİG Standard Kit (manufactured in UK) on the Bio-Rad CFX96 PCR instrument.

RESULTS AND DISCUSSION

In general, this surveillance has determined the extent of the spread of Rabies in the country. The map below shows the level of rabies spread throughout the country during 2000-2017. Mostly, the spread in the Absheron peninsula and northern regions (Gakh, Balakan, Zagatala, etc.) has been more noticeable.

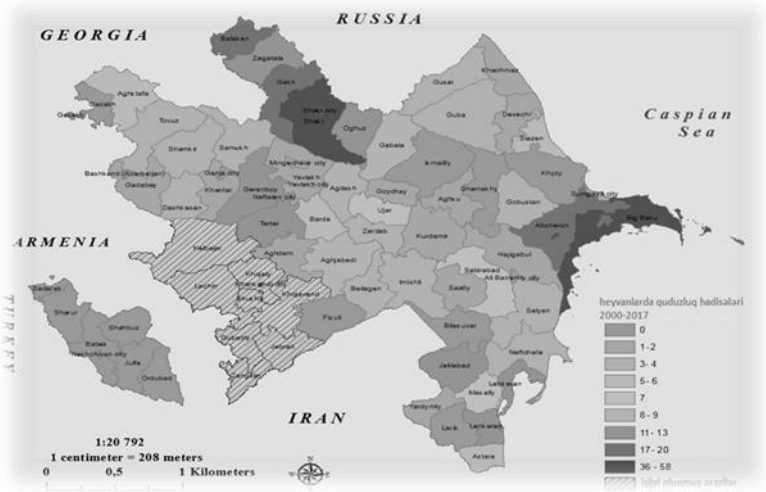


Fig. 1. Distribution of rabies in Azerbaijan 2000-2017

In our research, the positive brain samples of 2016 and 2017 were used (Figure 1). Thus, in 2016- 18 domestic and 3 stray dogs, 17 cattle, 1 donkey, 5 cats, and 3 jackals- a total of 48 animals tested positive. The analysis was conducted by the National Reference Laboratory (former Republican Veterinary Laboratory).

In 2017 – 17 domestic and 14 stray dogs, 32 cattle, 2 small ruminants, 1 horse, 1 donkey, 2 cats, 1 wolf, and 3 jackals- a total of 48 animals tested positive. The analysis was conducted by the National Reference Laboratory (former Republican Veterinary Laboratory).

While analyzing the 2016 and 2017 positive samples, we found that there were more cases of rabies among cattle. Thus, in 2016, this number was 17, while in 2017, this number was 32. In addition, rabies was not detected among small ruminants in 2016, but 2 small ruminants tested positive in 2017. Finally, both years of the analysis showed that there were cases of rabies found amongst cats and both domestic and stray dogs.

From 2016 to 2017, 12 randomly selected samples from a total of 121 positive samples were given to the FSI. A total of 12 brain samples from different animal species (5 cows, 3 donkeys, 1 horse, and 3 jackals) were provided by the National Reference Laboratory. No scientific investigation has been carried out since the collection of these 12 brain samples stored in the AFSI, and the samples are simply stored at -80°C in the BSL-2 laboratory. All the samples were tested again for rabies positivity by the NRL. Of the 12 samples, 3 were damaged and were not in good condition, so they were neutralized without being tested. In the other 9 brain samples, firstly the FAT resulted positive. For Agent identification, the gold standard test is the fluorescent antibody test (FAT). The preferred method for routine diagnosis of rabies in fresh or frozen brain tissues is the fluorescent antibody test (FAT). For the 9 samples which were found positive in the FAT a PCR was done and the result was the same as the FAT. Next, molecular epidemiological studies were selected for PCR. Out of the 12 brain samples we observed Babes-Negri bodies in 9 by FAT. The positive results were confirmed by PCR.

The samples that tested positive were sent from different regions of Azerbaijan in 2016-2017 (NRL), including, the Absheron Peninsula, Kurdamir, Barda, Shaki, Zagatala, Ujar, Gakh, Balakan and Agdash (Figure 2).

Fig. 2. Randomly selected positive samples 2016-2017

From 12 samples-3 were damaged and were not in good condition. In our opinion, this is due to the replacement of the Institution conditions in a short time (moving the VSRI to another building and giving the samples to the AFSI for the BSL-condition) and the lack of a correct method for storing the samples.

As a result, the virus suspension and RNA extract from brain samples were stored at under -80 C degree. The main purpose of this is to allow future work to keep up the RNA as much as possible, that is, the RNA level may be reduced as the brain samples are frozen each time.

CONCLUSION

According the results in 2016-2017 we evaluated the statistical of positive results. In general, we can say that rabies is actual between agricultural animals, domestic animals and wildlife. Although several studies have been carried out, there is still a lack of information in the areas mentioned below: oral vaccination program and evaluation of statistical data.

REFERENCES

1. Aubert, M.F. Sensibilité et fidélité du diagnostic de rage au laboratoire // Comparative Immunology, Microbiology and Infectious Diseases, – 1982. – p. 369-376.
2. Tenzin, W.P. Review of rabies epidemiology and control in south, southeast and east Asia: past, present and prospects for elimination // Zoonoses Public Health, – 2012. – p. 451-467.
3. Dettinger, L. Detection of Apparent Early Rabies Infection by LN34 Pan-Lyssavirus Real-Time RT-PCR Assay in Pennsylvania / L.Dettinger, M.G.Crystal [et al.] // Viruses, – 2022, 14 (9), – p. 1845.
4. OIE Terrestrial Manual Rabies / – 2008. – p. 304.
5. Schlottau, C.M. Development of molecular confirmation tools for swift and easy rabies Diagnostics-Kore / C.M.Schlottau, T.M. Freuling, B.Martin [et al.] // Virology Journal, – 2017.
6. OIE (Handbook on Import Risk Analysis for Animals and Animal Products / Paris: – vol. 1. – 2004. – 57 p.
7. Pal, S.K., Ghosh, B., Roy, S. Dispersal behaviour of free-ranging dogs (Canis familiaris) in relation to age, sex, season and dispersal distance // Applied Animal Behaviour Science, – 1998. – p. 123-132.

AZƏRBAYCANDA QUDUZLUQ VİRUSUNUN TƏDQİQİ 2016-2017

Ç.V. Əliyeva

Quduzluq başverdiyi zaman insanlar və heyvanlar arasında ölüm hallarına 100% rastlandığı üçün hələ də bu xəstəlik xüsusilə təhlükəli xəstəlik hesab olunur. Quduzluq sinir hüceyrələrinə təsir edən RNT tərkibli virusdan qaynaqlanır. Quduzluğa yoluxmaq üçün insanı xəstə heyvan dişləməlidir. Ümumdünya Heyvan Sağlamlığı Təşkilatı (WOAH-OIE) üzv ölkələrin quduzluqla bağlı hesabat verməsini tələb edir. Beləliklə, Azərbaycan hər il quduzluq statistikasını OIE-yə təqdim edir.

OIE məlumatlarına görə, quduzluq hər il dünyada təxminən 70.000 insanın ölümünə səbəb olur. Statistik məlumatlara görə, ölkədə hər il quduzluq xəstəliyi qeydə alınır. Virus əsasən ev heyvanları və sahibsiz itlər arasında geniş yayılıb.

Azərbaycan Cənubi Qafqazda, Avropa ilə Asiya arasında keçid qapısında yerləşən geosiyasi əhəmiyyətə malik regionda yerləşir. Bu coğrafi yerləşmə bölgəni epidemioloji tədqiqatlar və quduzluq kimi transsərhəd yoluxucu xəstəliklərə nəzarət üçün mərkəzi əhəmiyyət kəsb edir.

Aparılan tədqiqatın məqsədi 2016-2017-ci illərdə quduzluq virusunun yayıldığı rayonların, xəstəliyə yoluxmuş heyvanların növünün öyrənilməsi və laboratoriya diaqnostikasının aparılmasıdır. Nəticədə 2016-2017-ci illərdə ölkədə virusun ən çox yayıldığı zona Zaqatala-Şəki və Bakı olub. Laboratoriya diaqnostikasında əsas üstünlük polimeraza zəncirvari reaksiyaya verilmişdir (PZR). Bu üsul erkən aşkarlama üçün istifadə olunur və təsdiqedici diaqnostik üsul hesab edilir.

Açar sözlər: *Quduzluq, Azərbaycan, ocaqlar, PZR (polimerazisasiya zəncir reaksiyası), virus.*

ИЗУЧЕНИЕ ВИРУСА БЕШЕНСТВА В АЗЕРБАЙДЖАНЕ 2016-2017 ГГ

Ч.В. Алиева

В связи с тем, что бешенство является причиной 100% смертей людей и животных, оно до сих пор считается особо опасным заболеванием. Бешенство вызывает РНК-содержащий вирус, поражающий нервные клетки. Чтобы заразиться бешенством, человеку необходимо укусить больное животное. Всемирная организация по охране здоровья животных (ВАОЗ-МЭБ) обязала страны-члены сообщать о бешенстве. Таким образом, Азербайджан ежегодно представляет в МЭБ статистику по бешенству.

По данным МЭБ, ежегодно от бешенства во всем мире умирает около 70 000 человек. По статистическим данным, заболевание бешенством регистрируется в стране ежегодно. Вирус распространен преимущественно среди домашних животных и бездомных собак.

Азербайджан расположен на Южном Кавказе, в регионе геополитического значения, расположенном на стыке Европы и Азии. Такое географическое положение делает этот регион центральным для эпидемиологических исследований и борьбы с трансграничными инфекционными заболеваниями, такими как бешенство.

Цель проведенных исследований - изучение регионов распространения вируса бешенства в 2016-2017 гг., вида зараженных животных и лабораторной диагностики. В результате в 2016-2017 годах зоной наибольшего распространения вируса в стране стали Загатала-Шеки и Баку. Основное преимущество в лабораторной диагностике отдается полимеразной цепной реакции. Этот метод используется для раннего выявления и считается подтверждающим.

Ключевые слова: *Бешенство, Азербайджан, очаги, ПЦР (полимеразная цепная реакция), вирус.*

UDC: 619:616981.51
ORCID: 0000-0003-3438-2230 (Abbasov)

LARGE CATTLE CORONAVIRUS: EPIZOOTIC STATUS, GENOME STRUCTURE, CLINICAL SYMPTOMS AND PREVENTION-MINI REVIEW

Vusal Jarchy Abbasov
Scientific-Research Veterinary Institute
E-mail: vusalabbasov8414@gmail.com
Received: 18.05.2023
Accepted: 02.09.2023

Bovine diarrhea is of multifactorial origin, causing heavy mortality risk and having a negative impact on animal welfare along with high economic loss in animal husbandry. Coronoviruses are one of the main enteropathogenic viruses of humans and newborn calves. A review of the available data indicates that further research is needed to understand the underlying pathogenesis mechanisms of BCoV respiratory and intestinal diseases, as well as the variables and interactions between the virus, host, and environmental factors that can exacerbate the disease or lead to increased spread and transmission. Further extensive research is needed to determine the correlates and attributes of immune defense needed to develop effective vaccines/regimens that can prevent severe disease and limit the spread of the virus.
Keywords: *coronavirus, RNA (ribonucleic acid), epidemiology, genome*
DOI: 10.59849/2409-4838.2023.3.77

INTRODUCTION

Viral diseases occur as a result of the pathogen entering the body of an animal. The interaction of a virus with an animal organism is a biological process. The genus Coronovirus belongs to little-studied viruses and was separated into an independent group in 1968 [1-4]. The modern classification of coronaviruses is presented in the following form:

Coronaviruses (CoV) belong to the Coronavirinae subfamily of the Coronaviridae family, phylum Nidovirales. CoVs are currently classified into four genera: alphacoronaviruses, betacoronaviruses, gammacoronaviruses, and deltacoronaviruses, while alphacoronaviruses and betacoronaviruses are mammalian CoVs and members of the other two genera cause disease in all birds [14, 16].

Despite differences in natural hosts, coronovirus virions share many common biological features in their morphological structure. Five main features determine the belonging of the virus to the genus of coronoviruses. The average size of the virion is 80-160 nm, the presence of RNA, membranes with lipids, the peculiar morphology of virions and the reproduction of viruses in the cytoplasmic vesicles of the cell.

MAIN PART

The genomic RNA of coronoviruses is a single-stranded linear "plus" RNA molecule with a molecular weight of 5.5-8.1 mD and a sedimentation coefficient of 48-70 S. Of great epidemiological importance are the infectious bronchitis virus of birds, infectious gastroenteritis of pigs, hemagglutinating encephalomyelitis of pigs and coronovirus of large horned animals. Mouse hepatitis viruses are known to be coronoviruses. The main way for the introduction of coronoviruses from an infected cell is its lysis. There is an antigenic relationship between human coronoviruses and murine hepatitis virus [9, 10, 19].

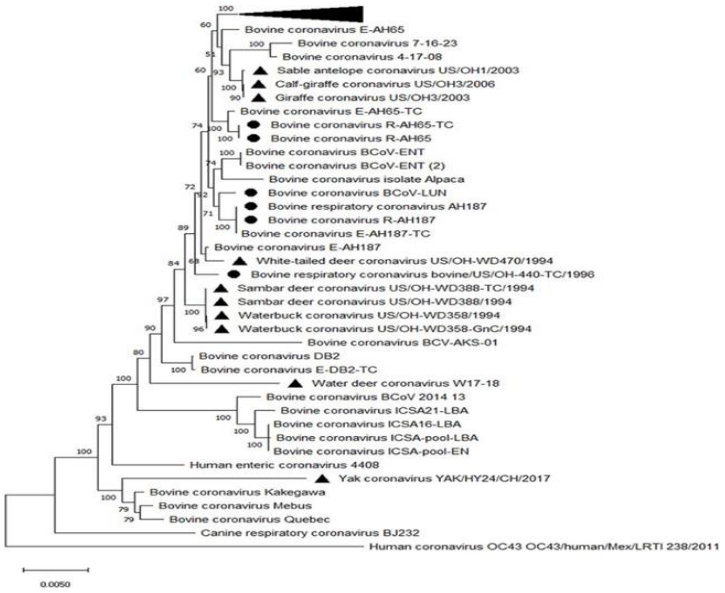


Fig. 1. Phylogenetic analysis of the complete genomes of enteric and respiratory BCoVs from wild ruminants and bovine CoVs (source: https://doi.org/10.3390/v12020183)

The phylogenetic tree of the hemagglutinin esterase protein (HE), glycoprotein (S), nucleocapsid protein (N), and ORF1 genes in Figure 1 revealed similar clusters throughout the genome.

Determining how target genes can influence the disease process is important because coronaviruses are increasingly spreading in livestock around the world, and can be helpful if the disease process of other coronaviruses is not understood. A possible common mechanism of spread between species may provide more data on the etiology of the disease and potential treatment options in the future [24].

Table 1.

The gastric BCoV degree of positiveness in Different countries

Spread area by years	**Countries**	**Spreading speed (%)**
2010-2019	Korea	5.6-58.2
	Turkey	1
	Australia	14
	New Zealand	21.6
	Algeria	20.73
	Iran	7.2.
	China	12.20-69
	India	8.88-16
	Thailand	12
2009	Canada	57-66
2000-2009	Ireland	22.9-60.7
	Italy	9.6-65
	Brazil	22-67

Table 1 shows the gastric BCoV degree of positiveness in different countries [24].

It shows that, in 2000-2009, the gastric BCoV degree of positiveness in Italy and Ireland was 9.60-65.85% and 22.9-60.7%, respectively. From 2010 to 2019, a positive BCoV was detected for the first time in Australia. In China, a positive BCoV rate has been detected for the first time since 2020. Other countries respectively as mentioned in table 1.

Seasonal changes are one of the most important and predictable systems affecting humans and ecosystems. The spread of many pathogenic infections is seasonal, for example, respiratory diseases in humans and rotaviruses in children are more common in winter [20, 21, 23]. In addition, nodular dermatitis of large ruminants' spreads depending on seasonal changes also [22]. Annual seasonal fluctuations can cause changes in the susceptible organism and infection biology and lead to epidemics, but other factors leading to seasonal epidemics should be considered [5, 6, 8]. The coronavirus pandemic, which is a viral disease that the planet is facing in the modern period, has shown that in order to prevent such diseases and stay prepared for the possible occurrence of such risks in the futures. Thus, just 5 months after the global pandemic caused by the SARS-CoV-2 virus in China at the end of 2019, millions of people were symptomatically or asymptomatically infected with the virus, and 360,000 of them died [18]. There for, it is very important to study viral diseases in depth and reduce biological threats.

Pathogenic viruses, spreading in the environment with different serotypes, change their own serotypes, mutating and causing epizootics, epidemics and even pandemics. Along with humans, coronaviruses are observed in diarrhea in animals, including calves. In the US, BCoV-WD is more common in northern states [11, 13, 17].

According to statistics, 75-95% of infectious diarrhea in calves in Azerbaijan is caused by Escherichia coli, Rotavirus, Coronavirus and Cryptosporidium, including rotovirus 27-36%, coronavirus 20-26%.

Clinical signs

Coronoviruses that cause respiratory and intestinal diseases in farm animals and other ruminants can be found in the respiratory tract and intestines of healthy farm animals [7]. BCoV is excreted in faeces and nasal secretions and is associated with 3 different clinical syndromes in farm animals [15]: calf (neonatal) diarrhea [12], winter dysentery characterized by hemorrhagic diarrhea in adult animals [22, 23].

Preventive care

After an illness, calves develop immunity against coronavirus for up to a year. Colostral immunity in newborn calves provides them with resistance to disease or prevents the disease from becoming severe. For specific prophylaxis, live and inactivated vaccines are used. Calves are vaccinated orally after birth, and cows are vaccinated parenterally to induce colostral immunity. In addition, for oral-nasal administration, the coronavirus vaccine uses a multivalent that combines type I, II, and III viruses. Currently, an associated inactivated vaccine with aluminum hydroxide against rotavirus, coronavirus and intestinal diarrhea of newborn calves has been developed. Timely epizootological control and prevention of infection in healthy farms are the basis of preventive measures. To do this, all new animals entering the farm are kept in quarantine, the calves are looked after separately and they are not allowed to be kept together with older animals. In the maternity ward, veterinary and sanitary rules are observed and regular disinfection is carried out. Other preventive measures include epidemiological monitoring and biosecurity rules [1].

CONCLUSION

A review of the available data indicates that further research is needed to understand the underlying pathogenesis mechanisms of BCoV respiratory and intestinal diseases, as well as the variables and interactions between the virus, host, and environmental factors that can exacerbate the disease or lead to increased spread and transmission. Further extensive research is needed to determine the correlates and attributes of immune defense needed to develop effective vaccines/regimens that can prevent severe disease and limit the spread of the virus. The lack of awareness of the mechanisms that

regulate interspecies transmission of BCoV and identify a wide range of its hosts predetermines the importance of studying this area. Finally, detailed studies are needed in wildlife waters (including wild ruminants or other susceptible species) to better understand the similar bovine CoV ecology or the threats such ecology poses to human or animal health.

REFERENCES

1. Aliyev, E. Epizootologiya və infeksion xəstəliklər / E.Azimov, N.Safi, İ.Azimov – 2013. – 5 p.
2. Bertoni, E. First report of group A rotavirus and bovine coronavirus associated with neonatal calf diarrhea in the northwest of Argentina / E.Bertoni E, M.Aduriz, M.Bok [et al.] // Tropical Animal Health and Production, – 2020. – p. 2761-2768.
3. Brar, A.P. Periurban outbreaks of bovine calf scours in Northern India caused by Cryptosporidium in association with other enteropathogens / A.P.Brar, N.K.Sood, P.Kaur [et al.] // Epidemiology and Infection, – 2017. – p. 2717-2726.
4. Castells, M. Bovine coronavirus in Uruguay: Genetic diversity, risk factors and transboundary introductions from neighboring countries / M.Castells, F.Giannitti, R.Caffarena [et al.] // Archives of Virology, – 2019. – p. 2715-2724.
5. Clark, M.A. Bovine coronavirus // British Veterinary Journal, – 1993. – p. 51-70.
6. Parker, M.D., Babiuk, L.A. Bovine coronavirus nonstructural protein ns2 is a phosphoprotein // Virology, – 1991. – p. 509-512.
7. Decaro, N. Respiratory disease associated with bovine coronavirus infection in cattle herds in Southern Italy / N.Decaro, M.Campolo, C.Desario [et al.] // Journal of Veterinary Diagnostic Investigation, – 2008. – p. 28-32.
8. Family coronaviridae / R.J.Groot, S.C.Baker, R.Baric [et al.] – Elsevier Science Publishing, – 2012.
9. Fulton, R.W. Lung pathology and infectious agents in fatal feedlot pneumonias and relationship with mortality, disease onset and treatments / R.W.Fulton, K.S.Blood, R.J.Panciera [et al.] // Journal of Veterinary Diagnostic Investigation, – 2009. – p. 464-477.
10. Francoz, D. Respiratory pathogens in Quebec dairy calves and their relationship with clinical status, lung consolidation, and average daily gain / D.Francoz, S.Buczinski, A.Belanger [et al.] // Journal of Veterinary International Medicine, – 2015. – p. 381-387.
11. Gustin, K.M. Bovine coronavirus nonstructural protein 1 is an RNA binding protein that binds terminal genomic cis-replication elements / K.M.Gustin, B.J.Guan, D.A.Brian [et al.] // Journal of Virology, – 2009. – p. 6087-6097.
12. Hick, P.M. Coronavirus infection in intensively managed cattle with respiratory disease / P.M.Hick, A.J.Read, I.Lugton [et al.] // Australian Veterinary Journal, – 2012. – p. 381-386.
13. Ksiazek, T.G. A novel coronavirus associated with severe acute respiratory syndrome / T.G.Ksiazek, D.Erdman, C.S.Goldsmith [et al.] // The New England Journal of Medicine, – 2003. – p. 1953-1966.
14. Mekata, H. Molecular epidemiological survey and phylogenetic analysis of bovine respiratory coronavirus in Japan from 2016 to 2018 / H.Mekata, S.Hamabe, P.E.Sudaryatma [et al.] // Journal of Veterinary Medicine Science, – 2020. – p. 726-730.
15. O'Neill, R. Patterns of detection of respiratory viruses in nasal swabs from calves in Ireland: A retrospective study/ R.O'Neill, J.Mooney, E.Connaghan [et al.] // Veterinary Record, – 2014. – p. 345-351.
16. Pratelli, A. Bovine respiratory disease in beef calves supported long transport stress: An epidemiological study and strategies for control and prevention / A.Pratelli, F.Cirone, P.Capozza [et al.] // Veterinary Science, – 2021. – p. 450-455.
17. Saif, LJ. Bovine respiratory coronavirus // Food Animal Practice, – 2010. – p. 349-364.

18. Saif, L.J., Jung, K. Comparative pathogenesis of bovine and porcine respiratory coronaviruses in the animal host species and SARS-CoV-2 in humans // Journal of Clinical Microbiology, – 2020. – p. 3291-3298.
19. Salem, E. Global Transmission, Spatial Segregation, and Recombination Determine the Long-Term Evolution and Epidemiology of Bovine Coronaviruses / E.Salem, V.Dhanasekaran, H. Cassard [et al.] // Viruses, – 2020. – p. 512-534.
20. Singasa, K. Molecular and phylogenetic characterization of bovine coronavirus virus isolated from dairy cattle in Central Region, Thailand / K.Singasa, T.Songserm, P.Lertwatcharasarakul [et al.] // Tropical Animal Health and Production, – 2017. – p. 1523-1529.
21. Shin, J. Genetic characterization of bovine coronavirus in Vietnam / J.Shin, D.Tark, S.Choe [et al.] // Virus Genes, – 2019. – p. 415-420.
22. https://doi.org/10.3389/fmicb.2016.01022
23. Zhu, Q. Epidemiological survey and genetic diversity of bovine coronavirus in Northeast China / Q.Zhu, M.Su, Z.Li [et al.] // Virus Research, – 2021. – p. 198632.
24. *Zhu, Q. Heilongjiang Provincial Key Laboratory of the Prevention and Control of Bovine Diseases, College of Animal Science and Veterinary Medicine // Advances in Bovine Coronavirus Epidemiology,* – 2022. – p. *163319.*

İRİ MALLARIN KORONAVİRUSU: EPİZOOTİK VƏZİYYƏT, GENOMLARIN STRUKTURU, KLİNİKİ ƏLAMƏTLƏRİ VƏ PROFİLAKSİYA-İCMAL

V.C. Abbasov

İri Buynuzluların dihareasi multifaktorial mənşəli olmaraq ağır ölüm riski yaradır və heyvandarlıqda yüksək ekonomik zərərlə bərabər heyvan rifahına mənfi təsir edir. Koronoviruslar da bu qəbildən olmaqla insanların və yeni doğulmuş buzovların əsas enteropatogen viruslarındandır. Məlumatların icmalı onu göstərir ki, BCoV-nun tənəffüs və bağırsaq xəstəliklərinin patogenezinin əsas mexanizmlərini və xəstəliyi şiddətləndirən və ya yayılmasının artmasına və ötürülməsinə səbəb ola bilən viral, ev sahibi və ətraf mühit amilləri arasında dəyişənləri və qarşılıqlı əlaqəni anlamaq üçün əlavə tədqiqatlara ehtiyac var.

Açar sözlər: *koronavirus, RNT (ribonuklein turşusu), epidemiologiya, genom*

КОРОНАВИРУС КРУПНОГО СКОТА: ЭПИЗООТИЧЕСКИЙ СТАТУС, СТРУКТУРА ГЕНОМА, КЛИНИЧЕСКИЕ СИМПТОМЫ И ПРОФИЛАКТИКА-ОБЗОР

В.Ч. Аббасов

Диарея крупного рогатого скота имеет многофакторное происхождение, вызывая высокий риск смертности и оказывая негативное влияние на благополучие животных, а также высокие экономические потери в животноводстве. Короновирусы относятся к основным энтеропатогенным вирусам человека и новорожденных телят. Анализ данных показывает, что необходимы дальнейшие исследования для понимания основных механизмов патогенеза BCoV респираторных и кишечных заболеваний, а также переменных и взаимодействий между вирусом, хозяином и факторами окружающей среды, которые могут усугубить заболевание или привести к увеличению распространения и передачи.

Ключевые слова: *коронавирус, РНК (рибонуклеиновая кислота), эпидемиология, геном.*

UDC: 582.751.5
ORCID: 0000-0001-5306-5850 (Salahova)

FLOWERING AND PRODUCTIVITY OF *BERBERIS* L. SPECIES INTRODUCED TO THE ABSHERON PENINSULA

Elnara Xanhusein Salahova
Dendrology Institute of the Ministry of Science and Education
E-mail: Salahova.elnara@bk.ru
Received: 14.03.2023
Accepted: 29.08.2023

To expand international cooperation in the field of biodiversity conservation, the Republic of Azerbaijan acceded to the UN Convention on Biological Diversity in 2000. The National Strategy and Action Plan for the implementation of the "National Strategy for the Protection and Sustainable Use of Biological Diversity in the Republic of Azerbaijan for 2017-2020" are aimed at implementing effective measures in this area and achieving concrete results. For this purpose, the bioecology of Berberis L. species was studied to regulate the ecological balance. The main purpose of the research is to learn the biological characteristics of flowering and fruiting of barberry species. In the dry subtropical climate of Absheron, the age of the species barberry first flowering, the biological characteristics and duration of flowering, the shape and length of the inflorescence, the number of flowers in an inflorescence, the shape, color, size of the fruit, etc. morphological features were investigated.

The study of fruit and seed productivity in barberry species with food, medicinal and decorative properties is of theoretical and practical importance [1, p. 196-222].

Keywords: *inflorescence, cluster, fertilization, productivity.*
DOI: 10.59849/2409-4838.2023.3.82

INTRODUCTION

Global warming, declining biodiversity, and food shortages are major concerns for the whole world. Plants play an important role in solving these problems. The species belonging to the genus *Berberis* L. have been selected as the object of study due to their great industrial and practical importance.

Many researchers have studied the biological characteristics of flowering and fruiting. According to these authors, the beginning of the flowering and fruiting phase of plants is a transition moment in their lives [2, p. 3-170], [5, p. 39-44], [6, p. 64]. Studies on the biological characteristics of flowering and fruiting in the species of barberry grown in Absheron conditions and used as a research object will be important in mastering the biological characteristics of plants. Because there is very little literature information about the flowering and fruiting characteristics of these plants in Absheron conditions. Taking into account the importance of the mentioned biological characteristics, the age of the first flowering, the biological characteristics and duration of flowering, the shape and length of the inflorescence, the number of flowers in one inflorescence, the shape, color, size of the fruit, etc. morphological signs were investigated.

MATERIAL AND METHODS

Nine species of the *Berberis* L. genus belong to the *Berberidaceae* Juss. the family was used as the study objects: *Berberis vulgaris* L. L. (Common barberry), *Berberis iberica* Stev & Fisch. Ex DC. (Georgian barberry), *B. densifolia* Rusby. (Densifolia barberry), *B.amurensis* Rupr. (Amur Barberry), *B.levis* L. (Levis barberry), *B.thunbergii* DC. (Japanese barberry), *B.julianae* C.K.Schneid

(Chinese barberry), *B.koreana* Palib. (Korean barberry), *B.heteropoda* Schrenk.(Hetrepoda barberry).

Grain yield during the study was calculated according to the method of I.V. Vaynaqy [3, c.826-830]. Morphological traits of fruits and seeds were studied by the method of I.A. Ivanov and N.M. Dudik [4, c. 43-54]. Mathematical calculations on the size of barberry fruits and seeds were performed on a personal computer using Microsoft Excel [5, p. 12-14].

RESULTS AND DISCUSSION

The first flowering age of barberry species in Absheron conditions is given in Table 1. As is well known, species of barberry begin to bloom in the 5th year. The flower group is formed at the end of the branches of the current year. Young twigs grow strongly, grow to a length of 15-30 cm, and a cluster of flowers is formed on them.

During the research, the morphological features of flowers and flower clusters in species of barberry were studied. The results of the study are given in Table 1.

Flower clusters of different shapes were observed on the species we studied: sparse, simple cluster (*Berberis vulgaris, B.amurensis*), sparse, swinging cluster (*B.iberica, B.koreana*), dense, swinging cluster (*B.densifolia*), cluster adjacent to the leaf axils (*B.levis, B.julianae*), rare or sparse clusters (*B.thunbergii*), pile cluster with different stalks (*B.heteropoda*) (Figure 1). The length of the flower cluster varies from 3 to 10 cm depending on the species. Thus, the longest cluster of flowers is *Berberis heteropoda* Schrenk. (4-10 cm), the shortest cluster is *B.iberica* Stev & Fisch. Ex DC. (3-6 cm). *Berberis levis* Franch. and *B.julianae* C.K.Schneid flowers bloom in a ball from 1 point on the leaf axil. This type of flower group has not been recorded in other barberry species we have studied. In other species, the length of the inflorescence varies from 4 to 9 cm. In a cluster of flowers, the flowers are arranged in a ball and individually. The number of flowers in a cluster is the highest in *Berberis densifolia* Rusby (13-20) and the lowest in *B. koreana* Palib (8-10). The length of the flower stalk is different in the cluster.

The longest flower stalk is *Berberis heteropoda* Schrenk. (0.5-1.5 cm), the shortest flower stalk is *B. koreana* Palib. (0.5-0.7 cm). The diameter of the flower crown varies from 0.5 to 1.5 cm, the length of the petals from 0.4 to 0.9 cm, and the width from 0.2 to 0.6 cm. The stamens are 6, 0.2-0.5 cm long. The ovary consists of 1-4 ovaries.

The color and shape, size, and weight of the fruit of species of *Berberis* L. are of particular importance. Observations and calculations were made in this direction and the results obtained are given in Table 2.

As can be seen from the table, the color of the fruit varies from crimson to purple or bright black (Figure 2). *Berberis densifolia* Rusby. species are red, *B. vulgaris* L. and *B. iberica* Stev & Fisch. ex DC. in species are scarlet. *B. julianae* C.K. Schneid and *B. heteropoda* Schrenk fruits change color from purple to black. *B. amurensis* Rupr. and *B. levis* L. the shape of the fruit is similar and elliptical.

As can be seen from the table, the morphological characteristics of the fruit differ from the biometric indicators of the species we studied. The length of the fruit varies from 0.5 to 1.2 cm depending on the species. The fruits are divided into 3 groups according to size and weight:

Group I: large fruits - *Berberis vulgaris* L., *B. thunbergii* DC., *B. amurensis* Rupr. and *B. densifolia* Rusby. types;

Group II: medium-sized fruits - *Berberis julianae* C.K.Schneid, *B. iberica* Stev & Fisch. Ex DC., *B.heteropoda* Schrenk. and *B. koreana* Palib species;

Group III: small fruits *Berberis levis* Franch. kind of.

The weight of 100 fruits of barberry species varies from 6.5 grams (*Berberis iberica* Stev & Fisch. Ex DC.) to 10.0 grams (*B. thunbergii* DC.).

The study found that a certain percentage of the flowers in the flower clusters of each species are pollinated and bear fruit as a result of the fertilization process. Thus, this indicator is *B. vulgaris* L., *B. densifolia* Rusby. 77-80% in *B. julianae* C.K. Schneid species, *B. iberica* Stev &

Table 1.

Morphological features of flowers and flower clusters of *Berberis* L. Species

Species	A cluster of flowers			Flower				
	Types	Lenght, cm	Number of flowers, pcs	The length of the flower stalk, cm	Diameter, cm	The length of the petal, cm	The width of the petal, mm	The length of the stamen, mm
Berberis vulgaris L.	sparse, simple cluster	6-9	12-18	0,8-1,2	0,8-1,0	0,5-0,7	0,4-0,5	0,3-0,4
B. iberica Stev & Fisch. Ex DC	sparse, swinging cluster	3-6	8-12	0,6-0,8	0,8-1,0	0,5-0,6	0,4-0,5	0,2-0,3
B.densifolia Rusby	dense, swinging cluster	6-8	13-20	0,5-1,0	0,8-1,2	0,5-0,7	0,4-0,5	0,3-0,4
B.amurensis Rupr.	sparse, simple cluster	6-8	10-15	0,8-1,2	1,0-1,1	0,5-0,8	0,4-0,5	0,3-0,5
B. levis Franch.	cluster adjacent to the leaf axils	-	13-17	0,8-1,0	0,9-1,0	0,6-0,9	0,4-0,6	0,3-0,5
B.thunbergii DC.	rare or sparse clusters	5-8	8-12	1,0-1,2	1,0-1,2	0,4-0,7	0,4-0,6	0,2-0,3
B.julianae C.K. Schneid	cluster adjacent to the leaf axils	-	14-18	0,7-0,8	0,8-1,0	0,5-0,8	0,4-0,6	0,3-0,5
B. koreana Palib.	sparse, swinging cluster	4-6	8-10	0,5-0,7	0,9-1,0	0,4-0,5	0,3-0,4	0,3-0,5
B.heteropoda Schrenk.	pile cluster with different stalks	4-10	15-18	0,5-1,5	0,8-1,0	0,4-0,6	0,2-0,4	0,2-0,4

1.

2.

3.

4.

Fig. 1. Appearance of flowers of 1-*Berberis thunbergii* DC., 2-*B.amurensis* Rupr., 3-*B. julianae* C.K.Schneid, 4-*B.vulgaris* L.

1.

2.

3. 4.

Fig. 2. The fruits of the species of 1- *Berberis julianae* C.K. Schneid, 2- *B. heteropoda* Schrenk, 3- *B. densifolia* Rusby., 4- *B. vulgaris* L.

Fisch. Ex DC., *B.thunbergii* DC. and *B. heteropoda* Schrenk. 64-70% of species, *B. koreana* Palib., *B. amurensis* Rupr. and *B. levis* Franch. species was 55-63%. 1-2 seeds were found in 60-72% of fruits of the studied species, and 3 seeds were found in 28-40% (per 100 fruits).

The number of seeds in a fruit depends directly on the size of the fruit, as the number of seeds in large fruits is greater than in small fruits [Figure 3]. The ripening period of fruits is not the same as in the flowering stage of barberry species. However, this biological process does not prevent the fruits from being harvested at the same time, and the ripe fruits remain in the bush for a long time. Fruits remain on the plant until the end of December.

When studying the seed productivity of the species we studied, was evaluated with 2-3 points, referring to the 3-point scale adopted by V.G. Kapper for shrubs [7, p. 12-14].

Thus, no species corresponding to the low-yielding (1-point) group were observed [Table 3]. The species of barberry we studied were divided into the following groups according to the methodology for seed yield:

1. 2 points - average productive species - *Berberis levis* and *B. heteropoda*. The productivity of these species is estimated to be 30-40%. Fruit clusters on the plant are sparse.

2. 3 points - good productive species- *Berberis vulgaris* L., *B. thunbergii* DC., *B.amurensis* Rupr., *B.densifolia* Rusby, *B. julianae* C.K. Schneid, *B. iberica* Stev & Fisch. Ex DC., *B. koreana* Palib. In these species, fruit clusters cover 60-80% of the plant. The fruit covers more than half of the shrub.

The productivity of the studied species was determined by the "average model tree" method per plant per unit mass. For this purpose, the selected mass of 5 medium-sized bunches of fruits of each species was calculated (from 6-year-old plants). Based on the productivity of the model tree, the mass of fruit collected from a single branch and a corresponding plant in the studied species was calculated. The number of branches for each species, the weight of the fruit, and the number of branches in the bush were calculated for the area of $1m^2$ cultivated under favorable conditions and the productivity of 1 bush was determined (Table 4).

Table 2.

Comparative study of fruits in *Berberis L.* species

Species	Fruit			100 fruit mass (average), g	100 seed mass (average), g
	color	shape	Lenght, cm		
Berberis vulgaris L.	scarlet	Oblong	0,8-1,1	8,5	2,55
B. iberica Stev & Fisch. Ex DC	scarlet	oblong cylindrical	0,7-1,0	6,5	2,0
B. densifolia Rusby	red	ovoid or oblong	0,8-0,9	7,5	2,25
B. amurensis Rupr.	bright red	Elliptical	0,9-1,1	8,5	2,55
B. levis Franch.	violet	Elliptical	0,5-0,7	7,5	2,25
B. thunbergii DC.	Dark red	Longish	0,9-1,2	10,0	3,0
B. julianae C.K. Schneid	bluish black	Ovarid	0,7-0,9	8,5	2,55
B. koreana Palib.	bright red	oblong-ovoid	0,8-1,0	7,5	2,25
B. heteropoda Schrenk.	bluish or bright black	Spherical	0,8-1,0	7,5	2,25

Table 3.

Productivity of *Berberis* L. species

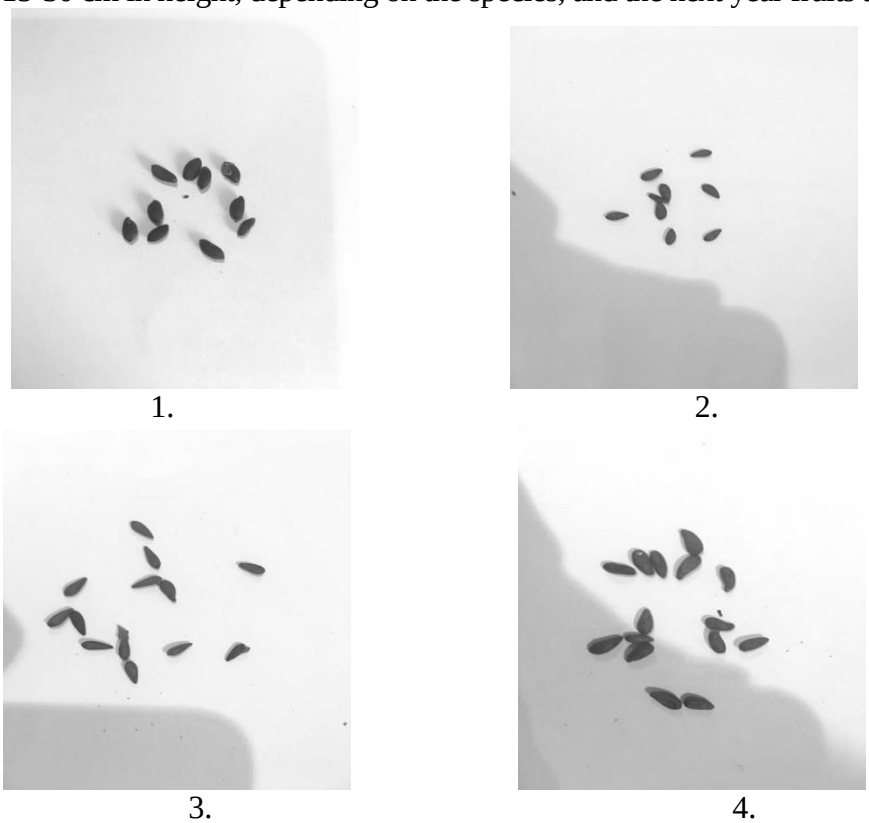
№	Species	Productivity (points)		
		1	2	3
1.	*Berberis vulgaris* L.			+
2.	*B. iberica* Stev & Fisch. Ex DC.			+
3.	*B. densifolia* Rusby.			+
4.	*B. amurensis* Rupr.			+
5.	*B. levis* Franch.		+	
6.	*B. thunbergii* DC.			+
7.	*B. julianae* C.K. Schneid			+
8.	*B. koreana* Palib.			+
9.	*B. heteropoda* Schrenk.		+	

Table 4.

Productivity of 1 bush of barberry species (in 6-year period)

№	Species	Number of branches	Weight of fruit (in grams)	Quantity of fruit on 1 branch, (in numbers)	Productivity of 1 shrub (in grams)
1.	*Berberis vulgaris* L.	40	0,085	60	204
2.	*B. iberica* Stev & Fisch. Ex DC.	39	0,065	58	147
3.	*B. densifolia* Rusby.	39	0,075	62	181
4.	*B. amurensis* Rupr.	37	0,085	54	170
5.	*B. levis* Franch.	35	0,075	50	131
6.	*B. thunbergii* DC.	40	0,1	60	240
7.	*B. julianae* C.K.Schneid	32	0,085	60	163
8.	*B. koreana* Palib.	36	0,075	56	151
9.	*B. heteropoda* Schrenk.	32	0,075	50	120

In 6-year-old barberry species, the average fruit yield per shrub was 120-240 grams of middle-aged *B. vulgaris* L., *B. thunbergii* DC., and *B. densifolia* Rusby. It is possible to collect up to 1 kg of fruit from the bushes. In barberry species, the fruits are formed on last year's branches. Young branches give a growth of 15-30 cm in height, depending on the species, and the next year fruits are formed on it.



1. 2. 3. 4.

Fig. 3. The seeds of the species of 1- *Berberis julianae* C.K. Schneid, 2- *B. koreana* Palib., 3- *B. amurensis* Rupr., 4-*B. densifolia* Rusby

CONCLUSION

Flower clusters of different shapes were observed on the species we studied: sparse, simple cluster (*Berberis vulgaris* L., *B.amurensis* Rupr.), sparse, swinging cluster (*Berberis iberica* Stev & Fisch. Ex DC., *B.koreana* Palib.), dense, swinging cluster *(B.densifolia* Rusby.*),* cluster adjacent to the leaf axils (*B.levis* L., *B.julianae* C.K.Schneid*),* rare or sparse clusters *(B.thunbergii* DC.), pile cluster with different stalks (*B.heteropoda* Schrenk.).Seed productivity of the studied species received 2-3 points on a 3-point scale of V.G. Kapper for shrubs. Thus, no species corresponding to the low-yielding (1-point) group were observed. 2 points - average productive species - *Berberis levis* and *B. heteropoda.* The productivity of these species is estimated to be 30-40%. Fruit clusters on the plant are sparse. 3 points - good productive species- *Berberis vulgaris* L., *B. thunbergii* DC., *B.amurensis* Rupr., *B.densifolia* Rusby, *B. julianae* C.K. Schneid, *B. iberica* Stev & Fisch. Ex DC., *B. koreana* Palib. In these species, fruit clusters cover 60-80% of the plant. The productivity of 1 bush was studied on the studied species. In 6-year-old barberry species, the average seed yield per tree was 120-240 grams. From the middle age bushes of *B. vulgaris* L., *B. thunbergii* DC., *B. densifolia* Rusby. up to 1 kg of fruits can be harvested. The seed mass was 30% of the total fruit mass (average). Seed mass varied from 6.5 g to 10.0 g for the species studied. The mass of 100 seeds was higher in *Berberis thunbergii* DC. and less in *Berberis iberica* Stev & Fisch. Ex DC. The number of fruits containing 1-2 seeds was higher than those containing 2-3 seeds. Thus, the number of seeds in large fruits exceeds the number of seeds in small fruits.

REFERENCES

1. Məmmədov, T.S. Azərbaycan dendroflorası: [3 cilddə] / T.S.Məmmədov. – Bakı: Səda nəşr, - c. 2. – 2015. – 26 s.
2. Арифханов, К.Т. Виды рода *Berberís* L., интродуцированных Ботаническим садом АН УзССР / К.Т. Арифханов, Т.И. Славкина – Ташкент: – 1981. – 167 с.
3. Вайнагий, И.В. О методике изучения семенной продуктивности // – Санкт-Петербург: Ботанический журнал, – 1974, 59 (6), – с. 826-830.
4. Иванова, И.А. К методике описания морфологических признаков семян. Составление определений растений по плодам и семенам / И.А. Иванова, Н.М. Дудик – Киев: Наукова думка, – 1974. – 11 с.
5. Куклина, А.Г. Барбарисы / А.Г.Куклина. – Москва.: Изд. Дом МСП, – 2009. – 5 с.
6. Куклина А.Г. Красивоплодные кустарники (барбарис, магония, снежноягодник, бересклет) / А.Г.Куклина. – Москва: Изд. Дом МСП, – 2010. – 64 с.
7. Каппер, В.Г. Шкала глазомерной оценки цветения и плодоношения взрослого дерева и кустарника. Лесные культуры / В.Г.Каппер, Г.И.Редько, А.Р.Родин [и.др.] // Агропромиздат, – Москва: – 1985. – с. 12-14.

ABŞERON YARIMADASINA İNTRODUKSİYA OLUNMUŞ *BERBERİS* L. NÖVLƏRİNDƏ ÇİÇƏKLƏMƏ VƏ MƏHSULDARLIQ

E.X. Salahova

Biomüxtəlifliyin qorunması sahəsində beynəlxalq əməkdaşlığı genişləndirmək üçün Azərbaycan Respublikası 2000-ci ildə BMT-nin Bioloji Müxtəliflik Konvensiyasına qoşulmuşdur. "Azərbaycan Respublikasında bioloji müxtəlifliyin mühafizəsi və davamlı istifadəsinə dair 2017-2020-ci illər üçün Milli Strategiya"nın icrasına dair Milli Strategiya və Fəaliyyət Planı bu sahədə səmərəli tədbirlərin həyata keçirilməsinə və konkret nəticələrin əldə olunmasına yönəlib. Bu məqsədlə ekoloji tarazlığı tənzimləmək üçün *Berberis* L. növlərinin bioekologiyası tədqiq edilmişdir. Abşeron şəraitində becərilən və tədqiqat obyekti kimi istifadə olunan zirinc növlərində çiçəkləmə və meyvəvermənin bioloji xüsusiyyətlərinə dair tədqiqatların bitkilərin bioloji xüsusiyyətlərinin mənimsənilməsində əhəmiyyət kəsb edəcək. Çünki bu bitkilərin Abşeron şəraitində çiçəkləmə və meyvəvermə xüsusiyyətlərinə dair ədəbiyyat məlumatı çox azdır. Qeyd edilən bioloji xüsusiyyətlərin əhəmiyyətini nəzərə alaraq, quru subtropik iqlimə malik Abşeron şəraitində tədqiq etdiyimiz zirinc növlərində ilk çiçəkləmə yaşı, çiçəkləmənin bioloji xüsusiyyəti və davametmə müddəti, çiçək salxımının forması, uzunluğu, bir çiçək salxımındakı çiçəklərin sayı, meyvənin forması, rəngi, ölçüləri və s.morfoloji əlamətlər araşdırılmışdır. Qida, dərman və dekorativ xüsusiyyətlərə malik olan zirinc növlərində meyvə və toxum məhsuldarlığının öyrənilməsi nəzəri və praktiki əhəmiyyətə malikdir.

Açar sözlər: *çiçəklənmə, salxım, mayalanma, məhsuldarlıq*

ЦВЕТЕНИЕ И ПРОДУКТИВНОСТЬ ВИДОВ *BERBERIS* L., ИНТРОДИЗИРОВАННЫХ НА АБШЕРОНСКИЙ ПОЛУОСТРОВ

Э.Х. Салахова

Для расширения международного сотрудничества в области сохранения биоразнообразия Азербайджанская Республика присоединилась к Конвенции ООН о биологическом разнообразии в 2000 году. Национальная стратегия и план действий по реализации «Национальной стратегии охраны и устойчивого использования биологического разнообразия в Азербайджанской Республики на 2017-2020 годы» нацелены на реализацию действенных мер в этой сфере и достижение конкретных результатов. С этой целью была изучена биоэкология видов *Berberis* L. для регулирования экологического баланса. Основной целью исследований является изучение биологических особенностей цветения и плодоношения видов барбариса. В условиях сухого субтропического климата Абшерона возраст первого цветения вида барбариса, биологические особенности и продолжительность цветения, форма и длина соцветия, количество цветков в соцветии, форма, окраска, величина плодов, и др. были исследованы морфологические признаки. Изучение плодово-семенной продуктивности у видов барбариса с пищевыми, лечебными и декоративными свойствами имеет теоретическое и практическое значение .

Ключевые слова: *соцветие, гроздь, оплодотворение, продуктивность*

HUMANITARIAN SCIENCES

UDC: 94 (479.24)
ORCID: 0009-0000-8491-5539 (Garayeva)

ADR IN THE PARIS PEACE CONFERENCE

Sevil Elshan Garayeva
Institute of Manuscripts named after Muhammad Fuzuli of ANAS
E-mail: sevilqarayevaa@gmail.com
Received: 03.02.2023
Accepted: 25.08.2023

The Azerbaijan Democratic Republic (ADR) was the first democratic, secular and the first parliamentary republic in the entire Muslim world that existed from May 1918 to April 1920. After the invasion of Tsardom of Russia, Azerbaijani people regained their independence with big hardships and martyrs' blood. The founders of the ADR felt foreign danger from the first day, therefore they tried to bring the problems to the attention of the world states and the public. As we know, the delegation, sent to participate in the peace conference in Paris has faced great difficulties in obtaining visas, which, at the same time, hinder the recognition of the ADR as a subject of the international community. The article provides information about the situation during the Paris Peace Conference, the historical conditions of that period, the decisions made at the conference, as well as the foreign policy of the Azerbaijan Democratic Republic and its future aspirations.
Keywords: *Deligation, Topchubashov, independent, government, de-facto*
DOI: https://doi.org/10.59849/2409-4838.2023.3.92

INTRODUCTION

It is known that Northern Azerbaijan, which came under Russian influence through the Gulistan and Turkmenchay treaties, was in a colonial situation until the February Revolution of 1917. With the dissolution of the Tsarist Empire, new political conditions emerged in the Caucasus. Initially, South Caucasus was administered by the Transcaucasian Commissariat and later by the Seim. However, the Seim was unable to defend the rights and equality of all nations within it, leading to its dissolution. As a result, independent states were established in Georgia and Armenia on May 26, and in Azerbaijan on May 28, 1918. The National Council that declared the independence of the Azerbaijan Democratic Republic (ADR) consisted of 12 ministers. ADR emerged under extremely complex conditions, with Baku city being temporarily under the control of the Centrocaspian Dictatorship created by the British. Additionally, in Baku and the regions, Armenians massacred thousands of people on March 31, 1918. The first task of the government, which liberated Baku with the assistance of the Caucasian Islamic Army on September 15, 1918, would be to introduce itself on the political arena.

MAIN PART

The territory of ADR was 94,137.38 square kilometers. The Northern border of Azerbaijan starts from the spot where the river Tcholock throws itself into the Black Sea. Beginning 20 km. south from Bouinakh station the border is formed by the Caspian Sea and extends as far as the town of Astara (Caucasus) near the old Russia-Iran border. From Astara, this border confines with Persia as far as the point of intersection of the old borders of Russia, Iran, and Turkey; afterwards it follows the former Russia-Turkey border as far as cape Kop-Mour on the Black Sea. From cape Kop-Mour as far as the mouth of the Tcholokh the western border of Azerbaijan follows the shore of the Black Sea. Finally, it descends towards the south-west passing successively on the mountains Shakh-Alham, Shakh-Takhte, Lialvar, Ledjan and reaches the summit of Mount Aglagan which is the frontier

between the two states: Azerbaijan and Armenia [5, p. 81-82]. The ADR was established after the collapse of the Russian Empire. Its founders were primarily Azerbaijani intellectuals, political activists, and members of the Azerbaijani National Council. The Council declared Azerbaijan's independence on May 28, 1918, and established the ADR. The ADR was characterized by its commitment to democratic values, human rights, and secularism. It had a parliament that was elected through a system of proportional representation, a constitution that guaranteed individual liberties, and a legal system that was based on Western models. During its brief existence, the ADR faced significant challenges, including territorial disputes with neighboring countries, ethnic tensions, and economic instability. Despite these challenges, the ADR achieved some notable accomplishments. It established diplomatic relations with other countries, including the Ottoman Empire and the United States. It also played a key role in the development of the oil industry in Azerbaijan, which became a major source of revenue for the country. The Paris Peace Conference was a meeting of the Allied powers that took place in Paris, capital of France, from January to June 1919. The conference was held after the end of World War I and aimed to establish a new international order that would prevent future wars [9, p. 6].

The new states might have settled the differences that led them to war with each other. They might have held off General Denikin, the White Russian, because he had to deal with the Bolsheviks as well. What they could not withstand was the combination of a determined Russian assault from the north and a resurgent Turkey in the south. Even then, with some support from outside, they might have had a hope. Of all the powers, Britain was best placed to provide immediate aid [7, p. 559].

After the establishment of the Azerbaijan Democratic Republic (ADR), several issues questioned the existence of the state. These included questions about citizenship, where the borders would be drawn and defended, and how foreign policy would be determined with neighboring countries [8, p. 6].

Paris Peace Conference was held from 18 January 1919 to 21 January 1920. The aim of conference was solving problems what were created after World War 1. It was involved with 32 countries and nationalities. However, the biggest powers were France, Great Britain, USA, Japan and Italy. They must decide to fate of countries what have lost war during World War 1 like Ottoman Empire and Germany. The "Big Four" were French Prime Minister Georges Clemenceau, British Prime Minister David Lloyd George, US President Woodrow Wilson and Italian Prime Minister Vittorio Emanuele Orlando. The principal aim of the Conference was to create conditions favorable to the progress of civilization on new lines [2, p. 104].

Like the newly created independent national states, the ADR had high hopes for the Paris Peace Conference for being recognized by the countries of the world, becoming an equal member of international organizations, and ensuring the sovereignty and territorial integrity of the republic. The first step of the new Azerbaijani government, which was established on December 26, 1918, was to determine the composition and status of the delegation to be sent to the Paris Peace Conference on December 28. On December 26, 1918, Fatali Khan Khoyski had offered speech to parliament: “This independence does not mean that we should build a wall around Azerbaijan. We will endeavor to establish relations with other nations. Our independence will be acknowledged and recognized at the peace conference our voice will be heard on the world stage” [1, p. 287-288]. Alimardan Bey Topchubashov, speaker of the Parliament of Azerbaijan, was appointed as the head of the delegation to the peace conference, and Mammad Hasan Hajinski appointed his deputy. Members was of the delegation: Akbar agha Sheykhulislamov, Ahmad bey Agaoglu, Jeyhun Hajibeyli, Mahammad Maharramov, Miryagub Mirmehdiyev, Mahammad Zamanbayli. The delegation were provided with diplomatic passports and left Baku on January 4, 1919. They arrived in Istanbul on January 20, after serious meetings in Tbilisi and Batumi. On January 22, A. Topchubashov held first meeting and divided the works. At the meeting, the delegation included technical workers: Expert - Ali bey Hu-

seynzade, secretaries - Sheffat Malikov and Alakbar bey Topchubashov, translators - A.Gafarov (French language), G.Gafarova (English language), H.Mammadov (French and Turkish languages), personal secretary -Rashid bey Topchubashov. Two members of the delegation - A.Huseynzadeh and A.Agayev were arrested by the allies in Istanbul. Although it was possible to release A.Huseynzadeh from prison, he was not granted a visa to go to Paris. A.Agayev was exiled to the island of Malta [1, p. 287-288]. On December 21, 1918, the newspaper what is called "Azerbaijan" published article what consisted of some critical questions: "What can we see in relation to Azerbaijan? Who will support its interests in Paris? Who will create public opinion about Azerbaijan in Western Europe?". On December 28, 1918, Britain's General Thomson declared his view about ADR: "I declare that I recognise Azerbaijani Government what is under the presidency of Fatali Khan Khoyski, as the only legal power within the limits of Azerbaijan" [4, p. 131]. The five great powers (France, Britain, Italy, Japan and the United States) controlled the Conference. The "Big Four" were French Prime Minister Georges Clemenceau, British Prime Minister David Lloyd George, US President Woodrow Wilson, and Italian Prime Minister Vittorio Emanuele Orlando. While the representatives of ADR were still in Istanbul, representatives of Armenia and Iran performed territorial claims what affect the interests of Azerbaijan. This situation encouraged Armenians and their claims against ADR. British attitude towards Azerbaijan was hopeful. In his conversation with British representative Admiral Richard Webb, A.Topchubashov said: "Great Britain should be interested in independent of Azerbaijan, our interests is reliable protection for you against the threat from the north. Our geographical situation is the main reason for recognizing our state independence. Me and many people in my country believe in that the interests of Great Britain and Azerbaijan completely are same" [6, p. 170-206]. While the delegation of ADR was still in Istanbul, Paris Peace Conference commenced on January 18, 1919. On March 6, Great Britain stated that it did not object to Azerbaijan and others being in Paris. A.Topchubashov wrote: "Delegation was established for conference. They understand their responsibilities and they wanted to get to conference in time. Unfortunately, they have been waiting in Constantinople for visas for more than a month" [6, p. 170-206]. Admiral Web promised to help to the representatives of ADR to go to the Paris Peace Conference. On 21 March, A.Topchubashov prepared letter with M.Maharramov's signature and sent it to Paris. It was shown: "Azerbaijan declared its independence on May 28, 1918. Capital is Baku, population is four million and area is about 100,000 square kilometers. Azerbaijani representatives came to Istanbul on January 20 and they are waiting permission for visa. Representatives of Georgia and North Caucasian people already protect the interests of their country. But the economic, territorial, border issues cannot be resolved without the participation of Azerbaijan. Azerbaijanis hope that president Wilson will hear their voices" [6, p. 170-206]. At the same time, a copy of the application sent to the government of the United States, England, France and Italy. On March 27, Davis Heck, the American commissioner in Istanbul, told that he will be pleased with coming of representatives of ADR. The Azerbaijani delegation had to wait for a visa in Istanbul for 3 months to go to Paris. Finally, on April 22, the representatives of Azerbaijan left Istanbul for Paris. They came from Rome to Paris on May 7. Thus, delagation has spent more than three months in Istanbul. Thought challenges it was the great success of Azerbaijani diplomacy [6, p. 170-206]. The demands put forward by the Azerbaijan Democratic Republic (ADR) at the conference were printed in 2,000 copies in French and 1,500 copies in English. A thousand copies of the English edition were sent to the United States. The main objective here was to ensure the recognition of the interests of the ADR by the United States. Additionally, Topchibashov met with US citizens Walter Chandler and Max Robinov in Paris and signed a cooperation agreement with them [8, p. 12].

You can see events in Paris from letters of Topchubashov: "After the long wait and suffering we were able to leave Constantinople only on April 22. Until now, we have met with the representatives of Poland, Georgia, Mountainous Republic, Armenia and Iran. We have created a joint commission with the Caucasian Republics. We also sent an invitation to the Armenians; however, they

are not joining us yet. The most essential day for us was 28 of May. We met president Woodrow Wilson. The meeting made a good impression on everyone. The day of admission coincided with the anniversary of the independence of ADR. President Wilson spoke briefly and told us in reply:

1. They do not want the world to be divided into small parts.
2. It would be better for us if we support the idea of creating a federation in the Caucasus.
3. This Confederation could be under the auspices of any state under the mandate of the League of Nations.
4. Our issue cannot be resolved before the Russian issue.

The reception ended with my presentation of a small written report. In that report we have declared that we are ready to join League of Nations. We also informed that it is impossible to recognize Kolchak's rule in this area [9, p. 15-17].

President Woodrow Wilson met 1600 community leaders in San Francisco, on September 18, 1919. He recalled his experiences about delegation of ADR: “One day I met interesting group of gentlemen who came from Azerbaijan. I was talking to man who had very respective ideas about liberty and justice”. This day was May 28, 1919. On the first anniversary of Azerbaijan's independence - May 28, 1919, the President of the United States, Woodrow Wilson, had received the delegation, there were Alimardan Topchubashov, his translator Heydar bey Mammad and President Woodrow Wilson. Topchubashov realized the strange situation and said: “We must work more intensively and productively and to be ready to have challenges and reversals of fortune. We just need to allocate our strength appropriately so that each person stands in his own place and believes in his power” [4, p. 29].

During this period, Topchubasov met with Georgian and Armenian leaders, also met with representatives from Italy and Ukraine. Prime Minister Lloyd George said: “General Denikin says that Georgia is the part of Russia. However, Azerbaijan and Dagestan do not accept this. They are fighting for their independence. It is straight forward, that if they attack to the Bolsheviks, we should supply them with army and guarantee to their independence” [4, p. 29].

During the meeting with Woodrow Wilson on May 28, six requirements was requested by ADR: 1. Azerbaijan’s independence shall be recognized; 2. Wilson’s principles shall also be valid for Azerbaijan; 3. Azerbaijani Delegation shall be represented in negotiations at the Peace Conference; 4. Azerbaijan Democratic Republic shall be admitted to membership in the League of Nations; 5. Diplomatic relations shall be established between Azerbaijan Democratic Republic and USA; 6. To establish diplomatic relations between the United States and the Republic of Azerbaijan. If these demands are accepted by the United States, A.Topchubashov guaranteed that he would gradually pay part of the past debts of Tsarist Russia. Topchubashov did not come away empty handed from meeting with Woodrow Wilson, Wilson agreed that he will increase relationship with Caucasus. Lloyd George believed that Red Army is so dangerous for Europe, the reason to recognise the de facto independence of ADR is really urgent [6, p. 221].

During waiting time, Topchubashov didn’t want to waste time and tried publish documents in different languages. We must say that, Lucien Bouvat who was the French orientalist help to delegation to publish and translate documents. A.Topchubashov, A.Aghayev and J.Hajibayli published “Memorandum on the Azerbaijan Democratic Republic to the Paris Peace Conference” in English and French [10, p. 65].

One of the important issues facing the Azerbaijani delegation was the struggle against the "Great Armenia" claims of the Armenians. Armenians considered themselves "Small allies of big allies" and dreamed of creating "Greater Armenia" from the Mediterranean Sea to the Black Sea, from the Black Sea to the Caspian Sea. They claimed not only 6 provinces of Anatolia, but also Cilicia and even a part of South Azerbaijan. [1, p. 289].

By the way, Christian Georgia and Armenia, and Moslem Azerbaijan the three states collectively called Transcaucasia were now independent. Germany urgently needed the agricultural and mi-

neral wealth and the railroad system of Georgia, and even more so, the oil wells of Azerbaijan, to sustain her war effort. [3, p. 354].

On January 12, 1920, British statesman George Nathaniel Curzon proposed to the Council to recognize the independence of Azerbaijan and Georgia [11, p. 92].

In January 1920, the realization of the Bolshevik threat in the Caucasus made the Europe seriously think. Recognition of Azerbaijan's independence has become an urgent task. For this purpose, a session of the Supreme Council of the Paris Peace Conference was called on January 10. At the meeting of the Supreme Council of Versailles on January 11, at the suggestion of British Foreign Minister J.Curzon, the Supreme Council de facto recognized the independence of Azerbaijan. On January 15, Azerbaijani representatives were invited to the French Ministry of Foreign Affairs. With the participation of British representative Philip Kerr and Italian representative Marquis de la Torreta, the secretary general of the ministry Jules Cambon, presented the official decision on the de-facto recognition of Azerbaijan by the Paris Peace Conference to A.Topchubaahov. On January 17, a meeting of military experts was held in "Klaric" hotel with the participation of Azerbaijani representatives and chaired by field marshal H.Wilson. The council had to prepare proposals for the meeting of the heads of state on January 19. On January 19, Lloyd George, Clemenceau, Nitti, Cambon, Curzon, Churchill, Foch, Beatty, Wilson and other well-known statesmen and the delegation of Azerbaijan participated in the meeting of the Supreme Council. While Foch, H.Wilson, W.Churchill, J.Clemenceau insisted on sending an army to the South Caucasus, the prime ministers of Great Britain and Italy, Lloyd George and Nitti, considered it necessary to provide only military ammunition. At the January 19, in meeting, a four-point decision on the Caucasus issue was adopted: 1) Armenia and Dagestan should be de facto recognized; 2) The allied states do not have the opportunity to send troops to the South Caucasus Republics; 3) The allies will provide assistance to the South Caucasus Republics by sending weapons, ammunition and food; 4) Marshal Foch and Field Marshal Wilson were asked to look into the specifics of the military ammunition to be sent to the South Caucasus Republics and how it would be delivered [1, p. 290-291].

The representative of Great Britain in the Caucasus, O.Wardrop, informed the Azerbaijani Government about the de-facto recognition of Azerbaijan's independence. On January 11, 1920, British Foreign Secretary Lord George, the Supreme Council of the Versailles Peace Conference adopted a decision on the de-facto recognition of the Azerbaijan Democratic Republic. On January 14, 1920, a day before the official decision of the Paris Peace Conference was presented to A.Topchubashov. Nasib bey Yusifbeyli, Prime Minister of the Republic of Azerbaijan, addressed the citizens and informed them of the recognition. M.A.Rasulzade, the founder of the Azerbaijan Democratic Republic, concluded his speech with the following words: “The people of Azerbaijan have demonstrated their independence to the rest of the world. The flag, once raised, will never fall!”**.** As soon as the telegram was sent from Tbilisi on January 12, was received, an emergency meeting of the government of Azerbaijan was called. On January 13, government information about this important event was announced, and January 14 was announced as a holiday in all of Azerbaijan. A military parade of the Azerbaijani army and a ceremonial meeting of the Parliament of the Azerbaijan Democratic Republic were held in the capital. January 14 was declared as a National Holiday. On January 14, Prime Minister Nasib Bey Yusifbeyli's address to "Citizens of Azerbaijan" was announced. The 12th issue of "Azerbaijan" newspaper, dated January 24, 1920, published news and materials related to the recognition of the Azerbaijan Democratic Republic in the international world, was published under the name "Independent Azerbaijan" [1, p. 240-241].

Thus, the political recognition of the Azerbaijan Democratic Republic at the Paris Peace Conference in January 1920, was the result of the successful diplomatic activity of the Azerbaijani delegation, including A.Topchubashov, and the government of the Republic as a whole. Azerbaijan was the first Turkic and Muslim republic recognized by the Supreme Council of Versailles [1, p. 290].

The delegation achieved its main task: “The will of the people of Azerbaijan and the existence of the state of Azerbaijan could bring to worlds attention. If the Republic of Azerbaijan did not achieve its international recognition, the creation of socialist Azerbaijan would also be under great question. The financial power and moral qualities of our people, their moral wealth, love for hard work, respect for rules and principles of statehood is a good guarantee for existence of Azerbaijan as a free republic." - Azerbaijani delegation at the Paris Peace Conference concluded his "Demands" with these words [5, p. 8-21]. Despite the Allies’ reluctance to allocate military aid to Azerbaijan at the Paris Peace Conference, their de facto recognition of the ADR allowed some Western countries such as Finland, Belgium, Holland and Switzerland to open consulates in Baku. Similarly, Iran recognized Azerbaijan as a government on March 20, 1920, in accordance with a friendship agreement signed between the two countries, and in the following days, Azerbaijan opened an embassy in Tehran, a consulate general in Tabriz and vice-consulates in Enzeli and Mashad. Prior to the Russian invasion in April 1920, a decision was made to open diplomatic representations in England, France, Italy, USA, Sweden, Poland, Lithuania, Finland, Ukraine, Romania, Germany, Russia, Estonia and Latvia. Likewise, Georgia, Armenia, Iran, Belgium, Holland, Greece, Denmark, Italy, France, Switzerland, Sweden, England, USA, Ukraine, Lithuania, Poland, and Finland had official diplomatic missions in Baku at different levels. Furthermore, General Denikin officially recognized Azerbaijan’s independence on February 7. Around the same time, the government of Japan announced that it was seeking to establish diplomatic relations with Azerbaijan. Moreover, the Pope based in Rome delegated his representative to Baku [12, p. 71]. As we said, On January 11, 1920 Supreme Council of the Paris Peace Conference had adopted a decision on recognition of Azerbaijan and Georgia as newly- independent states. The environment of Paris Peace Conference was being used not only for the recognition of Azerbaijan's independence, but also for the establishment of democratic and civilized state, meeting Western standards and democratic requirements. The efforts of the delegation had ensured dissemination of objective information regarding Azerbaijan's historical past, rich natural resources, character and scale of a century-long Russian occupation of Azerbaijan, neighborhood policy in the Caucasus. The delegation was struggling for independence and ideological unity of not only of their country, but also of that of the entire Caucasus. Historian professor Jamil Hesenli said: “Political recognition of the Republic of Azerbaijan at the Paris Peace Conference in January 1920 must be regarded as an outcome of successful diplomatic activity of Azerbaijani delegates headed by Topchubashov”. Azerbaijan had been de-facto recognized with the great efforts of delegation. Azerbaijani delegation to the Paris Peace Conference was the first landing party of the newly independent state dispatched to Europe. Therefore, one of the primary claims of the delegation to the Peace Conference was the official recognition of secession from the Russian Empire of Azerbaijan and other republics of the Caucasus. Staunchly supporting this idea, Azerbaijan had clearly rejected both the participation of Azerbaijan in the Constituent Assembly and entering into new state to be established under federative principles. The delegation of the Republic of Azerbaijan to the Paris Peace Conference had concluded their “Claims” with the following words: “Material resources and moral values of our nation, its respect for the law and order, principles of statehood are the biggest guarantees of its further independent existence” [5, p. 61-80].

In 1929, when J. Clemenceau passed away, E.M. Topchubashov, as the head of the Azerbaijan Peace Delegation, sincerely expressed his condolences to the French government for their recognition of Azerbaijan's independence and the services rendered in this regard. It was said: "The death of Jorj Clemenceau, one of France's great political servants, has deeply saddened us. We Azerbaijanis will always remember that Azerbaijan's independence was recognized under Clemenceau's presidency" [6, p. 366].

CONCLUSION

Undoubtedly, during that period's international conditions, it was normal for the newly formed small state of the Azerbaijan Democratic Republic (ADR) to initially escape the immediate attention of leading states. However, above all, the end of World War I had been favorable for France and England, with the United States being the biggest winner of the war. Although these three states were allies within the Russian Entente during the war, the former Entente members realized very well that Russia had transitioned from tsarist rule to a period where the Bolsheviks entered the political arena. Undoubtedly, the states under Soviet rule, especially Azerbaijan, which had control over the oil in Baku, suffered greatly during the war, but this was not apparent to the United States, England, and France. The division of the Caucasus and the creation of small states in the region served the interests of the Entente, on the other hand the existence of small independent states in the Caucasus and the idea of eventually strengthening them disturbed Europe. Therefore, while initially waiting for a long time and disregarding the ADR's visa requests, Europe also recognized its importance in the political arena. Unfortunately, the Allies only provided food support to the ADR, not weapons and military aid. Naturally, this led to the inevitable situation of the April 28, 1920 occupation. Despite all this, the de facto recognition at the Paris Peace Conference allowed Azerbaijan to relatively protect its borders, and Armenia and Georgia were compelled to recognize the territorial integrity and capital Baku. It is well known that the present-day Republic of Azerbaijan is the successor of the Azerbaijan People's Republic. The Azerbaijan People's Republic, a century ago, managed to assert itself in the political arena against the leading states amidst tense international conditions. Naturally, this achievement owes much to the exceptional services of Ali Mardan bey Topchubashov.

AKNOWLEDGEMENTS

I am very grateful for my teacher’s-Aynur Hajigadirli and Samira Aliyeva’s help. I have used majority of books from libraries of Azerbaijan National Academy of Sciences and National Library of Azerbaijan.

REFERENCES

1. Azerbaijan Democratic Republic encyclopedia: [in 2 vol.] / ed. Y.M.Mahmudov. – Baku: Lider, – v. 2. – 2005. – 472 p.
2. Dillon, E.J. The Inside Story of The Peace Conference / E.J.Dillon. – New York: Harper brothers, – 2004. – 377 p.
3. Fromkin, D.H. A Peace to End All Peace: The Fall of the Ottoman Empire and the Creation of the Modern Middle East / D.H.Fromkin. – New York: Henry Holt and Company, – 2010. – 672 p.
4. Graeme, W.H. Azerbaijan Democratic Republic / W.H.Graeme. – Dubai: Media Prime, – 2018. – 244 p.
5. Guliyev, V.M. Azerbaijan in Paris Peace Conference / V.M.Guliyev. – Baku: Ozan, – 2008. – 244 p.
6. Hasanli, J.P. The Foreign Policy of ADR / J.P.Hasanli. – Baku: Garısma, – 2009. – 576 p.
7. MacMillan, M.O. Paris 1919: Six Months That Changed The World / M.O.MacMillan. – New York: Random House Publishing Group, – 2003. – 570 p.
8. Topchubashov, A.A. Caucasian Azerbaijan's *demands* from the Peace Conference / A.A.Topchubashov. – Baku: Qanun, – 2018. – 96 p.
9. Topchubashov, A.A. Letters from Paris. – Baku: Azərnəşr, - 1998. - 120 p.
10. Yagublu, N.G. Founders of the Republic / N.G.Yagublu. – Baku: Nurlar, – 2018. – 504 p.
11. https://dergipark.org.tr/tr/download/article-file/445483
12. https://irs-az.com/new/files/2019/258/3004.pdf

PARİS SÜLH KONFRANSINDA ADR

S.E. Qarayeva

1918-ci ilin may ayından 1920-ci ilin aprelinədək mövcud olmuş Azərbaycan Xalq Cümhuriyyəti ümumi müsəlman dünyasında ilk demokratik, dünyəvi və parlamentli respublika olmuşdur. Çar Rusiyasının dağılmasının ardından Azərbaycan xalqı böyük çətinliklər və şəhidlərin qanı ilə öz müstəqilliyini yenidən qazandı. AXC-nin qurucuları ilk gündən xarici təhlükəni hiss etdikləri üçün bir sıra problemləri dünya dövlətləri və ictimaiyyətin diqqətinə çatdırmağa çalışmışlar. Bildiyimiz kimi, Parisdə keçiriləcək sülh konfransında iştirak etmək üçün göndərilən nümayəndə heyəti viza alınması, eyni zamanda, AXC-ni beynəlxalq aləmin subyekti olaraq qəbul etdirmək prosesində çox böyük çətinliklərlə üzləşmişdir. Məqalədə Paris Sülh Konfransı zamanı mövcud olan vəziyyət, bu dövrdəki tarixi şərait, konfransda verilən qərarlar, həmçinin Azərbaycan Xalq Cümhuriyyətinin xarici siyasəti və gələcək taleyi haqqında məlumat verilmişdir.

Açar sözlər: *nümayəndə heyəti, Topçubaşov, müstəqil, hökumət, de-fakto*

АДР НА ПАРИЖСКОЙ МИРНОЙ КОНФЕРЕНЦИИ

С.Е. Гараева

Азербайджанская Демократическая Республика, существовавшая с мая 1918 года по апрель 1920 года, была первой демократической, светской и парламентской республикой в мусульманском мире. После распада царской России азербайджанский народ с большими трудностями и кровью мучеников восстановил свою независимость. Поскольку основатели АДР с первого дня ощутили внешнюю угрозу, они попытались довести ряд проблем до сведения мировых государств и общественности. Как известно, делегация, направленная для участия в мирной конференции, которая должна была состояться в Париже, столкнулась с большими трудностями в процессе получения визы и одновременно принятия АДР в качестве субъекта международного мира. В статье представлена информация о создавшейся ситуации во время Парижской мирной конференции, исторических условиях этого периода, решениях, принятых на конференции, а также о внешней политике и дальнейшей судьбе Азербайджанской Демократической Республики.

Ключевые слова: *делегация, Топчубашов, независимый, правительство, де-факто*

SOCIAL SCIENCES

UDC: 1.16.165.3
ORCID: 0009-0004-7491-3520 (Zulfugarov)
ORCID: 0000-0002-2906-9218 (Gurbanov)

TECHNOSCIENCE AND DIGITALITY: AN EPISTEMOLOGICAL ANALYSIS OF INTERACTIONS

[1]Vusal Rahman Zulfugarov
[2]Fuzuli Muhammed Gurbanov
Azerbaijan National Academy of Sciences[1]
The Institute of Philosophy and Sociology of ANAS[2]
E-mail: vzulfugarov@gmail.com
Received: 24.01.2023
Accepted: 06.09.2023

In the article, the phenomenon of technoscience is investigated in the context of a mixed relationship with digitality at the modern stage in a philosophical-scientific aspect. The analysis reveals that "technoscience" represents a novel cognitive phenomenon, closely intertwined with the fundamental mechanisms of scientific comprehension as a whole. Therefore, it is essential to investigate technoscience by considering both its cognitive and socio-cultural dimensions within the philosophical-scientific framework. Adopting an interdisciplinary approach that harnesses synergies can prove beneficial in this endeavor. In that context, the possibility of using the cognitive principle called "paradox of creativity" defined by one of the authors of the article is considered. For this, the principle of "double contingency" introduced by T. Parsons and also investigated by N. Luman and Y. Hui is applied.

Scientific Purpose: *The primary objective of the study is to attain a philosophical-scientific comprehension of the relationship between technoscience and digitality.*

Methodology: *In the article, synergetic-centered interdisciplinary methodology was used. In this framework, the methodological principles of non-linearity, intersubjectivity, synergetic synthesis and formation are taken as the basis.*

Method: *Differentiation of differences, synergistic synthesis of subsystems and double contingency methods are applied.*

Scientific Innovation: *The study introduces a novel investigation of technoscience-digitality relations, employing the "paradox of creativity" as a guiding principle and viewing these relations through the lens of the "double contingency" rule of understanding.*

Keywords: *creativity paradox, double contingency, NBIC-convergence, polysubjectivity, reflexivity, multiparadigmality, number, implicit knowledge, codification of knowledge.*

DOI: 10.59849/2409-4838.2023.3.101

INTRODUCTION

As we entered the 21st century, philosophical-scientific understanding embraced the dominance of the sophistication paradigm. The notions of "complexity" became prominent in scientific cognition during the latter half of the previous century. Within just a few decades, these concepts assumed a dominant role in the field. Towards the end of the 20th century, the renowned physicist Stephen Hawking's prediction that "the next century will be the century of complexity" became frequently cited in contemporary philosophical and scientific literature. Philosophical-scientific cognition is already recognized as a "complex phenomenon" in nature and essence. From a philosophical standpoint, "complexity" has been defined in various ways, reflecting its distinctive nature and how it is perceived in scientific contexts. However, in this article, we take the synergistic understanding

of complexity in the context of Edgar More's complexity or "thinking in formative complexity" paradigm, following V.I.Arshinov and V.G.Budanov, without referring to its other meanings [1, 2, 3]. On a more concrete philosophical-scientific level, it means "thinking in differences". Or it means accepting the existence of differences in thinking, provided that the unity and mutual relations of different thoughts are maintained. This understanding of complexity entails creating a comprehensive network of knowledge, fostering close interactions between different scientific fields at a theoretical level. Complex and complexity thinking is formed "actively in the problem- and innovation-oriented cognitive-project practices of the 21st century" [1-2, p. 50-51]. So, for us in this article, the meaning of increasing complexity in the conditions of increasing diversity is more important. This principle serves as a fundamental aspect of biological, technological, social, and cosmological evolution. In this context, "the synergistic convergence of knowledge, research, and project practices, along with information-communication, nano, bio-technologies, and cognitive sciences (or NBIC-Convergence-F.G., V.Z.)," emerges as one of the primary factors contributing to this growth [1, 2]. This includes social and humanitarian sciences.In turn, the integration of socio-humanitarian knowledge into the framework of synergistic convergence (characterized by synergetic synthesis and knowledge integration) demands careful consideration of its inherent ambiguity, polysubjectivity, reflexivity, multiparadigmality, and heterogeneity [1, 2]. The article primarily examines complexity within the context of the interconnectedness of cognitive and socio-cultural, scientific and technological processes, emphasizing their unified interactions. This theoretical-conceptual expression is observed through interdisciplinary projects, socio-humanitarian expertise, and the interrelations of technoscience. At a broader level, the article delves into the philosophical-scientific understanding of the global anthropo-socio-technological co-evolution, wherein the transdisciplinary research strategy for comprehending such intricate realities becomes crucial. In light of these considerations, philosophers discuss "the emergence of a new type of thinking - complexity thinking" [1-2, p. 6-8]. Thus, in this article we approach the understanding of “human-dimensional” systems in the conditions of Digital Culture against the background of the formation of Technoscience at the general level, the convergence of Natural Science and socio-humanitarian sciences through the prism of the content of complexity thinking. In this case, the synthesis of anthropo-socio-technological coevolution in the framework of a single theory on the basis of interdisciplinary, multidisciplinary and transdisciplinary study of knowledge is considered as the main epistemological condition. Such a setting of the issue requires a synergistically focused interdisciplinary approach. We utilize methodological principles such as non-linearity, intersubjectivity, and synergistic synthesis to frame our research. Within this interdisciplinary framework, we implement differentiation of differences, synergistic synthesis of subsystems, and double contingency methods to address the emphasized principles effectively.

MAIN PART

Devi Kevin, in his article "What's Kun's problem?", highlights in his article - there is a point of view in scientific understanding that " makes coming to see the world differently a deliberative process that". In this view, it is not considered correct to imagine this or that paradigm as an immutable system, on the contrary, it is considered as an "object of discussion" that calls into question the inclusion of the existing canon in the future paradigm [4, p. 112]. There are positions similar to this. For example, the Swiss philosopher Paul Hoyningen-Huene believes that "...there are situations in the history of science in which the conviction of scientists about a certain hypothesis is so strong that they treat it as fact. Nevertheless, this hypothesis may be abandoned at later times" [5, p. 69]. Philosophers connect paradigm innovation with a person's cognitive attitude towards the world as a whole. It goes beyond the realm of intra-science or the interaction between science and culture as separate systems. The ontological context of human cognitive activity, and even the universe at large, plays a significant role in this understanding. Canadian philosopher Nick Overduin introduces

the term "post-religious peace" to explain paradigmatic innovations in general. He sees scientific paradigms as attributes of a unified cognitive process, encompassing both cognitive and social aspects. He writes that for the formative aspect of human knowledge" the ongoing development of contemporary cosmization, a new epistemological paradigm of post-religious humility is replacing religious versions". The main philosophical concept here is that a person's scientific activity is not only shaped by their human existence but also heavily influenced by the context of "cosmization." In this sense, "post-religious peace" can lead a person's relationship with themselves and the world to a path free of creative contradictions. As a result, " new stance of post-religious humility therefore summons humanity to relinquish being anthropomorphic" [6, p. 145]. One of the important points in the context of the emergence of new sciences in this approach is that, according to N.Overduin, "The question as to which paradigm is "better" is ultimately inexpli-cable " [6, p. 146]. That is, against the background of D.Kevin's approach, the emergence of new knowledge, theories, scientific paradigms, and sciences as a whole are not relevant in the logical context of slogans such as "which one is better in the end", where the main thing is deliberativeness and deliberativeness, such as gestalt proceduralism. Within the context of these conversations, we can consider "technoscience" to be an emerging phenomenon on a human scale. For us, the epistemological and methodological significance of this element of the issue is significant, because there is an opportunity to synthesis the concept of perpetual innovation with scientific-epistemological succession in the construction of technoscience. They claim that French philosopher Gaston Bachelard first coined the term "technoscience" in 1953. The popularity of this word is credited to Belgian philosopher Jilber Ottua [7, p. 46]. But in 2018, J.Ottua emphasized in the article he wrote about the origin of the term technoscience and its meaning at the modern stage: "I have a long-standing relationship with the noun "technoscience." In recent years, I have been concerned with its evolution and connotations, since the period when I first thought it up" [8, p. 121]. It is a fact that J. Ottouan's ideas about technoscience are given a wide place in the philosophical and scientific literature. J. Ottua separates the concept of technoscience into 4 major aspects: 1. Technologies play a crucial role in modern science and they are widely applied; 2. Man's attitude towards the world and space changes, man aspires to constant transformations and manipulations; 3. The attitude towards the future changes, it is imagined openly and transparently; 4. Technoscience is such a force that it is infinitely "written" and expanded into the past, the future, and also through space [8, 9]. J.Ottua underlines the fact that technology is a multifaceted reality. It can no longer be described using the "science-technology" combination. He cites the absence of demarcation between basic and applied research in scientific laboratories as the explanation for this. This indicates that in technoscience, science and technology are naturally integrated and hence constitute oneness, according to J.Ottua. Science and technology can theoretically be separated in technoscience. It turns out that a completely new science has emerged in terms of quality and function, capable of having its own essence and functions within the context of digital culture. Because digitality has a direct impact on and even "creates" science and technology.

In the underlined context, J. Ottua states that the objectivity of modern science is in its effective technical actuality [8, p. 261-265].

In conclusion, we can state that technoscience, as defined by J. Ottoya, is the mutual penetration of science and technology to the point where they are inseparable and constitute a single entity [7, p. 46]. In the Great Oxford Dictionary, as an example of the penetration of science and technology into science, technoscience is indicated that "a single discipline has emerged": fundamental problems are applied in solving technical problems, and technical knowledge is applied in solving fundamental scientific problems [9, 10]. There is an intriguing philosophical generalization of such viewpoints as well. V.E.Terekovich's generalization is of significance to us. He suggests a "ontological pluralism model conditional on existence inheritance." "Every essence is a derivative of some structure and, in turn, creates new essences and structures," according to this definition. Finally,

structures and essences at each degree of complexity acquire the potential to partially operate and exist to some extent independently of previous levels' structures and essences [13, p. 149-150]. Upon applying these philosophical theses to the notion of "technoscience," it becomes evident that this novel discipline has assimilated aspects of existence and functionality from preceding levels of structure and essence. At the same time, the unity of science and technology in technoscience has introduced new nuances to philosophical and scientific thinking in this area. This cognitive, socio-cultural, and methodological approach transforms technoscience into a subject of analysis within the realm of philosophical-scientific cognition at large. The discussions of modern philosophers on this side of the matter show that our caution is not accidental.

The crux of the matter is that within the broader tradition of philosophical-scientific thinking, science has long been regarded as the primary path of rationality. Science actually programs the public consciousness in the course of epistemic and technological optimism. In light of this context, there is a growing emergence and spread of "non-critical belief in technoscience as the ultimate method for resolving all challenges and problems confronting humanity" [13, p. 7].

Indeed, this phenomenon can be seen as a manifestation of "scientific imperialism." The underlying causes of this issue are related to profound scientific and socio-cultural factors. Researchers characterize technoscientific imperialism as the expansion of scientists' influence into spheres beyond their own spheres of interest. Expanding this thesis further, we can envision "techno-scientific imperialism" as the aspiration of the scientific and technocratic worldview to exert dominance over all of humanity. A significant issue also arises in this situation: it is hard to predict in advance the risks caused by the politicization of scientific knowledge, including the great influence of scientists on political decision-making! Because of this, opponents of "scientific imperialism" advocate for a "broad expertocracy." However, supporters of "scientific imperialism" argue that science can protect society and cognition as a whole from populism. H.Collins and R.Evans write in this regard: “The risk of populism is ever-present in democratic societies. Herewe argue that science provides one way in which this risk can bereduced. This is not because science provides a superior truth butbecause it (a) preserves and celebrates values that are essential for democracy and (b) contributes to the network of the checks and balances that constrain executive power” [14, p. 200].

Those in the opposite camp consider that restricting scientific professional expertise to deliberative processes is more appropriate. It is possible to discern openly "what is close to the truth and what is far from the truth in the opinions of professional experts" because to the deliberative nature of expertise [15, p. 763].

The position between absolute faith in technoscience and distrust (scientific absolutism and populism) is considered more correct. It is believed that in addition to absolutizing science, it is possible to get rid of denialism, which is opposite to it (denial of the existence of scientific consensus outside the normative framework of scientific discipline) [13, p. 8]. According to this perspective, the viewpoint of V.E.Terekovich that was previously mentioned can "eliminate" both extremes. Overall, it is evident that understanding the phenomenon of technoscience in the framework of anthropo-socio-technological co-evolution is possible from both a philosophical and scientific standpoint.

Other aspects of technology can be emphasized. However, given the context of the principles discussed above, it is sufficient to limit ourselves to the theories of French philosopher Bruno Latour and American Alfred Nordman. According to B. Latour, technoscience is a "union of heterogeneous actors." Heterogeneous, that is, it is used in the system of elements with different composition. People, science, nature, society, economy, and politics are all seen as heterogeneous players by B. Latour [16, p. 7-34].

According to A. Nordmann, technoscience "caused an epochal shift in research culture." Technoscience, according to the American philosopher, is a hybrid phenomena that "throws down the gauntlet" to the old dichotomy of nature and culture. Therefore, theoretical concepts in techno-

scientific research cannot be separated from the material conditions of knowledge creation in principle [17].

In the background of all these discussions, a number of philosophers advanced theses about the essence and purpose of technoscience in digital cultural conditions (the most contemporary stage of creation of computers, artificial intelligences, robots, etc.) within the framework of human-science relations by delving deeper into philosophical, sociocultural, and psychological-spiritual perspectives. The Korean philosopher Y.Hui had some intriguing views at the time. J. Smonden, one of the founders of the philosophy of technology, asserts that "we cannot understand the relationship between man and machine until the concept of machine is reduced to an economic category" [32]. He bases this claim on his belief that understanding technology itself is at the core of understanding the phenomenon of technoscience.

In other words, there is a need to consider the philosophical implications of relationships between humans and machines, computers, and artificial intelligence. A more delicate situation is developing as a result of the greater and deeper application of digital technology to society. Therefore, "creative destruction" (J.Schumpeter) occurs when common people have access to such cutting-edge technologies.

Its tangible manifestation is the formation of a contradiction, or at the very least an inconsistency, between the rate at which new digital things are created and the philosophical understanding of their potential repercussions. In the framework of that logic, one can think that every serious achievement of technoscience in the era of digitalization, on the one hand, creates society (develops, creates progress), on the other hand, destroys something somewhere.

The convergence of science and technology in the age of digitalization, it turns out, actually generates a new sociocultural environment where numbers become the primary means of communication. Y.Hui refers to this concept as "cosmotechnics" in general. Y. Hui provides the following explanation of that concept's primary ideas: As new technologies are adapted by other cultures, those cultures develop them in line with their conceptions of space and man. By mastery, Y.Hui implies embracing contemporary technologies in a way that allows us to turn them into a "function of intelligence" and a part of ourselves [11, 12, 26]. This already means the adoption of new technologies, Digitalism, as an immanent element and function of existence on individual, public and cosmic scales.

This concept can be interpreted in the context of the cosmotechnical epistem. In reality, this means developing a new epistemology. The concepts of space and man are entirely different in this epistemology. For that epistemology, relationships with space are replaced by a desire to explore it, and myth is swapped out for computers (and narratives for algorithms). Digital technologies, in other words, qualitatively transform how a person views himself and the rest of the world [18, 32].

Several studies have explored the evolution of cultural practices within the realm of technoscience, referring to it as the "digital trend of culture." According to this perspective, the impact of information technologies on culture is considered to be widespread. With the application of digital technologies, "new socio-cultural phenomena and practices are emerging" [19, p. 70-71].

All of this brings to the center of techno-science-digital culture relations in the context of the problem we are interested in, the issue of mutual relations between the phenomena of scientific creativity (creativity) and digitality. Before delving into an examination of these interactions, let's first understand the definitions of these terms.

The term "creativity" encompasses diverse interpretations and perspectives. It is commonly regarded as being synonymous with innovation. In more comprehensive analyses, some philosophers view creativity as a psychological process or an expression of cognitive capabilities. Conversely, other philosophers conceptualize creativity as an outcome and groundbreaking innovation that gains recognition from the scientific community and society at large. Consequently, there exist

psychological, historical, and historical-epistemological accounts seeking to explain the concept of creativity [20, 21, 22].

I.T.Kasavin emphasizes that the idea of creativity or creativity is always based on a concrete way of understanding a person, his connections with society and nature. Along with this, the concept of creativity (and hence creativity at the moment) performs the function of normativity, showing a person a way to form a certain attitude towards his environment. In this sense, creativity is in the status of Western culture and other universal concepts of technogenic civilization. In the context that we highlight, the concept of creativity and the concept of creativity can be taken as synonyms [22, p. 20].

That is why A.Kurri understands the creation of knowledge as "group-level activity". He writes: "... science involves the coordination of groups with different abilities to achieve common epistemic goals" (that is, "to science, to the essence of scientific activity" - F.G, V.Z.) [21, p. 2].

These concepts lead to the conclusion that it is essential to consider the communication principles and relationships between the scientific community, scientific infrastructure, and society in order to comprehend scientific creativity, or how new, valuable knowledge is produced in science [22, p. 58].

We agree with this viewpoint and would like to make one point: in this context, creativity and creativity are synonyms. For us, creativity is not only sociohistorical, but also cognitive-anthropological and methodological. At each socio-historical stage, we see innovation in the synthesis of social-practical verification and individual aptitude. At this point, the innovativeness and utility of the resulting outcome might be used as a creative criterion.

In this article, we adopt the viewpoint that creativity and innovation are synonymous concepts, and we place significant emphasis on exploring their connection with digitality, which is crucial to our research topic. Within this perspective, digitality represents the epitome of creativity, signifying the highest level of expression for innovative ideas. The extent to which digital technologies can embody knowledge in the contemporary era is recognized as a pertinent philosophical, scientific, and epistemological issue. Here, there is relevance both in terms of the formation of knowledge, its social functions, and the prediction of its possible effects on the social environment.

In light of this, we wonder whether creativity can be fully expressed by digital technology. More specifically, philosophers and scientists from various disciplines ask if knowledge can be codified to what extent. In this connection, the philosophical-epistemological understanding of the concept of "implicit knowledge" introduced by M.Polanyi takes a new direction [17]. According to M.Polanyi, new knowledge always occurs in conditions that are not completely clear. Figuratively, M.Polanyi expresses the non-obviousness of knowledge as follows: " we can know more than we can tell" [17, p.4].

Numerous researchers have elaborated on M. Polanyi's concept, exploring the idea of "implicit knowledge" across various fields. Among them, a comparative analysis of symbolically expressed (including digital) and non-symbolically (including digital) knowledge was also conducted (for example, R.Cowan and J.Kimble). R.Cowan refers to this knowledge as being "not codified" [23, p. 212]. This means the existence of non-formalized (including digital) knowledge. Codification means codification of knowledge. It turns out that there is knowledge in modern sciences that is not codified. Because their full content is not clear or expressed. This situation always exists according to modern scientific approaches. That is, it does not depend on the approach in general, it is directly related to the peculiarity of human cognition.

C.Kumple summarizes what is said about non-obvious knowledge and concludes that: “Tacit knowledge is usually described as knowledge that is either (a) inarticulable, that is, it is impossible to describe in propositional terms, or (b) implicit, that is, articulable but only with some difficulty” [24, p. 5].

Philosophers have recognized various categories of non-obvious knowledge and defined which of them are associated with creativity by taking a more comprehensive approach to the issue. According to G. Collins' classification, the collective type of non-obvious knowledge is associated to creativity. G.Collins writes that the collective non-obvious knowledge is basically "contextualized in the language of collectivism" [27, p. 29]. Specifically, this implies the existence of underlying factors deeply embedded within the collective experiences of human societies, which form a part of their knowledge. In essence, this knowledge remains unexpressed and undisclosed, making it challenging to quantify or represent in numerical terms. "The language of collectivism" is clearly related to the spiritual, moral, psychological and other features of society. It is impossible to fully algorithmize them. Numerous philosophers draw the conclusion that the collective non-obvious knowledge is "...impossible to digitize" from all of this [25, p. 38].

But can the relationship between creativity and digitality from a cognitive-methodological perspective be explained by a mechanism or a theoretical-methodological tenet? Many significant features of relations between technoscience and digital technology in general may be understood philosophically and scientifically thanks to the solution to this issue. We suggest a guideline we refer to as the "paradox of creativity" as such a concept. Thus, scientific inventions appear rapidly, but the philosophical-scientific understanding of their socio-cultural impact is delayed. That is, in the cognitive aspect, the "speed of creativity" and the "speed of creativity" of the philosophical-scientific understanding of the results of the socio-practical application of discoveries (inventions) are in a paradoxical relationship. The paradox of creativity can be briefly expressed as follows: "We can evaluate the contradiction between the creative power of scientific cognition and its creative attitude to its own product as an internal paradox" [28, p. 49].

This rule and G. Moore's law are related in several ways. In contrast to Moore's law, the paradox of creativity refers to the epistemological expression of the contradiction in the interaction of two parts of the cognitive process that are in unity with each other. Moore's law relates to the peculiarity of a certain characteristic of scientific inventions being related to the time factor [29, p.1-4].

A cognitive rule known as "double contingency" can explain the creative dilemma. This concept was introduced into current philosophical and scientific literature by Talcott Parson. It explains the cognitive, logical-psychological, and behavioral aspects of communication participants' behavior. According to T.Parsons, one of the communication participants ("ego") chooses one of the available alternatives. The reaction of the second party ("alter") is related to both the choice of the first party and its own choice. That is, concretely, it is a synthesis of these two options. T.Parsons calls this a "situation of double dependence" [30, p. 437].

Expanding on this concept, Niklas Luhmann contends that reciprocal relations involve a "double contingency" [31, p. 151]. He also refers to a "double dependence on circumstances." According to the German sociologist, the "ego" possesses the capacity to select from various available alternatives. The alter's response is influenced by both the ego's choice and its own decision. Consequently, the choice made by the alter represents a synthesis of the ego's decision. N.Luman generally applies this mechanism to culture samples. As a result, the decisions made and conclusions made are "conventional" in nature. The German sociologist sees a connection between double contingency and the mixed relationship of concepts of system, complexity, self-reference and meaning [31, p. 152].

In light of this, Y.Hui's concept of "algorithmic contingency" has an intriguing effect. According to a Korean philosopher, there are scientific objects that "do not fit recursive calculation." If the number is not recursively calculated, then we have encountered the phenomenon of algorithmic contingency. If any number is given, the recursive algorithm used to express it must be shorter than the number itself. Algorithmic contingency arises when algorithmic compactness is impossible. Thus, contingency "becomes an expression of unpredictability and uncalculability" [32, p. 168-169].

Thus, when considering the ideas of T.Parsons, N.Luhmann, and Y. Hui, it becomes evident that the paradox of creativity can be philosophically and scientifically explained within the context of techno-science-digital relations and double contingency. The mixed relationship between technology and science constitutes one aspect of contingency, while the digital expression of these connections represents the other side. If we accept these sides as "ego" and "alter" in the sense of T.Parsons and N.Luman (such a reduction is possible because those concepts are universal in the sense of N. Luman and Y. Hui and can be attributed to the cognitive mechanism of thinking as a whole), we can say that technoscience-digital relations are formed and contented within the framework of the rule of double contingency.

Finally, all of these studies lead to the conclusion that in the digital cultural environment, technoscience becomes content under the conditions of double contingency in contact with digitality and evolves in the unity of uncertainty and certainty. This, in turn, demonstrates that, along with the cosmization of modern scientific thinking, it is always doomed to take into account the specific situational aspect. As a result, the paradox of creativity, i.e., the discrepancy between the rapidity of scientific discovery and the creative comprehension of its socio-practical application, will always be present.

CONCLUSION

The analysis conducted reveals that in the modern era, technoscience represents the next evolutionary stage of human cognition as a whole.

In fact, technoscience encompasses the overall content and nature of scientific cognition dynamics.

To gain a comprehensive understanding of technoscience, the element of digitality must be taken into account.

The philosophical-scientific comprehension of technoscience in digital conditions can be achieved through the lens of the "paradox of creativity" and the principle of "double contingency."

For the philosophical-scientific understanding of technoscience, the concept of "algorithmic contingency" can play a heuristic role.

REFERENCES

1. Аршинов, В.И. Системы и сети в контексте парадигмы сложности / В.И.Аршинов, В.Г.Буданов – 2017. – 11 с.
2. Аршинов, В.И. Сложность и проблема единства знания. Проблема. 1: К стратегии понимания сложности / В.И.Аршинов, В.Г. Буданов, В.Е. Лепский – М.: ИФ РАН, – 2018. – 105 с.
3. Морен, Э. Метод. Природа Природы / Э.Морен. – М.: Канон, – 2013. – 488 с.
4. Kevin, D. What is Kuhn’s problem? // Epistemology & Philosophy of Science, – 2022, 59 (4), – p. 111-125.
5. Hoyningen-Huene, P. Is Kuhn’s “world change through revolutions” comprehensible? // Epistemology & Philosophy of Science, – 2022, 59 (4), – p. 55-72.
6. https://doi.org/10.5840/eps202360112.
7. Моисеева, А.П., Баканова, Е.А. Феномен технонауки // Вестник науки Сибири, – 2017, 2 (25), – с. 45-58.
8. Hottois, G. Technoscience: From the Origin of the Word to Its Current Uses // French Philosophy of Technology: Classical Readings and Contemporary Approaches, – 2018. – p. 121-138.
9. https://link.springer.com/chapter/10.1007%2F978-94-017-9870-9_2#page-1.
10. Hottois, G. Techno-sciences and ethics // Studies in the Philosophy of Science and Humanities, – 2004. – p. 261-265.

11. Терехович, В.Э. Структуры, объекты и реальность. Часть 2 // Эпистемология и философия науки, – 2023, 60 (1), – с. 149–165.
12. https://en. oxforddictionaries.com/definition/technoscience
13. Тухватулина, Л.А. Наука как объект веры и недоверия: феномен дениализма // Эпистемология и философия науки, – 2023, 60 (1), – с. 6-20.
14. Collins, H.M., Evans, R. Populism and Science // Epistemology & Philosophy of Science, – 2019, 56 (4), – p. 200-218.
15. Jasanoff, S., Simmet, H.R. "No Funeral Bells: Public Reason in a 'Post-Truth' Age" // Social Studies of Science, – 2017, 47 (5), – p. 751-770.
16. Latour, B. Science in action / B.Latour. How to follow scientists and engineers through society Harvard University Press, – 1987. – 276 p.
17. https://www.unibielefeld.de/ZIF/FG/2006Application/PDF/Nordmann_essay2.pdf
https://www.colta.ru/articles/society/16061-yuk-huey-tehnologii-dolzhny-stat-chastyu-nas-funktsiey-razuma.
18. Hui, Y. Recursivity and Contingency / Y.Hui. – London: Rowman & Littlefield International Ltd., – 2019. – p. xv + 336.
19. Архипова, О.В. Цифровые тренды культуры: опыт трансформации культурных практик // Петербургский экономический журнал, – 2018. №1, – с. 70-76. https://plato.stanford.edu/entries/epistemology-social/
20. https://doi.org/10.5840/eps202259336
21. Currie, A. Creativity, Conservativeness & the Social Epistemology of Science // Studies in History and Philosophy of Science Part A, – 2019. – p. 1-4.
22. Касавин, И.Т., Сахарова, А.В. Креативность-не сущность, а существование! // Эпистемология и философия науки, – 2023, 60 (1), – с. 50-59.
23. Cowan, R. The explicit economics of knowledge codification and tacitness / R. Cowan, P. A. David, D. Foray // Industrial and Corporate Change, – 2000, 9 (2), – p. 211-253.
24. Kimble, C. Knowledge management, codification and tacit knowledge Information Research / C. Kimble. – 2013. – 15 p.
25. Масланов, Е.В. Креативность и цифровизация // Эпистемология и философия науки, – 2022, 59 (3), – с. 38-45.
26. Collins, H. Tacit and Explicit Knowledge / H.Collins. The University of Chicago Press, – 2010. – 186 p.
27. Коллинз, Г. Социальное картезианство и онтологическая асимметрия // Епистемология и философия науки, – 2011. № 3, – p. 17–34.
28. Qurbanov, F.M. Elmi idrakın kreativlik paradoksu // "Unikal". Beynəlxalq ictimai fənlərarası elmi-tədqiqat jurnalı, – 2014. № 1, – s. 47-55.
29. https://download.intel.com/newsroom/2022/manufacturing/Intel-Moores-Law-Investor-Meeting-Paper-final.pdf
30. Парсонс, Т. О структуре социального действия / Т.Парсонс. – М.: Академический Проект, – 2000. – 880 с.
31. Луман, Н. Социальные системы. Очерк общей теории / Н.Луман. – Санкт-Петербург, – 2007. – 644 с.
32. Хуэй, Ю. Рекурсивность и контингентность / Ю.Хуэй. – М.: Vac Press, – 2020. – 400 с.

TEXNOELM VƏ RƏQƏMSALLIQ: QARŞILIQLI ƏLAQƏLƏRİN EPİSTEMOLOJİ TƏHLİLİ

V.R. Zülfüqarov, F.M. Qurbanov

Məqalədə texnoelm fenomeni müasir mərhələdə rəqəmsallıqla qarışılıqlı əlaqə kontekstində fəlsəfi-elmi aspektdə araşdırılır. Göstərilir ki, "texnoelm" özlüyündə yeni idraki hadisədir və bütövlükdə elmi dərketmənin ümumi mexanizmləri ilə sıx əlaqəli olaraq meydana gəlmişdir.

Bu bağlılıqda texnoelm fəlsəfi-elmi idrakın koqnitiv və sosial-mədəni aspektlərinin vəhdətində tədqiq olunmalıdır. Bu zaman sinergetik əsaslı fənlərarası yanaşma faydalı ola bilər. Həmin kontekstdə məqalənin müəlliflərindən birinin müəyyən etdiyi "kreativlik paradoksu" adlı koqnitiv prinsipindən istifadə etməyin mümkünlüyü nəzərdən keçirilir. Bunun üçün T.Parsonsun daxil etdiyi, N.Luman və Y.Hui tərəfindən də araşdırılan "ikiqat kontingentlik" prinsipinin tətbiqinə baş vurulur.

Elmi məqsəd: Texnoelm-rəqəmsallıq münasibətlərinin fəlsəfi-elmi dərkinə nail olmaq.

Metodologiya: Məqalədə sinergetik mərkəzli fənlərarası mtodologiyadan yararlanılmışdır. Bu çərçivədə qeyri-xəttilik, intersubyektivlik, sinergetik sintez və təşəkkül metodoloji prinsipləri əsas götürülmüşdür.

Metod: Fərqliliklərin fərqləndirilməsi, altsistemlərin sinergetik sintezi və ikiqat kontingentlik metodları tətbiq edilir.

Elmi yenilik: Texnoelm-rəqəmsallıq münasibətləri "kreativlik paradoksu" çərçivəsində "ikiqat kontingentlik" dərketmə qaydası prizmasında tədqiq edilmişdir.

Açar sözlər: *kreativlik paradoksu, ikiqat kontingentlik, NBİC-konvergensiya, polisubyektlilik, refleksivlik, multiparadiqmallıq, rəqəm, qeyri-aşkar bilik, biliyin kodifikasiyası.*

ТЕХНОНАУКА И ЦИФРОВИЗАЦИЯ: ЭПИСТЕМОЛОГИЧЕСКИЙ АНАЛИЗ ВЗАИМОДЕЙСТВИЙ

В.Р. Зульфугаров, Ф.М. Гурбанов

В статье феномен технонауки в философско-научном аспекте исследуется во взаимосвязи с цифровизацией на современном этапе.

Показывается, что «технонаука» представляет собой новое познавательное явление само по себе и возникла в тесной связи с общими механизмами научного понимания в целом. В связи с этим технонаука должна изучаться в единстве когнитивного и социокультурного аспектов философско-научного понимания.

Для этого может быть полезен синергетический междисциплинарный подход. В данном контексте рассматривается возможность использования когнитивного принципа под названием «парадокс креативности», определенного одним из авторов этой статьи. Для этого применяется принцип «двойной контингентности», введенный Т. Парсонсом, а также исследованный Н. Луманом и Ю. Хуэем.

Научная цель: Достижение философско-научного осмысления техно-цифровых отношений.

Методология: В статье использована междисциплинарная методология, ориентированная на синергетику. В этих рамках за основу берутся методологические принципы нелинейности, интерсубъективности, синергетического синтеза и формообразования.

Метод: Применяются методы различение различений, синергетического синтеза подсистем и двойная контингентность.

Научные инновации: Взаимоотношение технонауки и цифровизации в научно-философском аспекте впервые исследуется в рамках «парадокса креативности» через призму научно-познавательного феномена «двойная контингентность».

Ключевые слова: *парадокс креативности, двойная контингентность, NBIC-конвергенция, полисубъективность, рефлексивность, мультипарадигмальность, число, неявное знание, кодификация знания.*

UDC: 94 (479.24)
ORCID: 0000-0001-6358-593X (Hasanov)

RESEARCH OF SOME ISSUES OF HISTORICAL GENEALOGY IN GANJA FROM THE RENAISSANCE PERIOD

Elnur Latif Hasanov
Ganja Branch of ANAS
E-mail: lnurh273@gmail.com
Received: 10.03.2023
Accepted: 01.08.2023

Based on various academic sources were investigated characteristics of development of science and education in the early middle ages period in Ganja. In this historical period city as an important political-cultural center was visited by famous scholars of different foreign countries and as well as important historical information about their teaching and scientific activities have been studied for centuries. Also in this study, based on historical and ethnographic sources, have been determined the significance of the scientific, literary and cultural development of Ganja in the revival of the characteristic features of the Renaissance period not only of the country, but also in the development of the Islamic world as a whole. The special significance of individual manuscripts and archival documents in the study of the centuries-old historical and cultural heritage of the city were scientifically researched.

Keywords: *Azerbaijan, culture, tolerance, Ganja, historical research, Renaissance period, science, education.*

DOI: https://doi.org/10.59849/2409-4838.2023.3.112

INTRODUCTION

Nizami Ganjavi is one of the main thinkers of the Renaissance period. It is clear from the works read and named by Sheikh Nizami Ganjavi that there were rich libraries in Ganja. Sheikh Nizami's deep knowledge of all known fields of science at that time shows that he received a comprehensive education in one of the madrasas belonging to the rich library in Ganja, where prominent scientists worked. The great poet's encyclopedic knowledge and perfect knowledge of all-important fields of science for the current period proves, first, that the city of Ganja is important as a center of science and culture for centuries. Gazi Tahir al-Janzi had a special place among Ganja scholars. As-Silafi stressed the peculiarities of Tahir al-Janzi, a Gazi official in Ganja, in jurisprudence (ie, Islamic law) and etiquette. Tahir al-Janzi, Abul Qasim Ali ibn Abdur-Rahman al-Nishapuri and his compatriot Abulfaz Shaban ibn Ali ibn Muhammad al-Bardai. Abulfaz al-Bardai was his teacher of jurisprudence [1].

Visit of merchants, travelers, prominent scientists and cultural figures from different countries of the world to ancient Ganja, located on the Great Silk Way and other caravan routes, first, created conditions for the integration of spiritual values of our nation with universal civilizations.

Settlement of the great thinker Gatran Tabrizi in Ganja in the XI century, during the heyday of the Arab caliphate, shows that the city became a great center of culture and science in the Muslim East. It is known from the sources that private and public libraries, madrasas at the level of modern universities, observatories and medical centers functioned in Ganja at that time. It is here that Muslim culture spread to neighboring the different Christian countries. Therefore, scientists, poets, architects and artists from many countries of the East settled in Ganja during the period of Renaissance, when culture, education and science, also socio-economical development was so high. Sheikh Nizami praised the cultural level of Ganja and sang his hometown "My Babylon" [2].

In general, based on the information of the sources, it can be noted that in the 10th century, some of the people known as Bardali continued their work while visiting different religious regions. Others lived in their homeland and taught the secrets of science to their compatriots. Probably, Abulfaz Shaban ibn Ali is one of such scholars.

MAIN PART

The main feature that distinguishes sheikh Nizami from other Eastern thinkers is his wide range of images of women**.** It is important to remember that the great poet who valued a woman collected the finest qualities of women in the image of Turkish lady Shirin and created a positive woman image for the first time in Middle Eastern literature. As we have already noted, Nizami mentions in various forms that he is from Ganja, both in his poems and in lyrical poems. He does not express any opinion that allows us to say that he is coming to Ganja. There are no indications in this direction in his works. On the contrary, the poet declares that he is a deep-rooted Ganjali in various ways.

We have reviewed the records of commentators, historians and geographers who have no doubts that Nizami was a native of Ganja. Let us now turn to the notes of the authors who lived and worked after them and were fed by the erroneous and incorrect opinions of some scientists.

Among such comments, A.Krymsky's attention was attracted by the author of the commentary "Seven climates" Amin Ahmad Razi and the author of the commentary "Ateshkede" Lutfalibey Azer Begdeli [3].

These commentators claim that Nizami Ganjavi or his father was from the village of Ta in the Tafrish region of the Iranian province of Gum. They based on verses not related to Nizami, added by scribes to the end of Nizami's "Iskendername".

Krymsky believes in these comments so much that on their basis he decides to reject the conclusions of the authors of earlier periods. A. Krymsky writes: "In order to criticize the very first lines of the article of Dovletzadeh, one cannot disagree with the notes of two commentators who compiled the biographies of the poets on a geographical basis. Both of them associate the birth of Nizami with the sacred Shiite city of Gum in western Iran, more precisely, with the province of Gum. These are "Seven Climates" and LutfaliBey's commentary on "Ateshkada", written in 1760-1779. In these comments, Nizami is presented as another personality from Gum as a result of writing biographies on a geographical basis, and he is not mentioned among the Ganja poets with whom he lived his entire life. A. Krymsky also draws attention to the fact that in the copy of "Hamsa" kept in the British Museum and copied in 1400 by Ch. Ryo, described in the second volume of his catalog of Persian manuscripts, the "Iskendername" also mentions that Nizami was from the "land of mountain sands" ("from the mountainous country of kuma") [4-5].

The fact that Nizami was from Gum is also shown in the "Khamsa" belonging to Sir G. Auzli and rewritten in 1612. And this fact is also,supposedly, authoritative confirmation of the alleged geographic comments. As mentioned above, A. Krymsky, who was indifferent to the sources claiming that Nizami was from Ganja, written much earlier than the Hamsa, which was rewritten in 1400, wanted to confirm the wrong assumption, trying to cling to fictions, errors that turn into a soap bubble [6].

However, A. Krymsky, as a great and experienced scientist, admits that along with the lists of "Khamsa", which mentions that Nizami was from Gum, there are also ancient lists of "Khamsa" without these verses.One truth is forgotten here.It is not shown that copies of "Hamsa" that do not contain these verses are older. But A. Krymsky does not stop there either. The absence of lines showing that he is from Gum in some manuscripts of Nizami's "Khamsa", Krymsky explains in a way that is far from any scientific thinking.

According to his fictitious conclusion, "of course there are copies of the "Khamsa", which, due to fanatical Sunni intolerance, copy secretaries have tried to refute his autobiographical confession that he came from serious Shia sands."A. Krymsky does not take into account at least the fact

that there is no Shiite spirit in Nizami's work.Nizami is a Sunni, a great cleric who wants to preserve the integrity of Islam [2, 7].

A. Krymsky mainly refers to Amin Ahmad Razi (16th century) and Lutfalibey AzerBegdeli and tries to substantiate their opinion with additional verses found in some manuscripts of “Iqbalname”. Besides, he presents his subjective opinion as the truth. We also know that not only the authors mentioned by A. Krymsky claim that Nizami comes from the province of Gum, the district of Tafrish or Farakhan. Krymsky explains the absence of lines showing that he comes from Gum in some manuscripts of Nizami's "Khamsa" in a way far from any scientific thinking.

A number of foreign scholars who did not like our nation claimed that Sheikh Nizami's father came to Ganja from Gum and that is why it should be underlined that his father was Persian. In this case, Nizami's connection with Akhili is also questioned. Because Ganja was one of the centers of Akhillis and at that time, the carriers of this ideology were Turks. Therefore, it would be appropriate to look at the scientific research and studies conducted by the prominent scholar Khalil Yusifli in this direction:

In fact, there is no serious debate about where Nizami was born and lived. Numerous notes in Nizami's works, as well as information provided by ancient and reliable sources, as well as the conclusions of the distinguished researchers of modern times, show that Nizami Ganjavi was born in a Turkish family in Ganja, lived and died in this city. His tomb is still in Ganja and a magnificent monument stands on his grave. Muhammad Ovfi, the author of the first tazkira in the East, in his tazkira Lubabul-albab, written between 1203 and 1228, begins his discussion about Nizami with these words "Al-Hakim al-Kamil Nizami al-Ganjavi", and notes that "Apart from these Masnavis, they recite less poetry of the great poet. But I heard these poems recited by a great man in Nishapur" [7-8].

Although M. Ovfi did not give detailed information about Nizami's life, he remembered him as a native of Ganja and leaved no room for doubt. Zakariyya Qazvini, who lived and created shortly after him, spoke about Ganja in his geographical work "Asarul-bilad and akhbarul-ibad". While talking about this city he indicates a great poet and erudite Nizami Ganjavi as a citizen of this city, as well as his poems and the "Divan" that many have not seen and a brief description of the poems in the "Divan". It is clear that Z. Qazvini had seen both the poet's poems and "Divan". It is noteworthy that he does not doubt that Nizami is from Ganja.

Hamdullah Mustovfi Qazvini, one of the 14th century historians, does not doubt that Nizami was from Ganja and writes in his own "Tarihe-gozide" that "Nizami Ganjavi was a contemporary of Sultan Togrul ben Arslan Seljuk". Abdurrahman Jami (15th century) writes in his masterpiece "Baharistan": "The late Nizami is from Ganja, his wisdom and virtues are clear and there is no need to comment."

At first glance, it may seem strange to make Nizami's birth date a topic of scientific discussion today. Because it is clear to everyone that Nizami Ganjavi was born in 1141 in Ganja. This fact was established in 1871 by the Hungarian scientist Wilhelm Baxter, who wrote the first research work on Nizami's life and work, and this date has been widely accepted in European countries, as well as in Azerbaijan. However, there are well-known scholars in both Iran and Azerbaijan who do not agree with this date and suggest different dates of birth for the poet. For example, Rustam Aliyev, one of the prominent legal scholars, writes that Nizami was born on August 7-22, 1140. Azadeh Rustamova, who made important contributions to the study of Nizami's legacy, tries to prove that Nizami was born in either 1148 or in 1149 and so on [2, 8].

Barat Zanjani, a well-known scholar of South Azerbaijan and a former professor at Tehran University, claims that Nizami was born in 526 AH (1131-1132), taking into account the opinions of various scholars [9]. B.Zanjani considers only M. Mirbagirzadeh's opinion to be true from these authors and made some corrections to it. He thinks he was born in 526, 1131/32. Given all this chaos and diversity of opinion, we need to clarify the date of Nizami's birth. In this case, the various

facts in the poet's works and all the notes of Nizami, which are likely to clarify this issue, must be taken into account.

Medieval sources do not contain any information about the date of birth of the great poet. Authors who usually lived in the Middle Ages gave the date of the poet's death. It should be noted that there is no common ground between them. For example, a respected commentator such as Dovletshah Samarkand stated the date of his death as 1180, but Taqiaddin Kashani wrote that he died in 1209. This last date is also present in the stamp of the poet's tombstone. Today, however, researchers are still relying on contradictory opinions. This is because various facts in the poet's works are interpreted by scholars in different ways. On the one hand, the passage depicting Nizami's death at the end of the Iqbalnameh, on the other hand, at the end of the same work, the signs that it was presented to the Mosul ruler Izzeddin Masud, who came to power in 1211, confuse scholars. At the end of Iqbalname, after describing the deaths of Alexander and seven Greek scholars, Nizami writes that he joins them after 63 years and six months later [10].

S.Nafisi also notes that Ibn al-Futi confuses Nizami Ganjavi with Nizami-mulk, inspite of hundred years` difference between them. However, he notes the person mentioned above is the one who belongs to Nizami`school exactly, he states him to own the pseudonym Nizami. He mentions Nizami`s two works. Contrary to Ibn al-Futi's opinion, Nizami's pseudonym was not taken from Nizam al-Mulk's nickname. Because the name of the great Nizamul-Mulk was not Abu Ali Hasan. Ibn al-Futi writes clearly: Majdaddin Abu Nasr Ahmad ibn Mahmud ibn Ali Nizami is a poet who memorizes Persian poems, the original of which reaches Nizami Ganjavi that he was Nizamul-Mulk Abu Ali Hasan, from whom he took the nickname Nizami, and he became a poet of sweet word. So it is clear from here that Nizamul-Mulk Abu Ali Hasan himself was one of Nizami`s proceeder. The note from Ibn Futi and his explanation of it is quite interesting. Majdaddin Abu-Nasr Ahmad, about whom Ibn Futi mentioned was still alive in 705 BC, in 1305-1306 AD he was poet and wrote poems under the pseudonym Nizami. He also had panegrics about Sahib Sadaddin who was in the camp. Ibn Futi also uses the following expression about Majdaddin Ahmad: “Memorizer of Persian poems.” This word is sometimes translated as “the protector of Persian poetry.” In our opinion, this is a misconception. According to us, the word hafiz here means a person who knows a lot of Persian poems by heart, memorizes them, and has a strong memory. One of the curious aspects of Ibn Futin's note is that he also mentioned the names of the father and grandfather of Majdaddin Ahmad Nizami, who lived in the second half of the 13th century and the beginning of the 14th century**.** His father's name is Mahmud and, his grandfather's name is Ali. There is a difference of only 100 years between the date of death of Mahmud and Ali Nizami, who was born from the son of this great thinker, Muhammad, and the meeting of Ibn Futi with Majdaddin Ahmad**.** At the same time, as Said Nafisi points out, if we consider that Majdaddin Ahmad was a man who lived mainly in the second half of the 13th century, or at least if we consider that this man was born in about 70-90s of the 13th century, as a result, the rate of his father and grandfather`s relation to the Nizami period is also determined. It would be wrong to think that Majdaddin Ahmad's grandfather, Ali Nizami, had a son other than Muhammad, who is now unknown to us [11].

However, as in the above examples from his poems, he says that in Ganja he is not appreciated, that he is the treasurer of sins, but that he gained fame in other places, and that he needs to escape from thirst in his own land, says that he wants to quit being a hermit and go on a journey and that he has long wanted to be in the service of the Kaaba, and writes that he wants to visit the Kaaba.

In a funeral speech dedicated to Nusrat ad-Din, who came to power after 1191, written much later than this ode, the poet praises the Kaaba in the language of fire and expresses a desire to see this place. However, this does not and cannot give any reason to say that he is from Mecca.

In particular, the fact that the poet praises Iraq and wants to see it does not give any reason to say that Nizami is from Iraq. Nizami did not aspire to Iraq, because this is allegedly his homeland, on the contrary, Nizami aspired to Iraq, because he could not get a decent price in his homeland, in

Ganja, “so that like a treasure that came out of its source, i.e. go beyond the borders of the motherland and get a worthy assessment”, “how silver comes out of the stone and becomes famous” gain fame with its skill and genius, be recognized, get rid of envious people, visit the great cultural center of the East, see, read books that he could not get, meet, talk, study and teach the people he wanted to but couldn't see.

So, once again it must be safely said that Nizami is from Ganja, he was born in Ganja, was born in a prosperous Ganja family, lived and worked in Ganja. Neither the verses added to the composition of Nizami, nor the opinions of the authors of the tazkire, who, on the basis of these verses, claimed that Nizami was from Qum, Tafrish, Farakhan, nor the senseless reasoning of Vahid Dastgirdi are capable of casting doubt on this clear truth [12].

CONCLUSION

The idea that Nizami was originally from the Iraqi part of Iran is more strongly defended by Aliakbar Shahabi, the author of the book "Nezami shaere-das-ansara". A. Shahabi is of the opinion that most Iranian and non-Iranian historians and tazkiras write that Nizami's birthplace is Ganja, one of the cities of Azerbaijan, but those authors also generally remind that Nizami's origin is from the land of pure Iraq (Gum and Tafrish districts). His father moved to Ganja from Iraq.

Right there an example is given from the tazkire "Majmaul-fusakh" by R. Hidayat: "Although Dr. Nizami is a native of Qum, he is known as he is from Ganja." According to A. Shahabi, allegedly G. Darab established that Nizami was born in 1145 AD near the city of Gum and emigrated to Ganja. Allegedly, contrary to the opinion of historians and researchers, Mirza Muhammadali Tarbiyat considered Nizami with an Azerbaijani prejudice an Azerbaijani poet and considered it wrong to consider him from Gum. This strict Persian chauvinist, instead of facing the truth and paying attention to the fact that older and more reliable sources say that Nizami is from Ganja, regards with regret the statement of M. Tarbiyat that Nizami is from Ganja, founded on Zakaria Kazvini and Abdurrashid Bakuvi as fanaticism.

He turns to Abdulnabi Ghazvini, the founder of the tazkir, who consider Nizami to be from Qom, and reminds him of his opinion that Nizami was from Farakhan of Qum. A. Shahabi is of the opinion that all the authors, except for M. Tarbiyat, considered Nizami to be an original Iraqi.

A. Shahabi's defense of V. Dasthirdi's opinion "But there is no doubt that he is from Iraq" is not a prejudice, but the words "Nizami Abu Muhammad Nizamuddin Ilyas bin Yusif bin Zaki Muayyad Ganjavi" by M. Tarbiyat who was the most famous of Iranian poets and the most eloquent among Azerbaijani masters of the word” is the result of prejudice! Strange logic!

A. Shahabi also expresses his attitude to the verses added by later periods, in which it is stated that Nizami is from Qum, and writes: “According to the author of these pages, the phenomenon of a poem with such a historical basis cannot be added on purpose. It is difficult to imagine what benefits and interests the one who made this addition expected. It is possible that the location was confused by the rewriters.

Said Nafisi, a well-known scientist, writer, who has done a remarkable job in the field of collecting and publishing lyrical verses of Nizami, takes the right position and writes: "In any case, it is reliably known that, with the exception of one or two trips (he made a pilgrimage), Nizami spent his entire life in Ganja and its surroundings. For this reason, he is always known as Nizami Ganjavi in Persian literature and is considered one of the poets of Azerbaijan.

On the other hand, I heard that some of the contemporaries even think that there is a descendant of Nizami and say that his son still lives in Tafrish.

The outstanding Azerbaijani scientist Abdurrashid al-Bakuvi in his work “A Brief Description of the Monuments and Miracles of a Powerful Ruler” also ends his article about Ganja with the following words: “The famous poet, sage and doctor Abu Muhammad Nizami are from here. Hehas an amazing "Divan" and beautiful epics called "Khosrov and Shirin", "Leyli and Majnun", "Makhzan

al-Asrar" and "Seven Peykars". Like Zakharia Qazvini, Abdurrashid Bakuvi does not mention the poem Iskendername. Apparently, he repeats the words of the author of "Monuments".

The number of authors who do not doubt that Nizami is from Ganja and who interpret this as an axiom can be increased to the maximum. Let's also take into account that all these authors lived until the 16th century and were closer to the Nizami period. They lived and worked at a time when the works of Nizami had not yet been distorted by the scribes who copied them, and were not supplemented in an inappropriate way.

This situation is well known to specialists who, since the 1930s, have been preparing scientifically critical texts of Nizami's works. People, who make additions to the texts of Nizami's works sometimes make these additions so clumsily and inexperienced that it does not correspond to the logical flow of Nizami's poems, violates it in terms of language, style and thought. It would be a big mistake to overlook this aspect when speaking about the life and thoughts of Nizami.

But, unfortunately, sometimes even more or less influential scholars of science try to raise doubts about the truths stated by authoritative sources and by the poet himself, based on such fake, fictional verses added to the works of Nizami. Such offenses existed in the Middle Ages and still exist.

We have reviewed the records of commentators, historians and geographers who have no doubts that Nizami was a native of Ganja. Let us now turn to the notes of the authors who lived and worked after them and were fed by the erroneous and incorrect opinions of some scientists.

REFERENCES

1. Hasanov, E.L. Nizami Ganjavi 880: heritage of Ganja based on architectural and craftsmanship features of Sebzikar graveyard // International Scientific Journal Theoretical & Applied Science, – 2021, 93 (1), – p. 144-150.
2. Əhmədov, F.M. Gəncənin tarix yaddaşı / F.M.Əhmədov. – Gəncə: Elm, – 2007. – 246 s.
3. Гасанов, Э.Л. Исследование высоких духовных ценностей в трудах Низами Гянджеви, предшественника А.Навои // “Alisher Navoiy va XXI asr” 8 – Uluslararo Konferansı materialları, – Toshkent-Baku, – 2023, – p. 232-238.
4. Hasanov, E.L. Ganja: City of Nizami (Gəncə: Nizami yurdu) / E.L.Hasanov, M.Marjanli – Dubai: IRS Publishing House, – 2019. – 208 s.
6. Yusifli, X.H. Nizami Gəncəvinin şəcərə tarixi / X.H.Yusifli, S.P.Pişnamazzadə, E.L.Həsənov – Gəncə: Elm, – 2021. – 182 s.
7. Muradov, V.H. Orta əsr Azərbaycan şəhərləri / V.H.Muradov. – Bakı: Maarif, – 1983. – 155 s.
8. Hasanov, E.L. Multidisciplinary basis of historical-ethnographic research of craftsmanship traditions in Ganja city / E.L.Hasanov. – Warsaw: – 2018. – 100 p.
9. Hasanov, E.L. Innovative research of national wisdom in works of Nizami Ganjavi // International Scientific Journal Theoretical & Applied Science, – 2022, 105 (1), – p. 475-481.
10. Həsənov, E.L. Gəncədə şəhər mədəniyyətinin inkişafında multikultural dəyərlərin əhəmiyyəti // – Gəncə: Azərbaycan Milli Elmlər Akademiyası Gəncə Bölməsinin “Xəbərlər məcmuəsi”. İctimai və humanitar elmlər seriyası, – 2023, 1 (5), – s. 55-64.
11. Poulmarc’h M., Laneri N., Hasanov E.L. Innovative approach to the research of ethnographic-archaeological heritage in Ganja based on materials of kurgans // International Scientific Journal Theoretical & Applied Science, – 2019, 77 (4), – p. 341-345.
12. Юсифли, Х.Г. Ренессанс и Низами Гянджеви / Х.Г. Юсифли. – Гянджа: Элм, – 2016. – 334 с.

GƏNCƏDƏ İNTİBAH DÖVRÜNÜN TARİXİ-ƏDƏBİ İRSİNİN BƏZİ MƏQAMLARININ TƏDQİQİ

E.L. Həsənov

Tədqiqat işində müxtəlif elmi mənbələr əsasında Gəncədə ilk orta əsrlər dövrünün elm və təhsil mühitinin inkişaf xüsusiyyətləri tədqiq edilmişdir. Bu tarixi dövrdə Gəncəyə mühüm siyasi və mədəni mərkəz kimi müxtəlif ölkələrin tanınmış alimlərinin səfərləri ilə yanaşı, onların tədrisi və elmi fəaliyyəti ilə bağlı mühüm tarixi məlumatlar da öyrənilmişdir. Tədqiqat işində tarixi-etnoqrafik mənbələrə əsaslanaraq Gəncənin elmi, ədəbi-mədəni inkişafının təkcə ölkənin deyil, həm də bütövlükdə İslam dünyasının İntibah dövrünün səciyyəvi xüsusiyyətlərinin dirçəldilməsində, eləcə də ədəbi-mədəni inkişafında əhəmiyyəti müəyyən edilmişdir. Şəhərin çoxəsrlik tarixi-mədəni irsinin tədqiqində ayrı-ayrı əlyazmalarının, arxiv sənədlərinin də xüsusi əhəmiyyəti elmi cəhətdən araşdırılmışdır.

Açar sözlər: *Azərbaycan, mədəniyyət, tolerantlıq, Gəncə, tarixi tədqiqat, İntibah, elm, təhsil*

ИССЛЕДОВАНИЕ НЕКОТОРЫХ ВОПРОСОВ ИСТОРИЧЕСКОЙ ГЕНЕАЛОГИИ В ГЯНДЖЕ ЭПОХИ ВОЗРОЖДЕНИЯ

Э.Л. Гасанов

В научно-исследовательской работе на основе разных научных источников изучаются особенности развития науки и образования в Гяндже эпоху раннего средневековья. Учитывая важность города как общественно-политического, экономического и научно-культурного центра, в исследование были привлечены научные аргументы о том, что наряду с местными учеными в средние века Гянджу посещали известные ученые разных стран, а также важные исторические сведения об их преподавательской и научной деятельности в течение долгих столетий были изучены. В исследовании на основе исторических и этнографических источников определяется значение научного, литературного и культурного развития Гянджи в возрождении характерных особенностей периода Ренессанса не только страны, но и в целом в развитии Исламского мира. Научно исследовано особое значение отдельных рукописей и архивных документов в изучении многовекового историко-культурного наследия города.

Ключевые слова: *Азербайджан, культура, толерантность, Гянджа, историческое исследование, Ренессанс, наука, образование*

UDC: 094
ORCID: 0000-0003-4094-464x (Aghayeva)

MULTICULTURAL VALUES IN THE 19TH CENTURY OTTOMAN EMPIRE

Natavan Galib Aghayeva
The Institute of Oriental Studies after acad. Z.M.Bunyadov of ANAS
E-mail: n.aghaeva@gmail.com
Received: 17.03.2023
Accepted: 25.08.2023

Today in the early 21st century, it is quite challenging to find completely mononational state. Throughout the world history new territorial gains, wars, willing or unwilling (forced) migrations, trade relations, economic and climate conditions changed the ethnic picture of the world not once. United under the rule of one state different cultural groups had to leave together and figure out the written or unwritten rules of peaceful coexistence. The need of respect for cultural, religious, social differences in the end gave a shape to the idea of the concept of multiculturalism. Although "the clear trend across western democracies towards the increased recognition and accommodation of diversity through a range of multiculturalism policies and minority rights" [15, p. 97] can be observed from 1970s to mid-1990s, such policies could be found in 19th century societies either. The present article deals with multicultural values existed in the Ottoman society formed by the 19th century in inhabited by more than 22 different ethnic groups the Ottoman Empire.

Keywords: *Ottoman, society, multicultural, 19th century, nation.*
DOI: 10.59849/2409-4838.2023.3.119

INTRODUCTION

Today in the early 21st century, it is quite challenging to find completely mononational state. Throughout the world history new territorial gains, wars, willing or unwilling (forced) migrations, trade relations, economic and climate conditions changed the ethnic picture of the world not once. United under the rule of one state different cultural groups had to leave together and figure out the written or unwritten rules of peaceful coexistence. The need of respect for cultural, religious, social differences in the end gave a shape to the idea of the concept of multiculturalism.

In some literature, multiculturalism is given a definition as a consisting part of political ideology, aimed to work out the political and legislative conditions of tolerant and harmonic coexistence of representatives of distinct ethnic groups, which carry their own cultural, economic, social mentality, without disturbing a stability of their traditional life style. Political side of this question mainly deals with granting of certain rights (individual or collective) to these groups on the grounds of the principles those cultures have, as well as with equal recognition of various cultures avoiding privileging any dominant communities. According to multicultural principles, a state has to "remain neutral between groups and ensure that basic liberal rights are fairly and consistently applied across cultural differences" [12, p. 10169]. As a reference for the main principals of multiculturalism, which include state's acceptance and valuing of cultural diversity, fair access to social resources and elimination of obstacles which prevent marginal cultural groups from socializing, encouraging their participation in all aspects of state's life, support of the reproduction and development of different cultures, etc., the ideologists and researchers of multiculturalism use the Universal Declaration of Human Rights (1948), the International Covenant on Civil and Political Rights (ICCPR, 1966), the UN Declaration on the Elimination of All Forms of Intolerance and of Discrimination Based on Religion or Belief (1981), the *Declaration on the Rights of Persons Belonging to National or Ethnic, Religious and Linguistic Minorities (1992), t*he Universal

Declaration on Cultural Diversity (2001) [9] and a list of other local and international documents which were designed to protect the rights each human has inherent. Thus, emerged as an opposition to the "melting pot" theory the concept of multiculturalism was put forward to support the "salad bowl" or the "glorious mosaic" [10, p. 10] image of multiethnic society, where an acknowledgement of diversity lets the different cultures maintain their distinctiveness.

Although "the clear trend across western democracies towards the increased recognition and accommodation of diversity through a range of multiculturalism policies and minority rights" [15, p. 97] can be observed from 1970s to mid-1990s, such policies could be found in 19th century societies either. The present article deals with multicultural values existed in the Ottoman society in the 19th century.

MAIN PART

Multicultural values in the 19th century ottoman society

Canadian political philosopher, the author of numerous works on multiculturalism, Will Kymlichka in his work "The rise and fall of multiculturalism?" puts forward an idea, stating that "multiculturalism is as old as humanity: different cultures have always found ways of co-existing and respect for diversity was a familiar feature of many empires throughout history" [6, p. 5]. The Ottoman Empire, which existed more than 600 years (1299-1922), was covering a vast territory inhabited by more than 22 distinct ethnic groups. To control this huge cultural diversity an efficient system was needed. As known, internal affairs in the Empire were regulated by the "Ottoman Law" (Osmanlı kanunu), which rested on two pillars - "Shar-i" and "Orf" (Şer-i ve Örf). The Shar-i consisted of "some basic principles of politics applied within the empire that did not change in general. The source of its unchanging politics and the legal foundation on which it was based were the provisions brought by Islam" [2, p. 9]. The Ottoman state regulated the social, economic and administrative aspects of the state life in accordance with these provisions established through the Holy book (Quran) and the sunnah. The policy of the state, which may change or support a diversity leaned upon the customs (örf). "The source of the custom based laws were national culture, traditions, rituals. Although some customary practices could go against the generally accepted by shari'a rules, however, the Ottoman ulema always used to know how to make the customary practices that did not comply with the shari'a more reconcilable" [2, p. 9]. Thus, being quite liberal in its approach to a different cultures and taking these principles as a base for the further actions, the Empire designed a specific control system called "millet system".

"Nation system" of the Ottoman Empire was a "political organization which granted to the non-Muslims the right to organize into communities possessing certain delegated powers under their own ecclesiastical heads" [13, p. 212]. It is known, that before the late 19th century the word "millet" - "nation" mainly referred to religious communities. During the Ottoman military campaigns non-Muslim population surrendered without armed resistance was guaranteed its live, property and the practice of their religion if accept the political superiority of Muslim Turks. Members of such communities who went under the Ottoman dominion were given a name "dhimmi" ("zimmi") - "protected people" [16, p. 190]. When Sultan Mehmet II the Conqueror captured Constantinople, present Istanbul (1453), he ordered the Greeks to hold the election of the patriarch as a token of the freedom they were given to continue practice their religion. The chosen patriarch would later receive not only church leadership responsibilities, but also a list of political duties to rule the community. Given a title of "Millet bashy" ("millet başı") - "Head of millet", he would also be engaged in the reforms of millet's internal governance, educational, court, tax, etc. systems, and from that time on he would be considered as one of the Empire's bureaucrats. Bulgarian, Serbian Churches, Antioch (Antakya) and Alexandria (Iskenderiye) Patriarchate were next placed under the jurisdiction of the Greek Orthodox Patriarchate. The similar administrative status was given also to the Armenian Patriarchate. This religious institution received the right to

control “the rest” of the Christian population of the Empire, which did not belong to the Greek Orthodox Patriarchate. Assyrian, Ethiopian, Coptic Churches, gypsies, Syrian and Egyptian monophysits, Bosnian bogomils were under its jurisdiction. The head of Jewish community in his turn was given a title of “Hahambaşı” and the same rights and responsibilities as his Christian peers and was responsible for the completely Jewish community within the Ottoman boarders [1]. Thus, within the Ottoman lands there considered four main “millets” - the Turks, the Greek Orthodox, Armenian and Jewish communities. Apropos for above mentioned it should be noted, that religious affiliation as a criteria for distinction existed in many world societies of those days. As an example, an American sociologist Nathan Glazer in his work “We are all Multiculturalists now” in terms of American society said, that “in the 1840s, 1850s, 1890s, and after the First World War in the days when the Ku Klux Klan boomed, the chief issues were whether Catholic children would attend public schools of a Protestant cast, whether children should be taught in German public schools” etc. [10, p. 9]. In times, when ethnicity, race, nationality, nation was not yet turned into an object of social and political segregation, religious affiliation was the only criteria for a determination of “others”. Nowadays, when all traits for further distinction were gathered under the one term “cultural diversity” the theorists of the ideology of multiculturalism offer various approaches to this question.

Australian political theorist Chandran Kukathas put forward four main models of responses of a state to the problem of cultural diversity: “isolationism” takes place when a society tries “to restrict membership by forbidding entry by outsiders, and also to enforce conformity within their boundaries by denying those who are different the opportunity to integrate; “interventionist” societies “want to see other people conform to their way of life but are unwilling to allow them to become a part of that society”; “assimilationist” societies tolerate or permit the admission of outsiders without seeking forcibly to enforce membership, but nonetheless require all members of society to integrate fully into the ways of the dominant culture; and the fourth type, “liberal multicultural” societies, in general, admit outsiders without either encouraging or deterring them from seeking membership and tolerate their ways whether they seek to integrate into the new society or elect to hold on to their separate traditions and beliefs [14]. Numerous travel accounts, reports, memoirs by representatives of various Western cultures, who spent time in the Ottoman Empire show that the fourth type of society can be easily attributed to the latter.

The work “Constantinople Essays” by the Russian orientalist, diplomat and traveller Constantine Bazili in the chapter dedicated to “four people” living in the Ottoman Empire gives a comprehensive account on the way these four millets co-existed in 1830s and the way the state reacted on their existence within the borders. He writes that for several centuries four people have been living in one city, but instead of drawing closer to each other, on the contrary, they only move away. They almost never live in the same quarter, have no relationship other than simple trades, and are governed separately, each nation by its own laws, its own justice. “The internal government of these four people resembles of four patriarchal republics, between which there is nothing in common, except for the storm of power hanging over them. They are completely alien to the fate of the Ottoman Empire; their happiness and grief will never be shared” [3, p. 145]. The Greeks traditionally lived in Phanar (Fener) neighbourhood, where they had their own churches, colleges, hospitals and a printing house, where they printed their own textbooks and prayer books: “Here they even printed an Encyclopedic dictionary of Greek and Byzantine literature, first two volumes of which were more than 3000 pages” [3, p. 156]. It was the biggest dictionary in whole Europe of those times. The most eminent institution which survived till our days was the Phanar Greek Orthodox College or Phanar Roman Orthodox Lyceum (Özel Fener Rum Lisesi) located in Balat, known in Greek as the Great School of the Nation and Patriarchal Academy of Constantinople, established in 1454 by the Patriarch Gennadius Scholarius, the first patriarch selected by Christian

population of Constantinople at the direction of Sultan Mehmet II the Conqueror. The curriculum of these schools had only Greek subjects, such as language, literature, philosophy, religion etc.

At this point, it should be noted that the preservation of a national language played a great role in the multicultural policy of the Ottoman Empire. After the conquest of Constantinople Sultan Mehmet II the Conqueror allowed the local population of Pera and Galata to leave the city peacefully, but most of the merchants soon returned with a guarantee of complete surrender, and later many Genoese inhabitants of Pera accepted Turkish citizenship [11, p. 274]. The origin of the inhabitants of Pera was evidenced, first of all, by "the native language that they preserved" [17, p. 2] and which was spoken until the second half of the 19th century. This knowledge of languages will later allow the "Perotes" to hold such an important public position as dragomans - court translators. The multicultural character of Galata and Pera was described by various travelers in their memoirs or travel notes. For example, in 1833, in his "Sketches on Turkey in 1831-1832", the American zoologist James De Kay described these places as follows: "Galata is almost completely occupied by Christians. It is here that all the shops and offices of merchants and artisans are gathered, and all foreign commercial centers are also concentrated here. After all, here they are exempt from taxes and are content with other important privileges" [8, p. 76].

The Armenians mainly inhabited the part of the city called Yedikule - "Seven towers", however they could be found scattered all over the Bosporus coastline: "They do not have past and historical memory, or at least hardly engaged with this issue; they are scattered all over the earth and did not save a devout memory about a common motherland. For them love for the motherland, ambitions and fame are a chimera; all their dreams and wishes aim for gold and all profitable trades are opened for them; as eastern Englishmen they took over all internal trade in Turkey and seem to lock in chests like in tombs all treasures" [3, p. 157]. The commercial success of the Armenians led to appearance of the so-called amira class in Constantinople - the elite group of wealthy merchants and financers of this millet. Due to their material wealth and religious affiliation, they had an open access to the most modern educative facilities of both the Empire and Europe. For their services some families, for example, were awarded management of the imperial mint. The Balyans held the post of an architect to the sultan from 1750 to the end of the nineteenth century and were responsible for the construction of a number of imperial residences and palaces. With their financial assistance and efforts the Armenian community of Constantinople was easily receiving licenses to establish educational centers, charitable institutions, hospitals, churches etc. The Ottoman government granted them all possible facilities to live their religious, traditional and daily life the way they are told by their own head of millet. The granted level of self-regulation of the millet was so high that it led to a draft of a so-called constitution (Nizamnâme-i Millet-i Ermeniyân) for the Armenian millet. The document was adopted by an assembly on 24 May 1860, came into force three years later. The 150 regulations written down in that document contained the rights and responsibilities according to which this millet throughout the empire reorganized the life of its own communities pursuing national traditions all by itself without state interference.

The Jews in the Ottoman Empire lived mainly in the district called Haskoy (Hasköy) in the Goldern Horn: "It was like a whole big city with 70.000 of population, which could be considered the world capital of Israel. The sons of Israel, not finding refuge in Catholic Europe, resorted to the hospitality of the East and found patronage and religious tolerance in the kingdom of the Koran. They are now more satisfied with their life here than in many European cities, and enjoy the same rights with all the millets - subjects of the Turks" [3, p. 173, 176, 177]. As other millets, they were engaged in trade, had their own small businesses, openly practiced religion, were given rights to build own schools and support traditions.

Professor of law Seyra Benhabib in her work "The Claims of culture" distinguishes "strong" or "mosaic" multiculturalism, when groups of people and cultures are clearly divided and those identifiable communities that exist with each other are like pieces of a puzzle, maintaining rigid

boundaries [4, p. 9]. Considering the way these four millets lived according to accounts the western travellers leaved on their stay in the Ottoman Empire it is somewhat possible to apply this definition to a type of multiculturalism existed within the Empire boundaries. Four millets lived mainly in certain districts, did not have any intentions to integrate into common society and did not thrive for any interactions except those for business, trade or state issues, freely practiced their religion and celebrated only their own religious holidays, however, creating one whole state population, indeed made an image of a piece of a puzzle with rigid edges but when put altogether creates a complete picture. Thus, the "millet system" turned out to be an effective implement to deal with main distinct cultural groups of the state, which allowed them co-exist peacefully for a long time, up to 19th century. New philosophic, political, social ideas spread all over the world after the French Revolution (1789), as well as a new economic reality appeared after the Industrial Revolution (late 18th century) led to certain changes also in political demands of society.

The 19th century is marked by a series of socio-political reforms, which led the different world societies along a new modern way of development. In those times, such concepts as liberty, equality, human rights etc. began to define the direction of a new political course in the western governments. In the history of non-European countries, this period of reforms was called a "period of modernization", "Europeanization" or "Westernization". Started as the implementation of certain reforms, the main purpose of which at first was to improve country's economic and military power, this reform activity went deeper and affected more areas, what would soon lead to the restructuring of the whole traditional centuries-old state system. For example, the reforms of Muhammad Ali (20s of the XIX century) in Egypt, the reforms of Tagi Khan (1848-1851) in Iran, the Meiji Restoration (1868- 1889) in Japan, etc., starting as military-economic reforms after the palace administration realized the weakness of the country in the face of the threat of the military-technical development of the West, soon spread to the social sphere and led to the emergence of a new stratum - the intelligence. This stratum would later be the initiator of the introduction of a western-style constitution in the country, the change of the regime of absolute monarchy to a constitutional one, and the convocation of parliament. The Tanzimat reforms (1839-1876) in the Ottoman Empire could also be added to this list. A new modern Ottoman bureaucracy appeared after those reforms were a stratum who took the question of multicultural policy to a new level. As Hoffman-Novotny writes, a "multiculturalism implies the pathos of striving for equality in the existence of different cultures" [18, p.39]. The Edict of Gulhane (Gülhane Hatt-ı Şerif) which crowned the Tanzimat reforms aimed exactly to provide an absolute "equality" between millets. This document proclaimed in 1839 consisted of description of equal rights for all millets to be equally protected in terms of life, property, dignity, to be treated equally fairly in terms of taxes and recruitment of soldiers. It says: "All imperial privileges apply to all my subjects without distinction of religion or sect; they will all without exception, exercise these rights" [5, p. 203-207].

CONCLUSION

Thus, although the concept of multiculturalism appeared in the mid-20th century, the values of peaceful coexistence were cherished even long before. To describe the typical middle ages societies the geographer J.S.Furnivall suggested the term "plural society": "The term plural society seems to have been coined by Dr.J.S.Furnivall to describe a society comprising two or more elements or social orders which live side by side within the same political unit yet without mingling" [7, p. 55]. In this sort of society each group practices its own religion, follows own culture and language, lives by its own ideas and ways. As individuals, representatives of these societies meet, but only in the marketplace in order to buy or sell something. The plural society consists of different sections of the community living side by side within the same political unit. Later, with the development of social relations, with the change of political map and appearance of new concepts in law and international relations, researchers who study complex societies used to face the issues pertaining to cultural

rights and politicization of diversity. In this case, the problem of multiculturalism and cultural diversity was put forward; new definitions and values were developed.

The history of the Ottoman Empire shows that all these processes are relevant to the historical development of its society either. The Empire was one of those old states who embraced diversity of four millets living on its territory and provided each of them with certain rights, which with the course of the time improved. Four main millets lived under the "millet system" for almost six centuries, openly practiced their religion, traditions and customs, were engaged in trade and many other businesses and prosper each in its own way. With the Tanzimat reforms, they were recognized as equal in terms of certain new political, social and economic conditions. All these proves that values of peaceful coexistence of different cultural groups as a further defined value of multiculturalist policy of modern democratic states can also be traces back then in the Ottoman society.

REFERENCES

1. Güler, A. Osmanlı'dan Cümhuriyete Azınlıklar / A.Güler. – Ankara: Tamga Yayıncılık, – 2000. – 371 s.
2. Kodaman, B. Sultan II Abdülhamid Devri Doğu Anadolu Politikası / B.Kodaman. – Ankara: Ankara Üniversitesi Basım Evi, – 1987. – 156 s.
3. Базили, К. Очерки Константинополя / К.Базили. – СПб.: тип. Н. Греча, –1835. – 285 с.
4. Бенхабиб, С. Притязания культуры / С.Бенхабиб. – Москва: «Логос», – 2003. – 350 с.
5. Убичини, А. Современное состояние Отоманской империи / А.Убичини. – СПб.: тип. О.И.Бакста, – 1877. – 240 с.
6. Atasoy, Ö. To what extent can the arrangements governing relations between the state and the communities of Islam, Christianity and Judaism under the Ottoman Empire be considered a type of early multiculturalism / Ö.Atasoy. – Istanbul: 2015. – 20 p.
7. Cowley, Ph. The Plural Society // – Oxford: Parliamentary Affairs, – 1952, 6 (1), – p. 55-77.
8. De Kay, J.E. Sketches of Turkey in 1831-1832 by an American / J.E.De Kay. – New-York: J.&J. Harper, – 1833. – 527 p.
9. https://www.un.org/ru/documents/decl_conv/decl1980.shtml
10. Glazer, N. We are all Multiculturalists now / N.Glazer. – London: Harvard University Press, – 2003. – 179 p.
11. Inalcık, H. An Economic and Social History of the Ottoman Empire. / H.Inalcık, D. Quataert – Cambridge: Cambridge University Press, – 1997. – 409 p.
12. Ivison, D. Multiculturalism // – Stanford: International Encyclopedia of the Social & Behavioral Sciences, – 2001. – p. 10169-10175.
13. Jaber, K. The millet system in the nineteenth-century Ottoman Empire // – Connecticut: The Muslim World, – 1967, 57 (3), – p. 212-223.
14. https://econfaculty.gmu.edu/pboettke/workshop/fall04/theoretical_foundations.pdf
15. Kymlicka, W. The rise and fall of multiculturalism? New debates on inclusion and accommodation in diverse societies // – Paris: International Social Science Journal, – 2010. – p. 97-112.
16. Somel, S.A. Historical Dictionary of the Ottoman Empire / S.A.Somel. – Maryland: The Scarecrow Press, Inc., – 2003. – 399 p.
17. Walsh, R. Constantinople and the scenery of the Seven Churches of Asia Minor / R.Walsh. – London: Fisher, Son, – 1840. – 100 p.
18. Hoffman-Novotny, H. Soziologicsh Aspekte der Multikulturalitaet / H.Hoffman-Novotny. – Osnabrueck: Migration. Ethizitaet. Konflikt, - 1996. - 183 p.

XIX ƏSR OSMANLI İMPERIYASINDA MULTICULTURAL DƏYƏRLƏR

N.Q. Ağayeva

Bu gün XXI əsrin əvvəllərində dünyada tamamilə monomilli dövlət tapmaq olduqca çətindir. Dünya tarixi boyu yeni ərazi uğrunda savaşlar, müharibələr, könüllü və ya məcburi köçlər, ticarət əlaqələri, iqtisadi və iqlim şəraiti dünyanın etnik mənzərəsini bir neçə dəfə artıq kökündən dəyişdirmişdir. Bir dövlətin hakimiyyəti altında birləşən müxtəlif mədəniyyət qrupları bir araya gəlib dinc yanaşı yaşamanın yazılı və ya yazılmamış qaydalarını müəyyənləşdirməli olmuşdurlar. Mədəni, dini, sosial fərqliliklərə hörmətin zərurəti sonda multikulturalizm anlayışı ideyasını formalaşdırmışdı. “Bir sıra multikulturalizm siyasəti və azlıqların hüquqları vasitəsilə müxtəlifliyin daha çox tanınması istiqamətində qərb demokratiyalarında aydın tendensiya” [15, p. 97] 1970-ci illərdən 1990-cı illərin ortalarına qədər müşahidə olunsa da, bu cür siyasətlərə XIX əsr cəmiyyətlərində də rast gəlmək olar. Təqdim olunan məqalə Osmanlı İmperiyasında 22-dən çox müxtəlif etnik qrupların yaşadığı XIX əsrdə formalaşmış Osmanlı cəmiyyətində mövcud olan multikultural dəyərlərdən bəhs edir.

Açar sözlər: *Osmanlı, cəmiyyət, multikultural, XIX əsr, millət*

МУЛЬТИКУЛЬТУРАЛЬНЫЕ ЦЕННОСТИ В ОСМАНСКОМ ОБЩЕСТВЕ XIX ВЕКА

Н.Г. Агаева

Сегодня, в начале XXI века, довольно сложно найти полностью мононациональное государство. На протяжении мировой истории новые территориальные приобретения, войны, добровольные или невольные (вынужденные) миграции, торговые отношения, экономические и климатические условия не раз меняли этническую картину мира. Объединенные под властью одного государства разные культурные группы были вынуждены вырабатывать писаные и неписаные правила мирного сосуществования. И эта необходимость уважения культурных, религиозных, социальных традиций друг друга в конечном итоге сформировала идею концепции мультикультурализма. Хотя «четкую тенденцию в западных демократиях к более широкому признанию культурного разнообразия посредством ряда политик мультикультурализма и прав меньшинств» [15, p. 97] можно наблюдать с 1970-х до середины 1990-х годов, подобная политика встречается и в обществах XIX века. В настоящей статье рассматриваются мультикультурные ценности, существовавшие в османском обществе, сформировавшемся к XIX веку в населенной более чем 22 различными этническими группами Османской империи.

Ключевые слова: *Османское, общество, мультикультурализм, XIX век, миллет*

UDC: 398
ORCID: 0000-0002-5496-744X (Garayev)
ORCID: 0000-0002-5088-3302 (Huseynova)

THE SMALL RUTUL PEOPLE ARE PART OF A SINGLE AZERBAIJANI FAMILY

Elvin Mahir Garayev, Sevinj Sabir Huseynova
Sheki Regional Scientific Center of ANAS
E-mail: sevinc-bdu89@mail.ru
Received: 06.02.2023
Accepted: 03.09.2023

Ethnic group is a classification by other people of a particular group of individuals, usually based on similarities or similarities in language, ancestry, history, society, culture, nationality, or social behavior. The concept of ethnic group is often used for nationality, ethnic nationality, and the distinction of one group of people from others on a national basis. Ethnic group – ethno-social education, special ethnic, has similar ethno-psychological, ethno-cultural, linguistic and religious characteristics. Its understanding is interpreted as "national minority" in political-legal terms. In international legal acts and UN Conventions, "national minority" and "ethnic minority" (group) are often used as adequate terms. Ethnic groups arise and develop in ethnic territory. Ethnic territory means a province where a certain people are located. This area is one of the important features that distinguish it from other nations. Ethnic groups Tats, Talish, languages of the Kurds belong to the Iranian branch of the European language family. The Caucasian-speaking peoples are the Lezgis, Avars, Sakhurs, Udins, Budugs, Grizs, Khinaliks, and Elghoys, who mainly settled in the northeastern and northwestern regions of Azerbaijan. The article provides information about the history of the Rutuls, who are representatives of a small number of peoples living in friendly and fraternal conditions on the territory of Azerbaijan, and samples of Rutul folklore and ethnography, which are part of the Rutul culture, were collected and included in the research. Along with the scientific works written in this direction, observation, interview and material collection methods were used in the research work.

Keywords: *Few peoples, customs, cultures, traditions, abay, dawat.*
DOI: 10.59849/2409-4838.2023.3.126

INTRODUCTION

Geographically, modern Azerbaijan, located on the border of the European and Asian continents, was established at the intersection of various civilizations: Achaemenid-Sasanian, Roman-Byzantine, Scythian-Khazar, Turkic-Oghuz cultures. Its location in favorable geographical conditions and rich nature have made this area a large settlement since ancient times. Both in ancient and modern times, Azerbaijan has been engraved in the memory of history as a nation distinguished by its high tolerance. This is the homeland of Zoroastrianism, the first cradle of Christianity in the Caucasus, the place where Islam is widely spread, the area where different ethnic groups live in peace, the land where colorful cultures and folklores flourish by benefiting from each other. Historical sources show that the ethnic composition of Azerbaijan is constantly expanding. Today, Azerbaijan stands out for its ethnic diversity. Along with Azerbaijani Turks, there are Rutuls, Lezgis, Avars, Tats, Talyshs, Mountain Jews, Kurds, Molokans, Ingiloi, Sakhurs, Khinaligs, Budugs, Grizs, Udins, etc. Ethnic groups live in unity and equality. Each ethnic group is part of the all-Azerbaijani culture, and each ethnic group has preserved elements of its own culture. Thus, the unique traditions, crafts, cuisine and various ceremonies of each ethnic group are among the main factors that serve to further enrich the culture of Azerbaijan. Dagestan, including Rutul, one of its territorial units, has been

and continues to be an interesting research place for travelers, historians, and scientists since ancient times. As a rule, in the center of interests is the history, etymology, ethnography, socio-economic conditions, economy of the mentioned region, as well as the research of the languages of the individual people settled in the area. Historically and today, researchers have been interested in the lifestyle and culture of the ethnic peoples living in the territory of Azerbaijan. One of these peoples is Rutul. The history of Rutuls is related to Caucasian Albania. In the VI-VII centuries, they were included in Lezgan. Rutul was one of the large political associations that existed in the territory of South Dagestan in the XIII-XV centuries. In the 15th-16th centuries, the village of Khnov in Rutul grew stronger and created its own special cavalry unit. Gazigumukh Shamkhali reported this to the Russian tsar. The inscriptions of those times found in Khnov confirm this fact. As shown in the book "Rutuls in the past and now" published in 1962 by L. I. Lavrov, a prominent Caucasian scientist, in the 15th century Rutul was a large feudal institution and played an important role in the political life of Dagestan. Over the centuries, Khazars, Mongols, Turks, and Persians attacked Rutul, but the representatives of this brave nation resisted them heroically. The fact that Nadir Shah's army besieged Rutul in 1741, but could not take it, gives a clear idea of how the Rutuls are a warlike people.

It occurs in the book "History of Abu Muslim" under the name of "Rutul". According to what is said there, some of the grandsons of Abu Muslim are settling in Rutul, Khnov and Shinaz. From the same source, we read that during the war with the Khazars, the ruler of Akht, Dervishal, "calls for the help of the brave warriors of Rutul, Jenik and Rufuk" [13]. According to LI Lavrov, a Sufi temple existed in Rutul in the 12th century. Arabic inscriptions, according to the scientist, indicate that Islam was strengthened among the Rutuls during that period. He calls the upper bank of the Samur River "the richest area in the Caucasus where Kufic writings are widespread [6].

The first written information about the places where the Rutuls lived can be found in the works of medieval authors. The 13th century Arab cosmographer Zakariyya al-Qazvini writes about the Rutul village of Shinaz: "Shinaz is a small town in the land of the Lezgis, it is located on the breast of a big mountain. The way there goes through the peak. They grow a variety of grain called "sul" and mountain apples. Residents are kind and attentive to guests. They are engaged in the production of weapons and armor" [7].

The Rutuls follow the Shafi sect of the artificial sect of Islam. As shown in the sources, the Rutuls were the first to accept Islam in Dagestan. Of the CaucasusThe inscription on the tomb of Sheikh Muhammad ibn Asad ibn Mughal, who was buried in Khnov in 675, which is considered a monument of early Islamic culture, as well as other epigraphic inscriptions from the XI-XIII centuries discovered in Dagestan, confirm this idea [13].

At the beginning of the 19th century, the military intervention of the Russian Empire in the Caucasus began. In 1812, Rutul was annexed to Russia. In 1838, under the leadership of Agha Bey al-Rutuli, an uprising against the Russians broke out. In 1839, Rutul district was incorporated into Ilusu sultanate. In 1844, when Daniyal Bey went to the side of Sheikh Shamil, the sultanate was abolished. When the rebellion was suppressed, the Rutul free society and the Ilusu sultanate came under the control of the Tsar-Balakan military district created by the Russian Empire. The district is divided into three districts: Rutul, Ilisu and Ingiloy. Each of them requires a deputy from the head of the district [13].

Families of Dagestanis, including Rutuls, who took an active part in the Caucasus war under the leadership of Sheikh Shamil, were exiled from Dagestan after the fall of the movement. They immigrate to a number of Eastern countries [13].

In the Mountainous Republic established in 1917, the Arabic language acquires the status of the state language, classes are held in this language in schools. When the Dagestan MSSR was established in 1921, the Rutuls, like a number of peoples, opposed the Soviet government. In May 1930, an anti-Soviet uprising broke out in Khnov and surrounded the surrounding villages. But the rebellion is brutally suppressed [13].

In 1925, when the anti-Islam campaign started in Dagestan, it was accompanied by the closing of schools, the banning of the Arabic language, and the destruction of local imams. That policy continued in the form of repressions in the 30s. Rutul intellectuals still feel its bitter consequences in their fate [14].

The ethnonym "Rutul" is related to the name of the district of the same name in Dagestan. Its origin is unknown. In general, this word appeared late, and the rutuls like it gave themselves names such as mukhads, shinaz, mukhrek, borrows, and khnovs. It is interesting that the Rutuls call their village МЫХІАІД, and themselves Мыхіабыг or Мыхіад [15].

According to the 1989 census, 25,397 ethnic Rutul people lived in the USSR. Representatives of this people live in Luchek, Shinaz, Ikhrek, Mukhrek, Amsar, Kina Vrush, Cilikhur, Gala, Pilek, Fartma, Aran villages located on the banks of the Samur River in Rutul district, Borch of Rutul district on the banks of Akhitchay, and Khnov of Akhtyi district.they live in their villages. They also settled in the villages of Rybalka of Kizlyar district and Novy Borch of Babayurd district in Northern Dagestan [15]. In Azerbaijan, the Rutuls live mainly in the villages of Shin, Shorsu, Gaynar, Dashuz, Goybulag, Kuderlü, Aydinbulag, Inche, Orta Zayzid, Baltali, Bash Goynuk, and Ashaghi Goynuk of Sheki region. There are Mukhad, Shinaz, Mukhrak, Ikhrak, Bortug and Khnov dialects of the Rutul language [16]. Until the 40s of the 20th century, the Rutul lived a nomadic life, engaged in cattle breeding. Another reason why the population leads a nomadic life is the unfavorable geographical position of Dagestan. The unfavorable geographical position of the villages of Borch and Khnov, where the Rutuls lived (Figure 1), made communication with other regions difficult. Therefore, the Rutuls were historically forced to communicate with Azerbaijan. That is why the population migrated to the grasslands of Dagestan (Rutul region) in the summer, and to Saatli, Salyan, Sabirabad, Kurdamir, Sheki and Shekinin Shorsu, Dashuz, Sarija, Acinohur areas of Azerbaijan in the winter [13].

Fig. 1. Rutul elders

Farmers engaged in migratory livestock farming were divided into two groups: The first group of farmers were farmers who migrated as a family. They took all their family members with them. The second group of farmers kept their families at home, bought and sent all the food items needed by the family from the city of Sheki, and they themselves were engaged in cattle breeding in Azerbaijan. Both groups of farmers were in Azerbaijan for nine months of the year, and in Dagestan for the remaining three months. One of the ties established by the Rutuls between Azerbaijan and Dagestan was kinship ties. Historically, relations between Azerbaijan and Dagestan have existed and these relations continue even now. The unfavorable geographical location of Rutul region, especially the villages of Abaorch and Khnov, caused the problem of food shortage for them. That's why they took the food they needed from Azerbaijan (Sheki). They used horses to carry 5-6 months of food supply and provide their own food supply. The Rutuls acquired these foodstuffs both with money and by exchanging wool, cheese, meat, and dairy products. They used Shin Gorge and Salavat Pass as the main transportation route. The period of transition from the nomadic lifestyle of the Rutuls to the sedentary lifestyle has left deep traces in the memory of the older generation. The li-

ving carrier of the traditions, folklore, way of life and household of each nation is the older generation of that nation. It lives in their memories and actions and is passed down to the present generations. These traditions are still remembered today [13].

Marriage ceremonies in Rutuls – The first stage of marriage ceremonies in Rutuls is girl approval [17]. On the eve of the spring holiday, every generation or every neighborhood would gather together in rutuls and perform various ceremonial rites on the occasion of the arrival of spring. At this time, young people would find an opportunity to like a girl, open their hearts, build a swing and have fun. Rutuls would call it "shadvaldi" [16]. In general, the tradition of swinging with a swing was characteristic not only of the Rutuls, but also of the peoples of Central Asia. In the past, wedding invitations in rutuls were different. Rutuls used to say "come with your spoon" (turukhhan dık`a) when inviting to a wedding. It was also a form of invitation to eat. The Rutuls call the wedding "Davat" [16]. In the village of Shin, where the Rutuls live, when the boys approach the girl's house, one of the bride's relatives hangs onions on a long tree. One of those who came to take away the bride had to aim and shoot her. One of the interesting customs was that the groom shot with a rifle at his wedding. The bridegroom was not in his own house (on the day of the wedding) but sat either in a neighbor's house or a close relative's house. When the boy comes to take the bride from his house, the girl closes the door and there is a ceremony called "bakhri". The duty of "Jilovdar" is silver decorated with a red ribbon from the girl's houseis to sell the bowl to the boy's house. The groom's "right or left female" buys it from the boy's house. Three days after bringing the bride, the "bulakha ek`iruraır" (taking out into the water) ceremony is held. At this time, those who take the bride to the water distribute halva and other sweets as sweets to those on the way [16].

In Rutul, marriage with relatives is not allowed. In other words, there is no marriage between uncles, cousins, aunts, cousins, great-aunts, aunts, great-great-grandsons, and great-great-great-great-great-great-great-great-great-granddaughters. From this it can be concluded that Rutuls prefer exogamous marriages, i.e. marrying from a different generation, rather than marriage based on blood kinship. In the 19th and 20th centuries, the beshikkertma marriage rule existed among the Avars and Lezgis, as well as among the Rutuls. During the cutting of the umbilical cords of newborn babies, the mullah recites a prayer and then declares that the babies belong to each other [16]. The Rutuls have preserved this uniqueness in their wedding customs as well as many of their customs and traditions. The scene with the participation of the Khan, the Vizier and the Executioner is also fashionable in modern Rutul weddings. This scene takes place on the day after the boy's wedding. In addition to bringing color to the wedding, this custom also has educational significance. Elders who have participated in the weddings of the village for many years also remember the past customs. They talk about the difference between present and past weddings. One of the interesting aspects of Rutul weddings is that they lasted for three days. There was a wedding for three days and three nights. At present, in the Novy Borch village of Babayurd district of Dagestan, where the Rutuls live, the bride is not taken directly to the boy's house during the wedding ceremony. On the first day, the bride is taken to the house of one of the boy's relatives, and after a day, they are taken back to the boy's house [16]. One of the peculiarities of Rutul is that they have their own language. The language of this people belongs to the group of Caucasian-speaking peoples. The Rutul language has four dialects with mainly lexical differences. Its lexicon contains many words of Arabic, Persian, especially Azerbaijani and Russian origin. Rutul poets who wrote and created in their own language created a number of examples of literature related to migration life, settlement and later construction. Despite the absence of the Rutul alphabet, this language has been preserved in the works of poets and writers and passed down
to generations. In their poems and songs, the Rutuls remind their way of life, some of their history, and some of their ancestral homes (Figure 2).

Fig. 2. Abay dance group

Almost the sourceThe folklore of this people, originating from Dagestan rutuls, continues in the village of Shorsu. The Rutuls keep alive and develop their folklore samples thoroughly. Along with the created examples of poetry and dance group, Rutul folklore also lives in the performances of "ABAY" dance ensemble, which is an integral part of it.

This ensemble is considered a decoration not only in the village of Shorsu, but also in all celebrations held in Sheki. Despite the fact that the Rutuls came to these places from Dagestan, many of their characteristics are distinguished from the peoples of Dagestan, including the Avars, Lezgis, and Sakhurs. This distinction is also reflected in their culture and art. Although the tunes played by the Rutuls and their national dances correspond to the type of those peoples, they are not the same. In addition to the compatibility between the peoples of Dagestan and the Rutuls, their language can also be shown among the different shades. As the Rutul language belongs to the Lezgi group of Dagestan languages, it is quite natural that there are similarities in the musical folklore of these peoples. Rutul musical folklore is distinguished by its variety of genres and forms. Among these genres, popular dance forms are usually accompanied by a troupe of trumpeters. (2 trumpets, kos drum, baby drum). Folk songs are accompanied by accordion and drum, as well as balaban. Solo, duet and choral singing of folk vocal music is widespread. Let's note one fact that one of the musical instruments used by the Rutuls is the mey. This tool occupies one of the main places among the tools used by rutuls. May instrument is made of reed (Figure 3). A horn is attached to its tip. Because it amplifies the sound coming out of the instrument. On the back side (the side of the mouth) a supsi is worn. The love of Rutuls for the art of dance cannot be compared with anything. Some of the dances are combined three by three ("Maharramkend", "Akushinka", "Koroglu return") or two by two ("Chuirni-chuirni" and "Arzurık`a") to form small series.

Fig. 3. Rutul players

As you can see, rutul dances also contain references from the folklore of neighboring nations. Commonalities and melodic types can also be seen in the creation of folk songs. "Lilay", "Maralkhanim", "Jeyranim" and others. Most, if not all, of the music samples are named in the native language. Others can be added to the ones mentioned above: "Jan Abay", "Paruk`ay", "Deydirish" (dance and instrumental melodyis the name), "Akushinka" is related to the name of a single male dance that is also found in the Avars. There are also known terms denoting the name of a number of genres. "Muk" me-

ans dance, “muk’ havin” means dancing, “chailbi” means song. “Avazaxhan” is reminiscent of mughams with its free (like) rhythmic improvisational style and stipulates the use of Azerbaijani mugham branches. As we mentioned, Rutul songs are the main part of Rutul folklore. Some examples of such so.

Dağıstanad bıç`kaldı, ay bıçadl riş
Yeyləxanad xhədkaldı, ay bıçadı riş
Dağıstanad bıç`kaldı, ay bıçadı riş
Yeyləxanad xhədkaldı,ay bıçadı riş
Suvumudu ceyran kaldı
Dərdimid dərman kaldı
Masarıd almaz kaldı
Ay xaşdi rutulaşdı riş.
Suvumudu ceyran kaldı
Dərdimid dərman kaldı
Masarıd almaz kaldı
Ay xaşdi bıçamıdı riş.
Ğudu cubra irxhur yi ay bıçadı riş
Ğudu dərdə irxhur yi can bıçadı riş
Ğudu cubra irxhur yi ay bıçadı riş
Ğudu dərdə irxhur yi can bıçadı riş
Suvumudu ceyran kaldı
Dərdimid dərman kaldı
Masarıd almaz kaldı
Ay xaşdi rutulaşdı riş.
Suvumudu ceyran kaldı
Dərdimid dərman kaldı
Masarıd almaz kaldı
Ay xaşdi bıçamıdı riş.

Yik`ə abı huxhus yıqar yəs ğada
Ğu ğarqudə yi lal ruk`ur Şahzada
Rıxdi ziya luzur alkar uyuxkal
Çulax ruk`ur, tupal ruk`ur Şahzada
Sa ğu rişixh, say i yişixh can qada
Did-nin yik`ir ğu yəs rişixh Şahzada
Hər bulaxa ruırk`uıdə ğu kaz xıla
Ğarazar yi favkıdıkal faz xıla
Yəsgi ağus yıqar laşur saz xhıls
Suk`ur yəşəs, keyghas yıqar Şahzada
Balabankal eyghas yıqar Şahzada
Sa ğu rişixh, say i yişixh can qada
Did-nin yik`ir ğu yəs rişixh Şahzada
Yuşa k`uşk`ud nak`bı ğaqar larxanə
Vıxhdı xalı seyvana yi salxan
Hirkanə yi şinara yişir larxanə
Ğudu şuklə siy vuruk`ur Şahzada
Xələ ubul, xiy vuruk`ur Şahzada
Sa ğu rişixh, say i yişixh can qada
Did-nin yik`ir ğu yəs rişixh Şahzada

Rutul proverbs and sayings form the basis of Rutul folklore. We can show the following examples from Rutul proverbs.

1) Sa yeylakha lixhimid or chaar or khasiyat kiikasi. (Those who graze in the same pasture have similar hairs or temperaments)
2) Ublus water that kivina maa ch`alagxdiil kavaghas tooth. (No matter how much you feed the monster, it still won't enter the forest)
3) Mık gıldıgır t`ulq`at. (The ice cracks from its thin place)
4) Tanbaldı yimayilas palan ki sa people ki ki. (A lazy donkey is also a heavy burden) Aldara yats lipxhude aa yiimal vashadvi. (When the bull's foot slips above, the donkey cries below)
5) Khhad khiyaitkhiir, kubkukhdakh khil ghama`. (Do not touch the foam after the water has run off)
6) Ghuas chigay mannas ki ma`. (Don't wish for others what you don't wish for yourself) Suvgudu aslanala luvzudu jackal alive vii. (A wakeful jackal is scarier than a sleeping lion)
7) Treacherous winter linsaddish. (A treacherous man does not get fat) (does not get rich) Gu kapirakhan yiixiiidi guc xhivaxhan yiix. (He who stabs you, stab him with bread)
8) Yik`is gachagud ulus gavagad tooth. (The eye cannot see what the heart cannot see)

a) In Kaçılmık, it was vykhid ubramıkia ki vishir. (He went by the horn, lost it in his ear)
b) Livxhid; Yiddish. (The grazer does not die) (after illness)
c) Ubluk's takhh kipt'a havirvi. (The sheep is given to the monster)
d) In was winter in the country. (Whose chicken said winter)

One of the interesting customs of the Rutuls is the "gudiy-gudiy" game, usually held in winter. As we know, it snows a lot in the village of Shin, which is one of the villages where the Rutuls live, and where the winter season is harsh and long. When it snows, a group of young and middle-aged residents (men) unite in a group of 10-15 people and decorate "jackals". One of the boys in this group of 10-15 people is decorated with skins and made into a jackal. Of course, the jackal is a mythical figure, and it is created to attract people's attention. Along with this group, there are also trumpeters. At this time, the group goes from door to door playing and playing, whichever house they go to, the owner of that house gives the jackal certain foods - potatoes, beans, rice, walnuts, hazelnuts, etc. like fruits and vegetables. Whichever house the jackal goes to, it plays in the yard of that house and symbolically dies. The jackal throws himself into the snow so that he does not get crushed when he falls. After giving the share, the owner of the house gets up and leaves. When the jackal crosses the road, it scares the children, whoever it can get hold of, knocks it to the ground and feeds it with snow. This game was very interesting for everyone, especially for children. If big people (men) come in front of the jackal, he wrestles with him. Thus, the jackal roamed the village for three days. After wandering around the village, the members of that group organized a meeting and ate and drank from the collected food. This custom belongs only to Shin village of Sheki.

CONCLUSION

1. The unique folklore and ethnography of minority peoples is a part of the folklore and ethnography of Azerbaijan and plays a special role in its enrichment;

2. Rutul songs, proverbs, ethnographic materials - ("Gudiy-gudiy" game, dances, etc.) are an interesting source in terms of researching the history and spiritual culture of the Rutul people;

3. Collecting and promoting the folklore of various ethnic groups living in our country is of great importance in strengthening the sincere relations between them and icreatinthe spiritual bond between people.

REFERENCES

1. Lavrov, L.I. Epigraphic monuments of the Northern Caucasus in Arabic, Persian and Turkish languages // Inscription X-XVII centuries. Texts, translations, comments, introductory article and applications, – 1966. – p. 141-206.
2. Lavrov, L.I. Historical and ethnographic essays of the Caucasus / L.I.Lavrov. Science, – 1978. – 36 p.
3. Ramazanov, H.Kh.,Sh ikhsaidov, A.R. Essays on the history of Southern Dagestan. Makhachkala // Dagestan branch of the Academy of Sciences of the USSR, – 1964. – 103 p.
4. Olson, J. Portal of the Culture of the Peoples of the North Caucasus-Rutulians / J.Olson. – 2015.
5. Olson, J. An Ethnohistorical Dictionary of the Russian and Soviet Empires / J.Olson. Greenwood Publishing Group, – 1994. – 576 p.
6. Lavrov, L.I. People of Dagestan: collection of articles // Publishing House of the Academy of Sciences of the USSR, – 1955. – 195 p.
7. Lavrov, L.I. Ethnography of the Caucasus / L.I.Lavrov. – Leningrad: "Nauka", – 1982. – 77 p.
8. Ikhilov, M.M. Materials on the ethnography of the Rutuls and Tsakhur // Brief reports of the Institute of Ethnography of the Academy of Sciences of the USSR, – 1960. – 28 p.
9. Alekseev, M. Dagestan people of Azerbaijan: politics, history, cultures / M.Alekseev, K.I.Kazenin, M.Suleymanov – M.: Europe, – 2006. – 88 p.
10. Abdul-Rashid, G. The origin of the people of Dagestan / G.Abdul-Rashid. – Elbrus: – 1996. – 245 p.
11. Borchinsky, S. "On the problems of the Sheki Rutulians" / S.Borchinsky. – Çernovik: Newspaper, – 2007. – 20 p.
12. Ikhilov, M.M. Materials on the ethnography of the Rutuls and Tsakhur // Brief reports of the Institute of Ethnography of the Academy of Sciences of the USSR, – 1960. – 26 p.
13. https://multikultural.az/az/medeni-muxteliflik/595/rutullar-tarix-medeniyyet-din/
14. http://samurpress.net/story.php?sid=2262
15. https://az.wikipedia.org/wiki/Rutullar
16. https://www.kaspi.az/az/rutullarin-folkloru
17. http://anl.az/down/meqale/kaspi_az/2019/oktyabr/679694(meqale).pdf

KİÇİK RUTUL XALQLARI YALNIZ AZƏRBAYCAN AİLƏSİNİN PARÇASIDIR

E.M. Qarayev, S.S. Hüseynova

Etnik qrup-müəyyən qrup fərdlərin, adətən dil, əcdad, tarix, cəmiyyət, mədəniyyət, milliyət və ya sosial davranış bənzərliklərinə və ya eyniliyinə əsaslanaraq digər insanlar tərəfindən təsnifləndirilməsidir. Etnik qrup anlayışı tez-tez milliyət, etnik milliyət və bir qrup insanın digərlərindən milli zəmində fərqləndirilməsi üçün istifadə edilir. Etnik qrup-etnososial təhsil, xüsusi etnik, oxşar etnopsixoloji, etnomədəni, dil və dini əlamətlərə malikdir. Onun başa düşülməsi siyasi-hüquqi terminlərdə "milli azlıq" kimi şərh edilir. Beynəlxalq hüquqi aktlarda, BMT Konvensiyalarında "milli azlıq" və "etnik azlıq" (qrup) çox zaman adekvat kimi işlənilir.Etnik qruplar etnik ərazidə yaranır və inkişaf edir. Etnik ərazi dedikdə, müəyyən xalqın yerləşdiyi vilayət başa düşülür. Bu ərazi onu başqa xalqlardan fərqləndirən mühüm əlamətlərdən biridir. Etnik qruplar tatlar, talışlar, kürdlərin dilləri-Avropa dil ailəsinin İran budağına aiddir. Qafqaz dilli xalqlar isə ləzgilər, avarlar, saxurlar, udinlər,

buduqlar, qrızlar, xınalıqlar, yengiloylardır ki, bunlar da başlıca olaraq Azərbaycanın şimalşərq və şimal-qərb rayonlarında məskunlaşmışlar. Məqalədə Azərbaycan ərazisində dostluq və qardaşlıq şəraitində yaşayan azsaylı xalqların nümayəndələrindən olan rutulların tarixi keçmişi haqqında məlumat verilmiş, rutul mədəniyyətinin tərkib hissəsi olan rutul folkloru və etnoqrafiyası nümunələri toplanaraq tədqiqata cəlb edilmişdir. Tədqiqat işində bu istiqamətdə yazılan elmi əsərlərlə yanaşı, müşahidə, müsahibə və materialların toplanması metodlardan istifadə edilmişdir.

Açar sözlər: *Azsaylı xalqlar, rutullar, folklor nümunələri, evlilik mərasimi.*

МАЛЕНЬКИЙ РУТУЛЬСКИЙ НАРОД-ЧАСТЬ ОДНОЙ АЗЕРБАЙДЖАНСКОЙ СЕМЬИ

Э.М. Гараев, С.С. Гусейнова

Этническая группа-это классификация другими людьми определенной группы лиц, обычно основанная на сходстве или сходстве языка, происхождения, истории, общества, культуры, национальности или социального поведения. Понятие этнос часто используется для обозначения национальности, этнической принадлежности, а также отличия одной группы людей от других по национальному признаку. Этническая группа-этносоциального образования, особая этническая, имеет сходные этнопсихологические, этнокультурные, языковые и религиозные характеристики. Его понимание трактуется как «национальное меньшинство» в политико-правовом плане. В международно-правовых актах и конвенциях ООН термины «национальное меньшинство» и «этническое меньшинство» (группа) часто используются как адекватные понятия.Этнические группы возникают и развиваются на этнической территории. Этническая территория означает провинцию, на которой проживает определенный народ. Эта территория является одной из важных особенностей, отличающих ее от других народов. Этногруппы таты, талыши, языки курдов относятся к иранской ветви европейской языковой семьи. Кавказоязычными народами являются лезгины, аварцы, сахуры, удины, будугцы, гризы, хиналики и эльгои, расселявшиеся в основном в северо-восточных и северо-западных районах Азербайджана. В статье представлены сведения об исторической предпосылке рутулов, представителей небольшого числа народов, проживающих в дружественных и братских условиях на территории Азербайджана, а также образцы рутульского фольклора и этнографии, входящие в состав рутульской культуры. Собраны и вовлечены в исследование. Наряду с написанными в этом направлении научными работами в исследовательской работе использовались методы наблюдения, интервью и сбора материала.

Ключевые слова: *Малочисленные народы, рутулы, образцы фольклора, брачный обряд.*

UDC: 3.327
ORCID: 0000-0003-2480-0056 (Safarova)

THE FOREIGN POLICY OF THE REPUBLIC OF TURKEY DURING THE AK PARTY

Chinara Gabil Safarova
Azerbaijan State Oil and Industry University, dissertation of GSU
E-mail: seferova.cinare@bk.ru
Received: 25.05.2023
Accepted: 01.09.2023

Turkey's foreign policy during the period of the AK Party traditionally aimed at ensuring the country's security, protecting and developing national interests in a perspective that comes from history and extending into the future, and creating the necessary foreign resources for development and prosperity. The party aims to realize these goals by establishing good relations and establishing cooperation with all countries, especially neighbors, and contributing to international peace, stability, security and prosperity. The AK Party government, like other governments that came to power before it, focused on the importance of Georgia, which is Turkey's gateway to Central Asia and a 276-kilometer border neighbor. Therefore, relations between the two countries have begun to be reconsidered in accordance with socio-economic and political interests.

Keywords: *Turkey, AK Party, Foreign policy, South Caucasus, Georgia*
DOI: 10.59849/2409-4838.2023.3.135

INTRODUCTION

After the end of the Cold War, significant opportunities in Turkey's foreign policy were achieved after the AK Party came to power after 2002. These opportunities were enhanced by the achieved political stability and economic growth. In this way, Turkey was expected to realize the leap it could not make in the 1990s in foreign policy in the 2000s with new opportunities and a new vision. After coming to power, the Justice and Development Party has always tried to normalize relations with neighboring and regional states, as well as with powerful and interested countries. After coming to power, the Justice and Development Party has always tried to normalize relations with neighboring and regional states, as well as with powerful and interested countries. The Caucasus, which had little place in Turkey's foreign policy during the Cold War, became one of the important regions in terms of both energy and security after the collapse of the Soviet Union. Changes in Turkey's foreign policy have affected the existing relations with the South Caucasus and especially with Georgia. The leadership of the Justice and Development Party, which claims to have a different view on foreign policy than previous governments, managed to focus attention on Turkey with its active and sometimes ambitious foreign policy. Until the end of the last century, Turkey's foreign policy was shaped by apolitical bureaucratic elites and controlled by a constitutionally empowered military bureaucracy that limited the legislature [1, p. 53]. However, the radical changes experienced in the post-Cold War period also affected Turkey's foreign policy.

Especially, with the coming to power of the Party, the foreign policy activities of decision-making bodies without political responsibility were reorganized in accordance with the constitutional limits. The Justice and Development Party approached the processes taking place in the world with a more active policy concept, not only by demonstrating rhythmic diplomacy in foreign policy, but also shaped Turkey's security policy around a new foreign policy concept. The Party's 2007 Election Manifesto that freedom and security are not contradictory and the need to create a balance between the two concepts and the 2011 Election Manifesto emphasizing that freedom is indeed a means of living security proved this concept in domestic policy and new concepts in foreign policy [5, p. 134]. After revealing the new concept of foreign policy, Turkey started new policy initiatives in the Caucasus and Central Asia within the framework of these perceptions, and was looking for

ways to solve problems with the countries of the region. It can be said that Turkey, which strives for the stability of countries struggling with ethnic and political problems in the region, shapes its foreign and security policy around the perspective of "zero problems with neighbors" [6].

If we look at how Turkey's foreign policy was formed during the party's activity, the first noticeable feature was the effort to reflect the growth experienced in the economic and military fields to foreign policy. Especially, with the rapid development between 2003 and 2008, Turkey began to implement a more independent and active foreign policy. However, due to the World Economic Crisis in 2008-2009, the destabilization of the Middle East as a result of the Arab uprisings that started at the end of 2010, the Gezi Park Operations on May 28, 2013, the Turkey Bribery scandal on December 17-25, 2013, and the treacherous coup attempt organized on July 15, 2016, the scope of the party's activities in foreign policy was limited. But the Justice and Development party government moved to a more active foreign policy with the support of the nation standing behind these calls. The Georgian government also supported the Turkish government.

Thus, after the attempted coup on July 15, 2016, Georgian Foreign Minister Mikheil Janelidze met with the Turkish ambassador in Tbilisi and Turkish Foreign Minister Mevlud Çavuşoğlu and showed their support to the Turkish government. Immediately after these meetings, Georgian President Giorgi Marvelashvili made a statement and stated that they support the democratically elected Turkish government. Prime Minister of Georgia Kvirikashvili stated that stability in Turkey, which is a strategic partner, is very important for them. After all these statements, immediately after the July 16 coup attempt, the Georgian side closed its land border and air borders with Turkey for security reasons. These steps of Georgia should not be evaluated only in terms of strategic partnership and border neighborhood. Important economic partnership with Ankara and great support from Turkey played an important role in Georgians taking such a step. Moreover, peace, stability and democracy in Turkey are vital for Georgia.All these are important factors in Georgia's relations with Turkey. It should also be noted that Georgia is another important ally of Turkey in the Caucasus as well as Azerbaijan.

MAIN PART

The internal situation in Georgia when the Justice and Development Party came to power

Shevardnadze was the president of Georgia when the party came to power. But against Shevardnadze's leadership criticisms were often voiced in the Georgian public. Demonstrations were held in the streets of Georgia. In November 2003, riots started due to the observation of bias in the general elections held in Georgia. As a result of this reaction of the Georgian people, President Shevardnadze was forced to leave the leadership due to the event known as the "Velvet Revolution". Also, uprisings have started to occur frequently in the separatist regions of the country. Even in such a situation, representatives of Turkish foreign policy advised Aslan Abashidze, the leader of the Ajara region, in order not to disturb the stability of the country by creating internal unrest.

The representatives of Turkish foreign policy did not ignore the current situation and made the following comment: "Turkey sincerely wishes that peace and unity prevail in friendly Georgia as soon as possible by continuing our relations that have developed after the elections at an excellent level.Turkey believes that difficulties will be overcome by ensuring political reconciliation and that Georgia will continue to advance on the road to democracy [9].

Saakashvili was elected president in the elections held in Georgia on January 4, 2004.Turkish MPs participated in the election process as observers.On May 20, 2004, and newly elected Georgian President M. Saakashvili visited Turkey. During his visit, Saakashvili spoke about the problems in the separatist regions while touching on the future of relations between Ankara and Tbilisi from the socio-economic and political point of view. At the same time, Saakashvili expressed Turkey's position by preferring cooperation with the West in order to ensure independence and stability in Georgia. Ahmet Necdet Sezer, who was the president of Turkey at that time, expressed his desire to ensure stability in the Caucasus with the support of the Turkish leadership for the territorial integrity of the Republic of Georgia.

The great importance of the military field in the relations between Turkey and Georgia

From the moment Georgia gained its independence, due to its existing relations with Russia, it has set itself the goal of strengthening relations with Western organizations. One of the most important international organizations for integration is NATO. Turkey, which is a member of NATO and aims to achieve stability in the South Caucasus together with the United States, supported Georgia's membership in international organizations and created democracy in its country. Another issue discussed in Turkey's military relations with Georgia is the war between Russia and Georgia in August 2008 [4].

In this war, which attracted the attention of the world community, Turkey also intervened in the situation.In the August 2008 war, Prime Minister Recep Tayyip Erdogan proposed meetings to the Russian and Georgian parties in order to establish a ceasefire and ensure stability in the South Caucasus [8].

For this purpose, R.T. Erdogan went to Moscow on August 13, and to Tbilisi on August 14. During these trips, Prime Minister Erdogan expressed Turkey's support for the territorial integrity of Georgia and expressed his support for the protection of Georgia's borders, which was also approved by the UN Security Council.

At the same time, with the aim of helping the Georgian people who are in a difficult situation after the conflicts Kizilay support said that it will be given. However, Prime Minister Erdogan's greatest statement was the creation of a platform for stability and cooperation in the Caucasus.In his talks in Tbilisi, Erdogan expressed that Russia is also interested in the issue, and stated that its goals are to establish peace in the Caucasus and create regional stability.

By proposing the Caucasus stability and cooperation platform, Turkey wants to provide an environment for solving both the Russia-Georgia crisis and other problems that may arise in the Caucasus. In fact, from the point of view of Turkey's Caucasus policy, the topic has many directions. On the other hand, Turkey, both in terms of general foreign policy, also defended the territorial integrity of Georgia due to its position in energy projects. Thus, in the Russia-Georgia war, Turkey remained neutral and used the soft power policy and published a short statement expressing only its concern in the face of this war. The Turkish government did this both to protect its security and because it did not want to turn its relations with Russia and Georgia into a crisis.

The foreign policy of the Republic of Turkey after the July 15, 2016 coup attempt

After preventing the July 15 coup attempt in the Republic of Turkey, a large cross-border operation such as the "Fərat Qalxanı" operation was carried out. This operation was announced by the Prime Minister of the Republic of Turkey on August 24, 2016 The Turkish Armed Forces and the Coalition Air Force of the city of Jarablus in the Aleppo region of Syria it started with the aim of cleansing it from ISIS.

In addition to Turkey's economic and military capabilities, with the "Fərat Qalxanı" operation, which allowed increasing the national power of the army with the purges after the coup attempt, Ankara began to play the role of a regional power again and showed that it will not remain silent to the forces that threaten its security outside its borders. Let me also mention that Turkey should not remain silent on the events in Iraq as well as Syria and keep troops especially in Northern Iraq is one of the requirements of being a regional power [2, p. 4].

Although opening of Turkey's foreign policy to the Middle East and coming to the fore as an independent regional force is a topic of discussion, the Justice and Development Party government did not have any problems with its neighbors during the said period.Although the increasing interest of the EU and the US in the framework of their policy and regional mediation activities in the Middle East is welcomed, this picture has started to change since 2009 [7, p. 3]. After the establishment of the Party government in 2002, there were many radical changes in Turkey's foreign policy. Turkey's image in the world was rebuilt. Especially, the presence of Ahmet Davutoglu in the Ministry of Foreign Affairs brought a systematic feature to these changes. With Davutoğlu's foreign policy, Turkey's voice was heard more in the international arena than during the previous periods of power. Of course, the reason for this new image of Turkey is not only Davutoğlu's policy, but there

are many other factors as well. After the establishment of the Party government in 2002, there were many radical changes in Turkey's foreign policy. Turkey's image in the world was rebuilt.

In particular, the presence of Ahmet Davutoglu in the Ministry of Foreign Affairs during the prime ministership of Recep Tayyip Erdogan brought a systemic feature to these changes. Turkey's voice was heard more in the international arena with its foreign policy than during the previous periods of power. Of course, many other factors also influenced the formation of this new image of Turkey.

Another factor was the increased need for Muslim Turkey by Western countries in the post-September 11, 2001 period for cooperation in the fight against terrorism around the world, which was an advantage for the Party government. Turkey is a country of strategic importance for the solution of problems in the countries of the Middle East and Central Asia, which are culturally and geographically close to Turkey, and for the communication of the region with the West. Within the framework of the foreign policy restructured with the Justice and Development Party, the active policy was targeted in the near geographies. In this direction, new developments began in the relations with the South Caucasus, which is the main topic of the thesis, and more specifically with Georgia.

However, since Turkey's capabilities are limited, relations could not develop at any level for a long time. At the same time, thanks to the increased opportunities during the Party period, Turkey began to conduct active political experiments in nearby regions within the framework of the new foreign policy concept. The South Caucasus and Georgia, which is part of it, are in a very important position in terms of Turkey's interests within the framework of the near region policy.For Georgia, preserving its independence, developing the country and integrating into the West could be possible with good relations with Turkey.Turkey is trying to develop the current dialogue with the Georgian government within the framework of its political and economic interests in foreign policy.

CONCLUSION

As you can see, the AK Party government presented a foreign policy perspective based on the understanding of the historical, geographical and general culture, along with the understanding of foreign policy based on Turkey's strategic importance. The party reflected concepts such as "central country", "multi-dimensional, multi-directional policy", "not crisis-oriented, vision-oriented policy" into the concept of politics and created the concept of soft power in Turkey [3, p. 131]. The Party government, which presented a foreign policy in line with these innovations, also formed the country's security policy within the framework of this soft power. He has implemented global and regional policies within the framework of steps taken to ensure zero problems in politics with neighbors, international peace and stability. Turkey is not only a country that responds to crises by implementing policies that prioritize economic, historical, geographical and shared cultural identity, but also plays the role of a country that detects and intervenes before crises occur. The AK Party, which established a new foreign policy with a "zero problem with neighbors" approach as a requirement of M. Kamal Atatürk's policy of "peace at home, peace in the world", took its place in Turkey's foreign policy.

REFERENCES

1. Akgün, A. Cumhurbaşkanı Abdullah Gülün Dış Politikadaki Rolü, Çankayada İlk Üç Yıl / A.Akgün. – İstanbul: – 2011. – 12 s.
2. Aslan, A. AK Partinin 15 yılı: Dış Politika / A.Aslan, K.İnat, B.Duran – İstanbul: SETA kitapları, – 2017. – 24 s.
3. Cavlan, T. Yeni Osmanlıcılık: Batı'dan Kopuş mu? / T.Cavlan. – YDÜ Sosyal Bilimler Dergisi, – 2010. – 30 s.

4. Davutoğlu, A. Stratejik Derinlik: Türkiye'nin Uluslararası Konumu / A.Davutoğlu. – İstanbul: Küre Yayınları, – 2014. – 600 s.
5. Emrah, B.H. Ak Parti 2007-2011 Seçim Beyannameleri: Süreklilik ve Değişim / B.H.Emrah. – Ankara: Ak Parti AR-GE Başkanlığı Yayınları, – 2011. – 32 s.
6. Gürbüz, M. Vedat Günümüz Türk Dış Politikası Stratejisinde, Kafkasya İle İlişkiler / M.Gürbüz. – Ankara: Nobel Yayın, – 2010. – 23 s.
7. Cornell, S. Turkish Foreign Policy under the AKP: The Rift with Washington / S.Cornell, S.Çağatay – The Washington Institute for Near East Policy, – 2011. – 15 s.
8. Keyman, E. Turkish Politics in a Changing World: Global dynamics and domestic transformations / E.Keyman, Z.Öniş – İstanbul: İstanbul Bilgi University Publications, –2007. – 342 s.
9. http://www.mfa.gov.tr/turkey_s-political-relations-with-georgia.en.mfa

AK PARTİYA HÖKUMƏTİ DÖVRÜNDƏ TÜRKİYƏ CÜMHURİYYƏTİNİN XARİCİ SİYASƏTİ

Ç.Q. Səfərova

Türkiyənin Ədalət və İnkişaf Partiyası hökuməti dövründə xarici siyasəti ənənəvi olaraq ölkə təhlükəsizliyinin təmin edilməsini, milli maraqların tarixdən gələn və gələcəyə uzanan bir perspektiv içində qorunub inkişaf etdirilməsini, inkişaf və rifah üçün lazımi xarici resursların yaradılmasını hədəfləmişdi. Partiya bu hədəfləri, başda qonşular olmaqla, bütün ölkələrlə yaxşı əlaqələr qurmaq və əməkdaşlığın təsisi, beynəlxalq sülh, sabitlik, təhlükəsizlik və rifaha töhfə göstərilməsi yolu ilə reallaşdırmağı qarşıya məqsəd qoymuşdur. AK Partiyası hökuməti özündən əvvəl iqtidara gələn digər rəhbərliklər kimi Türkiyənin Orta Asiyaya açılan qapısı olan və 276 kilometrlik sərhəd qonşusu olan Gürcüstanın əhəmiyyətini diqqət mərkəzində saxlayırdı. Ona görə də iki ölkə arasında sosial-iqtisadi və siyasi maraqlara uyğun olaraq əlaqələr yenidən nəzərdən keçirilməyə başlanmışdır.

Açar sözlər: *Türkiyə, AK Partiya, Xarici siyasət, Cənubi Qafqaz, Gürcüstan*

ВНЕШНЯЯ ПОЛИТИКА ТУРЕЦКОЙ РЕСПУБЛИКИ В ПЕРИОД ПРАВЛЕНИЯ ПАРТИИ СПРАВЕДЛИВОСТИ И РАЗВИТИЯ

Ч.Г. Сафарова

Во время правления Партии справедливости и развития Турции внешняя политика традиционно была направлена на обеспечение безопасности страны, защиту и развитие национальных интересов в перспективе, исходящей из истории и простирающейся в будущее, и создание необходимых внешних ресурсов для развития и процветания. Партия стремится реализовать эти цели путем установления хороших отношений и налаживания сотрудничества со всеми странами, особенно соседними, и способствуя международному миру, стабильности, безопасности и процветанию. Правительство Партии справедливости и развития, как и другие правительства, пришедшие к власти до него, акцентировало внимание на важности Грузии, которая является воротами Турции в Среднюю Азию и соседней границей протяженностью 276 километров. Поэтому отношения между двумя странами начали пересматриваться в соответствии с социально-экономическими и политическими интересами.

Ключевые слова: *Турция, Партия, внешняя политика, Южный Кавказ, Грузия*

UDC: 1.16.165.3
ORCID: 0000-0002-2906-9218 (Gurbanov)
ORCID: 0000-0002-6447-0170 (Alibeyova)

UNITY OF KNOWLEDGE, EXPANSION OF RATIONALITY AND "DIGITAL COGNITIVE EXPANSION": AN EPISTEMOLOGICAL APPROACH

Turana Vahid Alibeyova, Fuzuli Muhammad Gurbanov
The Institute of Philosophy and Sociology of ANAS
E-mail: turane.alibeyova91@icloud.com
Received: 30.04.2023
Accepted: 05.09.2023

Given the widespread use of digitalization across a variety of societal sectors, the question of the unity and integrity of scientific knowledge is becoming more important. The maintenance of knowledge's unity develops into a serious epistemological issue. This question is examined in the paper from a philosophical-scientific standpoint against the backdrop of the use of new digital technologies. It is shown that contemporary epistemological paradigms are directly tied to the creation and functionalization of knowledge. Epistemology of virtue holds a unique position among them. In the framework of this epistemology, the study of concepts such as rational acceptability, rational expansion, and digital cognitive expansion in interaction is relevant. The article explores how knowledge is generated and utilized in the context of contemporary digitalization, highlighting it as a multifaceted and diverse procedure.

Scientific Purpose. *Attaining a philosophical-scientific understanding within the cognitive-social-cultural environment, where knowledge generation is intricately intertwined, by examining it through the perspective of the epistemological phenomenon called "digital cognitive expansion."*

Methodology. *Interdisciplinary methodology is applied in the article. Methodological principles of intersubjectivity, synergetic integration, and cognitive expansion are applied specifically for this.*

Method. *Methods of comparative analysis and synergistic synthesis are used.*

Scientific Innovation. *The formation of scientific knowledge was investigated in the context of the concept of "digital cognitive expansion" within the framework of virtue epistemology.*

Keywords: *technoscience, postacademic science, finalization of science, rational acceptability, expanded intelligence, episteme of cosmotechnics, epistemology of virtue, intersubjectivity, cognitive ecology.*

DOI: 10.59849/2409-4838.2023.3.140

INTRODUCTION

Undoubtedly, within philosophical-scientific circles, the organization of scientific endeavors in modern science, the process of knowledge generation, the dynamics of knowledge-information relationships, and the philosophical comprehension of the connections between scientific and non-scientific knowledge are highly relevant topics. These issues are extensively explored as a "complex cognitive and cultural matter" as a whole. Additionally, there is a widespread consensus about the crucial role played by concepts such as science, knowledge, information, and digitality in shaping contemporary society. In concrete terms, the prevailing belief is that modern society is predominantly an information and knowledge-based society. In other words, information and knowledge are important to the existence, operation, and development of all aspects of society. They serve as a driving, determining sociocultural and intellectual force. As a result of this process, the idea of "technoscience" arose, which denotes the fusion of emerging technologies and scientific subjects. This is a phenomenon that fundamentally alters how an individual and society as a whole view the universe and their place in it. For this reason, concepts li-

ke "postacademic science" and "finalization of science," which were previously unheard of, are utilized in philosophical-scientific literature [2, p. 33]. The necessity of philosophical understanding is examined in the context of the coexistence of human-humanity-technoscience interactions in a number of studies as a result of the basic penetration of technoscience into society [1, p. 211].

The idea that new technologies play a crucial role on a cosmic scale is advanced in English-language literature, and the modern world is genuinely portrayed as a scientific-technical reality. In this context, it is highlighted that accepting new technologies as a "function of human intelligence" is necessary. This entails, broadly speaking, considering the digital universe as a whole, including the cosmic scale, as an integral part of reality. In light of this, it's intriguing that Y. Hui proposed the concept of a "cosmotechnics episteme" [3]. These brief examples clearly illustrate a fundamental transformation occurring in scientific comprehension during the modern era. The indications of this transformation are evident in the way knowledge is acquired, knowledge-information relationships are redefined, interdisciplinary connections take on new meanings, and how cognitive-social-cultural interactions are renewed, among other factors. This suggests that modern scientific understanding exhibits a hierarchical, complex, temporal, and non-linear nature. In this context, let's emphasize that "...The fact that scientific understanding has a hierarchical and non-linear nature is caused by its temporality. The non-linear aspect ensures that different domains of scientific cognition maintain their autonomy. Simultaneously, this characteristic imparts a unique content to their synthesis within a shared temporal dimension [4, p. 193].

Proceeding from this thesis, one can focus on the discussions conducted by philosophers in aspects such as the acquisition of scientific knowledge, the essence of the relationship between them, and the creation of conceptual apparatus in various scientific directions.

For this, it is possible to use an interdisciplinary methodological approach. In this article, we address the methodological principles of intersubjectivity, nonlinearity, system complexity, and synergistic synthesis. Comparative analysis, integration of diversity and pluralism are used as methods. Let us emphasize that this article also takes into account methodological pluralism in the sense of P. Feyerabend. Thus, we prefer to be open to different methodological approaches rather than to a potentially limited number of scientific or research methods [5].

MAIN PART

As we highlighted above, the question of the unity and integrity of knowledge is more frequently discussed in the framework of the complexity paradigm in contemporary philosophical and scientific literature. Philosophical-scientific understanding of the issues of the unity of knowledge with complexity at the level of mutual relations creates an opportunity to analyze a number of theoretical and methodological issues in the epistemological aspect as a whole. This topic is examined in works in the context of a philosophical investigation of the complexity-related problem of the unity and integrity of knowledge in general. One of the main issue lies in comprehending the philosophical aspects of how concrete knowledge is created and how it interacts with other subjects. Individuals or entities responsible for generating knowledge employ it in diverse activities and forms of communication. Subjects who produce knowledge incorporate it into a variety of activities and communications. The reflexive (subject's self-awareness, empathy context) aspect of that process is relevant [6, p. 60]. In this context, researchers examine the unity and integrity of knowledge, closely linked to the problem of the unity between natural sciences and humanities, especially concerning the aspect of growing complexity. It is fascinating to examine the emergence of the interdisciplinary complexity paradigm based on the interactions of network and system approaches within that framework [7, p. 50-61]. According to V. I. Arshinov and V. G. Budanov, system and network methods each have a positive and constructive potential for comprehending the integration of different natures in contemporary information-network societies, including the management of contemporary high technology convergence processes. The interaction of these two approaches increases their cognitive-project potential, and by including a number of additional methodological principles, it is

possible to achieve a philosophical-scientific understanding of the synthesis of natural sciences and humanities at the modern stage [7, p. 60-61].

The acquisition of information, its operation, the development of scientific theories, and the fact that these issues have a unique content in digital environments can all be philosophically and scientifically explored in the emphasized context.Currently, research is being conducted in this direction, and a number of issues of a philosophical, epistemological and methodological nature appear in that framework. Among them, the philosophical comprehension of knowledge, scientific developments, digital transformation, scientific veracity, and other current issues hold a distinct significance concerning the transformation of scientific rationality.

The point is that the process of renewal (including the evolution) of the philosophy of scientific rationality should be viewed in close connection with its creators (people). Simultaneously, those responsible for shaping, transforming, applying, and presenting knowledge to potential users need to be examined from a comprehensive standpoint. This consideration holds great relevance in terms of ensuring unity, synthesis, and integrity of knowledge in the context of the digital era.

The investigation of these three philosophical factors is particularly interesting to philosophers. The diversity of subjects' reflexive perceptions of knowledge in relation to the unity of knowledge is first examined. The second is the "incorporation" of newly learned information into other subject-related activities (such as communicative, reflective, socio-practical, and theoretical ones). The third is a philosophical-scientific investigation of reflexivity in polysubject systems in relation to knowledge organization management [7, p. 60].

The research conclusions obtained individually and at the intersection of their common theoretical-methodological and epistemological aspects hold significant importance in the ongoing discussions. Within the scientific goals of this article, let's try to conduct a comparative analysis of several of them. It is worth highlighting that the directions we have mentioned hold a prominent position in international philosophical-scientific congresses focused on system research and cybernetics [8]. During the WOSC congress in Moscow in 2020, presentations on topics like "Technology and humanity: joint development of hybrid reality" and "Creating new areas of knowledge in the transdisciplinarity of system sciences and cybernetics" were delivered [9]. Overall, in contemporary philosophical-scientific understanding, the prevailing notion is that humanity has formed a "unified and whole reality" through technology, and this process can be adequately understood through new fields of science arising from transdisciplinarity within interdisciplinary research domains. Against this background, the discussion about the development of scientific rationality and the change of ideas about reflexive activity in digital conditions is becoming more and more intense.

Thus, knowledge in the setting of digitality is often explored in discussions via the lens of the interconnected ties between the ideas of truth and rationality. At this time, the philosophical reflection is on the acquisition of knowledge, the integration of various knowledge, the emergence of new interdisciplinary scientific directions, and the content of all of these processes in the context of digital culture. The topic of "rational acceptability" has been included by researchers in the research context mentioned. This idea is widely used in neopragmatism. However, its philosophical-scientific framework is relevant to modern philosophical thought in general. It is particularly significant in the philosophical-scientific reflection on scientific cognition. Hilary Patnam, one of those who widely use this concept, believes that it is necessary to justify the acceptability of certain knowledge and certain truth. At this time, it is possible to justify calling "receptivity" rational, because "in the scientist's mind, not only the issue of justification, but also the choice becomes relevant" [10, p. 84]. Based on the aforementioned logic, H. Patnem provides the following explanation of "rational acceptability": "Scientific truth is one of the types of ideal alignment of our beliefs with each other and the knowledge obtained from experience." In this case, the "degree of adaptation" is determined by the "degree of representation in our belief system" of the experimental data. That is, it is not about adapting to reality that exists independently of consciousness [11, p. 70]. Understanding the justifications for the subject's selection of one theory over another and, consequently, the type of knowledge, is

made possible by acceptability. In other words, choice and axiological features are a necessary part of knowledge in the present era. The findings of H. Patnam about the conceptual relationship between scientific truth and rationality are intriguing from this standpoint. He sees a close relationship between logic and truth. It also implies that their meanings and contents are different at the same time. Any claim may be accepted logically for a while, but it may not actually be "true". This phenomena is what H. Patnem calls "realistic intuition" [11, p. 10]. From this perspective, philosophers arrive at specific conclusions regarding knowledge and scientific theories. It suggests that no scientific discipline can assert itself as an exact representation of reality. Instead, rational plausibility becomes the governing principle in determining the "value" aspect when favoring any theoretical model. In this sense, rational acceptability serves as an epistemological "map" that establishes connections between all conceptual frameworks and a particular "world" [10, p. 87]. Let's underline that Imre Lakatos' concept appears intriguing and pertinent within the context of this logic. In the 1970s, a Hungarian scientist who later became one of the 20th century's most renowned experts on scientific technique stated: "I decided to look for the best methodology capable of a more successful rational reconstruction of science" [12, p. 506]. The pursuit of "the truest knowledge" by philosophers and methodologists in the twenty-first century has an intriguing impact when viewed through the lens of the standard of rational acceptability. It can be said that this search will be constant and the possibility of a definitive final result is seriously doubtful. In the digital environment, this process is gaining importance and content. It can be seen as its signs of cosmotechnicization and imagining scientific knowledge as a "post-truth search" [13]. Given this context, it is not unexpected that some scientists refer to contemporary research as "postacademic science" (also known as "post-normal science"). In other words, current science is different from earlier sciences in terms of its structure, function, cognitive techniques, logical qualities, and research approach. There are philosophers who disagree with this view, however, at the same time. Other ideas that align with rational acceptability are also included in the discussions. For instance, N.D.Astashova and E.B.Maslanov propose that the rational foundations of creative consciousness in science hold philosophical relevance at the intersection of multiple alternative approaches. Understanding the concept of rationality plays a guiding role in this context.According to one approach, rationality is "associated with the particular way of thinking of the epoch". It shapes general notions of understanding the world and various "theoretical scientific strategies are formed". In this sense, rationality "determines the features of the scientist's creative thinking".The second approach heavily relies on logic to describe the world. Researchers utilizing this perspective believe they can eventually achieve a comprehensive problem description. It can be called that the consciousness of the researcher "casts a rational construct like a net on the uncertainty". Finally, according to the third position, preference is given to "giving dynamic, flexible grades to scientific results". Philosophers value this as a meaning that has a rational meaning and is contained within certain cultural conditions of reality. According to that approach, human intelligence always "strives to exceed the limit of what is possible" [14, p. 34].

Certainly, addressing the issue of uniformity, unity, and synthesis of knowledge within such a complex and multifaceted cognitive landscape is a non-trivial endeavor. In response to this challenge, efforts have been made to establish a theoretical and methodological foundation for dealing with these complexities. As discussed earlier, in the light of the principle of "rational acceptability", the relevance of the issue of "expansion of rationality", which has a wider meaning, is very clear in the digital culture. Rational acceptability is the epistemological and methodological basis of rational extension. In more concrete terms, rational acceptability establishes the methodological and epistemological foundation for selecting the rationality that is deemed to be superior to alternative rationalities. However, the philosophical-scientific reflection of the expansion of rationality is not limited to this. It is important to define the philosophical and scientific significance of the development of reason in the area of the organic integration of new digital technologies in cognition.

In this aspect, two points have a special place in the discussions. The first point is related to the approach to the expansion of rationality in the context of the factor of digitality in the aspect of uniformity, integrity and unity of knowledge. For this, the unity, uniformity and integrity of know-

ledge is considered in self-developing reflexive-active environments. In order to provide it, it is suggested that it is realized through ontologies. These ontologies consist of accompanying, supporting, developing, constructing, and applying types. A system of principles is added to them. And socio-humanitarian technologies are selected for both. In a broader philosophical context, it is suggested to address the unity of knowledge by synthesizing ontological, methodological, and technological (social practical) aspects in the context of modern digitalization. Within this approach, the analysis of different types of reflexive activity, understanding the complexity of reflexive activity, and clarifying the mechanisms of managing complexity emerge as pressing matters [7, p.67].

The acceptability of rationality and the expansion of rationality, which we emphasize under this general philosophical "theoretical-methodological umbrella", have an interesting cognitive phenomenon effect. Philosophers are currently delving into various aspects within this context. As mentioned by S.Y.Shevchenko, the topic of cognition, expanding through the utilization of digital technologies, is actively being discussed within the epistemological and social study of science and technology [15, p. 210]. These studies investigate the epistemic consequences arising from the application of different digital technologies. It is concerned, among other things, with "the epistemological study of memory-corrupting search engines that can favor false information." At this time, there are ample opportunities for theoretical comparisons between the automatic acquisition of knowledge and its epistemological results, in which one can talk about the expansion of intelligence [16, p. 1945-1963]. Researchers link the development of intelligence to social phenomena like the formation of "epistemological bubbles" on social media as an example of how it applies to the social environment [17, p. 61-73].

Discussions make it clear that such a method creates an intriguing philosophical conundrum. It is a matter of the aware subject accepting accountability for his cognitive processes based on his views after being "completed with digital technologies". So, philosophically speaking, the problem comes down to the study of the formula "subject (cognitive observer) + digital technologies".

Indeed, the expansion of intelligence in this sense is a serious philosophical, epistemological and methodological phenomenon. Because in this case it is not merely a matter of complementing non-classical epistemological, and methodological structures (systems, networks) with digital technology. The problem is related to the deeper layers' symbiosis, synthesis, unification, and "intertwining" of cognitive, social, cultural, and technological variables. This means that it is built on a foundation that is typically based on an organic synthesis of those factors. The fundamental principle behind Y. Hui's concept of "cosmotechnics" is this one. In this framework, rational acceptability and the expansion of intelligence can be imagined as concepts that stand at the foundation of the philosophical-scientific understanding of the "science + digital technology" tandem at the modern stage. They provide two explanations for how the cognitive "extended subject" bears epistemic responsibility. First, in a digital society, the subject is only accountable for the cognitive expansion he selects and not for the beliefs that result from the epistemic environment. The subject may also reduce the amount of justifications that can be offered within the context of causal dependence by engaging in "cognitive expansion" [15, p. 209].

In the modern digital environment, the question of knowledge, its acquisition, functionalization, and socio-practical application gives rise to wider considerations of significant intellectual, spiritual, cultural, moral, and ethical importance at the present stage. We believe that this particular aspect emphasizes the profound humanitarian, philosophical, ethical, and socio-cultural implications of Y.Hui's concept of "cosmotechnicism," which resonates with the cognitive essence of natural science. To be specific, terms like rational acceptability, rational expansion, and intelligence expansion are intrinsically linked to the process of understanding digital technologies. In a broader sense, they share a close connection with the epistemology of virtue.

In this context, S.Y.Shevchenko highlights that the discussion about expanded intelligence, particularly concerning cognition and understanding, can be seen as an extension of the relayabilist and responsibilityist approaches in virtue epistemology. It is known that relayabilism presents intellectual virtue as "reliable cognitive processes" within the framework of virtue epistemology [18, p. 22-37, 19].

In virtue epistemology, the concept of responsibility also refers to a group of views that describe intellectual virtue as excellent personal traits. However, some philosophers argue that responsibility and expanded intelligence may not be compatible with each other. For instance, the German philosopher Lucas Schwengerer posits that an Internet user cannot simultaneously possess an expanded consciousness and a virtuous consciousness. According to Schwengerer, a caring user either believes in the digital guide ("navigator") on the screen (has expanded awareness), or is critical of what he sees on the screen (virtue) [15, p. 213-216].

On the contrary, Hater Battay argues that responsibility and intelligence expansion can be compatible and even mutually beneficial in an epistemological context. There is an epistemological field in which consciousness expansion (a further expansion of cognitive horizons through digital technology) can be responsible. This viewpoint emphasizes the possibility of an intersection between the sense of responsibility and the cognitive domain [20, 21]. And discussions show that H.Battay is not alone in this position. Many researchers have begun to take an active approach to the issue against the background of increased accountability at a stage when the application of digital technologies is intensifying. For example, J. Simon came to this conclusion [22].

The issue has gained heightened relevance in light of the COVID-19 epidemic. Scholars like N. Levy and J. Savulescu label the dissemination of false information about the coronavirus through digital technology as "epistemological irresponsibility," emphasizing its perilous implications for science and society at large. They wrote: “The coronavirus crisis is different because there is not yet an expert consensus to which nonexperts can defer. Nor, however, is it a case in which the stakes are low, because decisions affect a variable that explains only a small part of the variance. For those decision-makers who must settle policy, it is a perfect epistemic storm” [23, p. 7]. Based on the philosophical-theoretical comparisons, it is possible to conclude that rational acceptability, cognitive (intellectual) expansion, the formation of knowledge and theories, their functionalization and globalization in socio-cultural practical communicative aspect, belong to the conceptual and methodological components of the general "digital cognitive expansion" phenomenon in the epistemological aspect. In other words, the epistemic responsibility of the cognizant subject is closely related to the digital "epistemic environment" that surrounds him and in that sense depends on it. As examples of this, we mentioned search services and social media above. As a result, digital cognitive expansion is an important topic in modern philosophical and scientific thinking. Among the study done on digital cognitive expansion, R.A. Heersmink and his colleagues' findings are remarkable [24, p. 1-12]. P. Smart, R. Heersmink and R. U. Clowes examine the role played by the Internet in digital cognitive expansion in the era of digitality based on the concept of "cognitive ecology". "Cognitive ecology" refers to the "multidimensional contexts" in which we individuate, think, perceive, communicate, imagine, and act. We do this mainly in a collective form and under conditions of constant active mixing with the environment [24, p. 251]. In this sense, the internet can be viewed as a new type of cognitive ecology that provides a vast amount of digital knowledge. And this process is becoming more "ingrained in our cognitive routine" [24, p. 251].

Situational cognition and cognitive ecology are inextricably linked. The cognitive process that "takes into account our living interactions with the socio-technological environment" is referred to as situational cognition. It turns out that the internet as a new type of cognitive ecology creates a unique cognitive situation and in this capacity gives a new impetus to the formation of digital cognitive expansion [24].

In the framework of digital cognitive expansion, R. Heersmink suggests nine intellectual or epistemological virtues. He divides them into the following categories: intellectual curiosity, intellectual autonomy, intellectual humility, intellectual attention, intellectual sanity, impartiality, intellectual boldness, and intellectual stability [25, p. 1]. By the way, in philosophy, the term "intellectual virtue" refers to the possession of traits like wisdom, knowledge, intelligence, perfection, skill, ability, and competence. In this piece, we also accept intellectual virtue in that sense.

Thus, the production of knowledge, the content of knowledge-information interactions, the functionalization of knowledge, and its social-practical application are all multi-vector linkages that are

created by digitality. The question of authenticity of knowledge takes on a completely new content. In modern studies, this point is investigated in close connection with phenomena such as rational acceptability and digital cognitive expansion. As a result, the relevance of the epistemology of virtue is heightened in the context of the digital age. In this sense, the phenomenon of digital cognitive expansion plays a determining and guiding role in interdisciplinary relations at the modern stage. The realization of digital cognitive expansion occurs within the framework of more general philosophical and scientific considerations. In that quality, for example, globalization of scientific knowledge, cosmotechnicism and epistemology of virtue can be shown. The question of integrity, uniformity, and unity of knowledge within the context of intersubjective understanding is the general scientific-research challenge shared by all of these choices in the philosophical-scientific perspective. Approaching interdisciplinary relations in that perspective would be more adequate.

CONCLUSION

1. The issue of achieving unity, synthesis, and integrity of knowledge in the intersubjective cognitive context at the contemporary stage is intricately linked to maintaining the subject's integrity and their engaged reflexive activity.
2. Another significant epistemological argument is related to the fact that these two components are "charged" to contemporary digital reality in substantive and communicative-functional dimensions.
3. From here, we might infer that the issue of the unity of knowledge and the structure of knowledge, or the development of scientific ideas, are closely related.
4. Furthermore, the importance of mechanisms that uphold knowledge unity in reflexive and active environments is evidently apparent.
5. The evaluation of knowledge based on the principle of "rational acceptability" in digital conditions shows that pluralism and alternative play an important role in the formation of knowledge. This process has a special meaning against the background of concepts such as "rational expansion", "cognitive expansion", "intellectual expansion".
6. In this context, the concept of "digital cognitive expansion" holds a significant place in contemporary philosophical and scientific comprehension.

REFERENCES

1. Волков, Ю.К. Технонаука, человечество и человек: в поисках формулы сосуществования // Эпистемология и философия науки, – 2022, 59 (1), – с. 211-224.
2. Ястреб, Н.А. Технонаука как современный этап развития технического знания // Вестник Пермского Университета. Философия. Психология. Социология, – 2014, 4 (20), – с. 33-37.
3. Hui, Y. Recursivity and Contingency / Y.Hui. – London: Rowman & Littlefield International Ltd., – 2019. – 336 p.
4. Qurbanov, F.M., Zülfüqarov, V.R. Müasir elmdə fənlərarası yanaşma: bəzi aspektlərin fəlsəfi analizi // Gənc tədqiqatçı elmi-praktik jurnalı, – 2018, 4 (2), – s. 192-197.
5. http:// psylib.org.ua/books/feyer01/index.htm.
6. Буданов, В.Г. Сложностность и проблема единства знания. Вып. 1: К стратегии познания сложности / В.Г.Буданов, В.И.Аршинов, В.Е.Лепский – М.: ИФ РАН, – 2018. – 105 с.
7. Аршинов, В.И., Буданов, В.Г. Системы и сети в контексте парадигмы сложности // Вопросы Философии, – 2017. № 1, – с. 50-61.
8. http://wosc. co/
9. http://mniipu.org/kongress-vsemirnoj-organizacii-sistem-i-kibernetiki-wosc-2020/

10. Никоненко, С.В. Парадигмы и принцип интернализма: исследование понятия «рациональная приемлемость» // Эпистемология и философия науки, – 2023, 60 (1), – с. 82-97.
11. Патнэм, Х. Разум, истина и история / Х.Патнэм, Т.А.Дмитриева, М.В.Лебедева – М.: Праксис, – 2002. – 296 с.
12. Лакатос, И. Фальсификация и методология научно-исследовательских программ; история науки и ее рациональные реконструкции // Структура научных революций, – 2002. – с. 269-524.
13. Levin, S.M. Intellectually virtuous inquirer and the practical value of truth // Epistemology & Philosophy of Science, – 2021, 58 (4), – p. 54-59.
14. Асташова, Н.Д., Масланов, Е.В. Рациональные основания творческого сознания в науке // Эпистемология и философия науки, – 2023, 60 (1), – с. 34-42.
15. Шевченко, С.Ю. Расширенный разум и эпистемическая ответственность в цифровом обществе // Эпистемология и философия науки, – 2021, 58 (4), – с. 209-227.
16. Miller, B., Record, I. "Responsible Epistemic Technologies: A Social-Epistemological Analysis of Autocompleted Web Search" // New Media& Society, – 2016, 19 (12), – p. 1945-1963.
17. Boyd, K. "Epistemically Pernicious Groups and the Groupstrapping Problem" // Social Epistemology, – 2019, 33 (1), – p. 61-73.
18. Pritchard, D. "Extended Virtue Epistemology" // Inquiry, – 2018, 61 (5), – p. 632-647.
19. Pritchard, D. In defence of veritism // Epistemology & Philosophy of Science, – 2021, 58 (4), – p. 22-37.
20. Battaly, H. "Extending Epistemic Virtue: Extended Cognition Meets Virtue Responsibilism" // Extended Epistemology, – 2018. – p. 20.
21. Schwengerer, L. "Online Intellectual Virtues and the Extended Mind" // Social Epistemology, – 2020, 35 (3), – p. 312–322.
22. Simon, J. "Distributed Epistemic Responsibility in a Hyperconnected Era" // Being Human in a Hyperconnected Era, – 2015. – p. 145-160.
23. Levy, N., Savulescu, J. Epistemic responsibility in the Face of a Pandemic // Journal of Law and the Biosciences, – 2020, 7 (1), – p. 1-17.
24. Smart, P., Heersmink, R., Clowes, R. "The Cognitive Ecology of the Internet." In Cognition Beyond the Brain // Computation, Interactivity and Human Artifice, – p. 251-282.
25. Heersmink, R.A. Virtue Epistemology of the Internet: Search Engines, Intellectual Virtues and Education // Social Epistemology, – 2018, № 32 (1), – p. 1-12.

BİLİKLƏRİN BİRLİYİ, RASİONALLIĞIN GENİŞLƏNMƏSİ VƏ "RƏQƏMSAL KOQNİTİV GENİŞLƏNMƏ": EPİSTEMOLOJİ YANAŞMA

F.M. Qurbanov, T.V. Əlibəyova

Rəqəmsallığın cəmiyyətin müxtəlif sahələrinə geniş tətbiqi şəraitində elmi biliklərin birliyi və bütövlüyü məsələsi daha da aktuallaşır. Biliklərin vəhdətini təmin etmək dərin epistemoloji problemə çevrilir. Məqalədə bu məsələyə yeni rəqəmsal texnologiyaların tətbiqi fonunda fəlsəfi-elmi rakursda baxılır. Göstərilir ki, biliklərin yaranması və funksionallaşması müasir epistemoloji yanaşmalarla sıx bağlıdır. Onların sırasında fəzilət epistemologiyası xüsusi yer tutur. Bu epistemologiya çərçivəsində rasional qəbuledilənlik, rasional genişlənmə, rəqəmsal koqnitiv genişlənmə kimi anlayışların qarşılıqlı əlaqədə tədqiqi aktuallıq kəsb edir. Məqalədə müasir rəqəmsallıq şəraitində biliklərin yaranması və funksionallaşması mürəkkəb və plüralistik proses kimi araşdırılır.

Elmi məqsəd. "Rəqəmsal koqnitiv genişlənmə" epistemoloji fenomeni prizmasında biliklərin yaranmasının koqnitiv-sosial-mədəni mühit qarışılqlı əlaqəsi kontekstində fəlsəfi-elmi dərkinə nail olmaq.

Metodologiya. Məqalədə fənlərarası metodologiya tətbiq edilir. Bunun üçün konkret olaraq intersubyektivlik, sinergetik inteqraiya və koqnitiv genişlənmə metodoloji prinsiplərindən istifadə olunur.

Metod. Müqayisəli təhlil və sinergetik sintez metodları tətbiq edilir.

Elmi yenilik. Elmi biliklərin formalaşması fəzilət epistemologiyası çərçivəsində "rəqəmsal koqnitiv genişlənmə" anlayışı kontekstində araşdırılmışdır.

Açar sözlər: *texnoelm, postakademik elm, elmin finalizasiyası, rasional qəbuledilənlik, genişlənmiş zəka, kosmotexnika epistemasi, fəzilət epistemologiyası, intersubyektivlik, koqnitiv ekologiya*

ЕДИНСТВО ЗНАНИЯ, РАСШИРЕНИЕ РАЦИОНАЛЬНОСТИ И «ЦИФРОВАЯ КОГНИТИВНАЯ РАСШИРЕНИЕ»: ЭПИСТЕМОЛОГИЧЕСКИЙ ПОДХОД

Ф.М. Гурбанов, Т.В. Алибайова

Вопрос единства и целостности научного знания становится все более актуальным в условиях широкого применения цифровизации в различных сферах жизни общества. Обеспечение единства знания становится глубокой эпистемологической проблемой. В статье этот вопрос рассматривается с философско-научной точки зрения на фоне применения новых цифровых технологий. Показано, что порождение и функционализация знаний тесно связаны с современными гносеологическими подходами. Эпистемология добродетели занимает среди них особое место. В рамках этой эпистемологии актуально изучение таких понятий, как рациональная приемлемость, рациональное расширение и цифровое когнитивное расширение во взаимодействии. В статье рассматривается создание и функционализация знаний в условиях современной цифровизации как сложный и плюралистический процесс.

Научная цель. Достижение философско-научного осмысления порождения знания через призму гносеологического феномена «цифровое когнитивное расширение» в контексте взаимодействия когнитивной и социокультурной среды

Методология. В статье применяется междисциплинарная методология. В частности, для этого используются методологические принципы интерсубъективности, синергетической интеграции и когнитивное расширение.

Метод. Применены методы сравнительного анализа и синергетического синтеза.

Научная новизна. Формирование научного знания исследовано в контексте концепции «цифровое когнитивное расширение» в рамках эпистемологии добродетели.

Ключевые слова: *технонаука, постакадемическая наука, завершение науки, рациональная приемлемость, расширенный интеллект, эпистема космотехники, эпистемология добродетели, интерсубъективность, когнитивная экология*

UDC: 330.3, 339.9
ORCID: 0009-0004-2411-4499 (Rahimli)

PERSPECTIVES OF INNOVATIVE DEVELOPMENT OF SCIENCE DURING THE TRANSITION TO DIGITAL ECONOMY

Arif Rashid Rahimli
Azerbaijan State University of Economics
E-mail: arif_rahimli@unec.edu.az
Received: 24.02.2023
Accepted: 04.08.2023

The article examines the steps taken to develop information and communication technologies and the digital economy during the Fourth Industrial Revolution, the work done to improve the efficiency of public administration, information security and living standards of citizens, and analyzes international statistics in detail. Also, in the document "Azerbaijan 2030: National Priorities for Socio-Economic Development" approved by the President of the Republic of Azerbaijan, in accordance with the importance of education in accordance with the requirements of the XXI century, the country's position in international assessments, International Science Rating and ICT Development Index. In accordance with the provisions of the Decree of the President of the Republic of Azerbaijan on improving governance in the field of digital transformation, a number of proposals were made in this direction, along with the possible results of the goals set in recent years for the development of science in our country. In addition, the article examines PISA (Programme For International Student Assessment), PIRLS (Progress in International Reading Literacy Study), TIMSS (Trends International Mathematics and Science Study) and ICILS (International Computer and Information Literacy Study), as well as the development of digital technology. There is also information on approaches.

Keywords*: Information and Communication Technologies, innovation, education.*
DOI: 10.59849/2409-4838.2023.3.149

INTRODUCTION

Thanks to the formation of the Fourth Industrial Revolution on the basis of new challenges, global advances in the field of digitization have been achieved, which has created a solid foundation for the development of new scientific fields in recent decades. Because high-quality, safe and efficient digital transformation in advanced practices, as well as effective use of resources in this field, is considered a driving force in the development of innovations. This driving force has become a great trend for the development of society in Azerbaijan, and has led to the taking of appropriate steps by the state in the direction of the development of this field. In order to increase the efficiency of the economy and state administration, information security and the living standard of citizens, the development of the broadband internet network that forms the basis of the Information and Communication Technologies infrastructure, "Government Cloud" (G-Cloud), "Big Data", "Smart City" Implementation of digital initiatives such as "Smart City" and "Smart Village" is one of the steps taken in the direction of turning our country into a digital center in the region.

In this regard, the Decree of the President of the Republic of Azerbaijan dated April 27, 2021 aims to effectively coordinate work in the field of managing the construction of modern telecommunications and digital architecture in the country, as well as developing a platform for digital services and solutions in various fields [1].

MAIN PART

Digitization, as in all fields in the world and in our country, took the field of economy and laid the foundation of a new stage in this field. The world has begun to take important steps towards the transition to the digital economy. From social relations to economic relations, from statistical data to assessment mechanisms, digital changes in our country led to the reduction of the "shadow economy" in the next period of activity. So, since the beginning of 2019, tax incentives have been defined for business entities to formalize their workplaces and salaries in the tax legislation. With this, the income tax (14 percent) on the salaries of individuals in the non-oil private sector up to 8,000 manats was canceled, which is 14 percent of the total tax payers.

As a result, the number of labor contracts in the private sector of the non-oil sector increased by 18.3 percent that year, and by 24 percent in 2020, compared to the period when tax incentives were introduced. At that time, the growth rates of the wage fund in that sector were 29.5 percent and 12.3 percent, respectively. Although this step caused an average annual tax loss of 300 million manats for the budget, in general, due to the "whitening" of the salary fund, it allowed more social insurance fees to enter the DSMF, which, as a result, made it possible to significantly reduce the subsidies allocated from the budget to the account of the fund. So, in 2019, the income from mandatory state social insurance payments increased by 26 percent compared to the previous year, and by 21.6 percent in 2020. Thus, in addition to compensating the state budget losses, it has succeeded in creating long-term sources of income for the budget [2].

In achieving these indicators, we can note the importance of the steps taken towards the wide application of digital technologies in the country, the establishment of digital service providers, e-commerce, and e-business networks. Because economic growth includes not only income from taxes, but all financial sources of the country. According to the 2017 reports, Azerbaijan ranked 65th out of 176 countries in the ICT Development Index with a score of 6.20, and according to the 2022 report, it rose to the 73rd place in the Economic Transformation Index (in 2020, this figure was 76, in 2018 and 85 in 2011) can be considered as one of the comprehensive measures taken in this field in the country [4, 5, 6] (Figure 1).

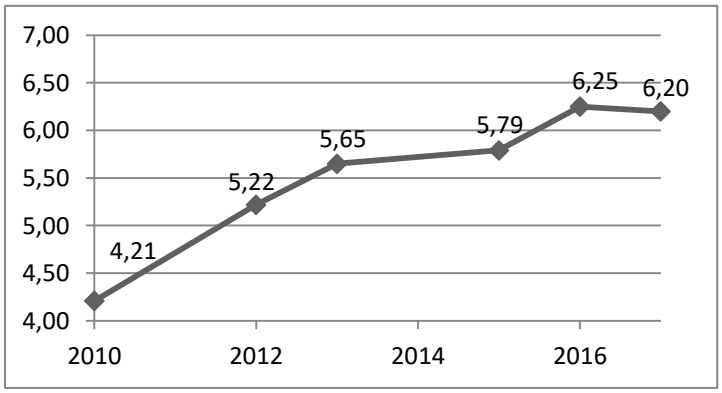


Fig. 1. ICT development index in Azerbaijan in different years between 2010-2017 (prepared by the author)

Of course, against the background of these processes, the development of science is reshaped by the influence of digital technologies, certain changes occur in the organization and methods of scientific research. The formation of digital platforms minimizes the time spent on conducting experiments, collecting and processing data, and plays a major role in building scientific infrastructure with the help of digital tools. It is no coincidence that in recent years, the scientific databases that prevent plagiarism and further stimulate the activity of researchers are among the

optimal methods for measuring the quantitative and qualitative indicators of scientific results. Considering that in the formation of these bases, two forms of activity evaluation approach (expert and statistical) are used, therefore, it is important to evaluate the creation of scientific databases such as "Scopus", "Web-Science", "Google Scholar" as an important step in the development of science with innovative methods[7].

If we conduct research based on international reports and statistics about the work done in the field of science in Azerbaijan, the International science rating is the main reference point for us. Thus, according to the number of published scientific works, Azerbaijan ranks 93 out of 240 countries, and according to the Hirsch index, it ranks 96. It should be noted that neighboring countries Russia (12th, 22nd places), Türkiye (20th, 36th places), Iran (21st, 40th places), Georgia (84th, 69th places) and Armenia (89th, 66th places), respectively, are in a higher position than our country in both ratings [8].

At the same time, the growth dynamics observed in the number of scientific works of Azerbaijani origin included in the "Scopus" scientific database between 1996 and 2020 indicates the success of the steps taken in this direction. In 1996, 251 of our scientific articles were included in "Scopus" during the year, but in 2020, this number increased to 1955 (Figure 2).

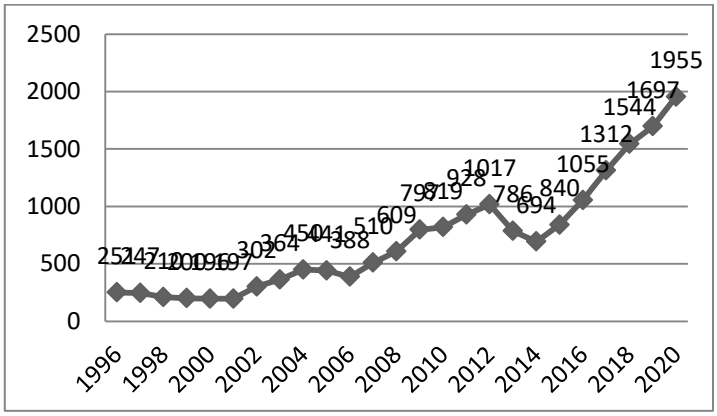


Fig. 2. The number of works of Azerbaijani origin included in the scientific database “Scopus” between 1996 and 2020 [3]

These statistics, in fact, challenge us to set bigger goals and move faster in our digital world. The document "Azerbaijan 2030: National Priorities for Socio-Economic Development" approved by the President's Order dated February 2, 2021 also emphasized the importance of education in accordance with the requirements of the 21st century and improved the country's position in international assessments (PISA, PIRLS, TIMSS, ICILS). is intended to be. Let's analyze the data in this direction and learn more about the position of our country.

PISA-Programme for International Student Assessment is a worldwide study by the Organization for Economic Cooperation and Development that aims to evaluate education systems by measuring the school performance of 15-year-old students in member and non-member countries. These studies have been conducted every 3 years since 2000, and studies cover 3 different areas (literacy, science, and mathematics).

Azerbaijan joined the international assessment since 2018 and ranked 65th among the 79 countries participating in PISA (Figure 3) (57th in mathematics, 69th in science, 69th in reading and writing). Among neighboring countries, Russia ranks 32nd on average (31st in mathematics, 30th in science, 34th in reading and writing), Türkiye 41st (43rd in mathematics, 40th in science, 40th in reading and writing), and Georgia ranks 71st (67 in mathematics, 71 in science, 74 in reading and writing).

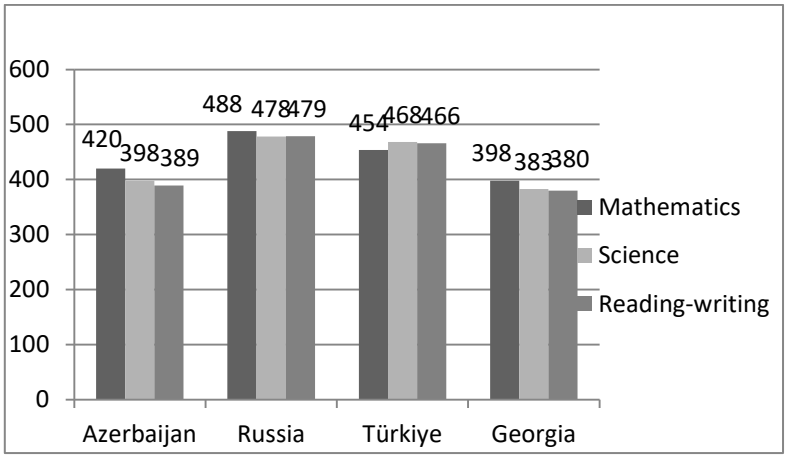


Fig. 3. Statistical data of Azerbaijan and neighboring countries on PISA 2018 assessment (prepared by the author) [9]

PIRLS - Progress in International Reading Literacy Study is an international study on the reading (comprehension) achievement of fourth graders. It is held every five years by the International Association for the Evaluation of Educational Achievement (IEA) since 2001. The main purpose of conducting the research is to measure children's reading literacy and collect information about different experiences of reading habits.

The most recent study was conducted in 2021, and the results will be made public in December 2022. Although our country joined the research in 2011 and ranked 37th with 462 points in the conducted research, in 2016 this number dropped to 39th with 472 points. According to the 2016 research, the neighboring countries - Russia ranked first (581 points), Georgia ranked 37th (488 points), and Iran ranked 45th (428 points). In 2011, Russia scored 568 points, 3 points behind Hong Kong and took the 2nd place. Georgia ranked 34th with 488 points, and Iran ranked 38th with 457 points [10] (Figure 4).

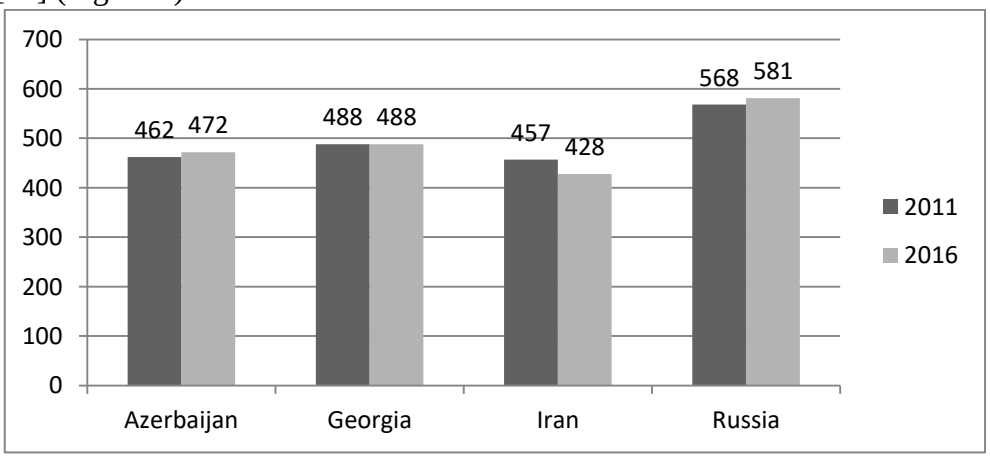


Fig. 4. Statistical data of Azerbaijan and neighboring countries on PIRLS assessment by year (prepared by the author)

TIMSS - Trends in International Mathematics and Science Study is an international assessment series of mathematical and scientific knowledge of students around the world. The students participating in the study are students of different educational systems in terms of economic development, geographical location and population size. A minimum of 4,000-5,000 students are evaluated in each country or regional jurisdiction during the study period. Assessments

are collected through contextual questionnaires from students, as well as their parents and teachers.

TIMSS is another study created by the International Association for the Evaluation of Educational Achievement (IEA) that allows education systems around the world to compare the educational achievements of students and learn from the experiences of other participating countries in developing effective education policies. This assessment was conducted for the first time in 1995, and after that every four years, covering 4th and 8th grade students of educational institutions [11].

The most recent study on Trends in International Mathematics and Science Study (TIMSS) was conducted in 2019, and Azerbaijan participated in the assessment of this study among 4th graders. In addition to Azerbaijan, which ranked 28th in mathematical knowledge with 515 points, and 50th in scientific knowledge with 427 points, other neighboring countries, except Georgia, participated in the assessment. The results are as follows: Russia ranks 6th (567 points) and 3rd (567 points), Türkiye ranks 22nd (523 points) and 19th (526 points), Armenia ranks 38th (498 points) and 43rd place (466 points), while Iran is 50th (443 points) and 48th place (441 points) [12] (Figure 5).

ICILS - International Computer and Information Literacy Study (International Computer and Information Literacy Study) assesses the knowledge of information and communication technologies (ICT) of students and teachers around the world. This test was created in June 2010 by the International Association for the Assessment of Educational Achievement. The research was conducted twice - in 2013 and 2018. The next stage of the research is planned to be held in 2023.

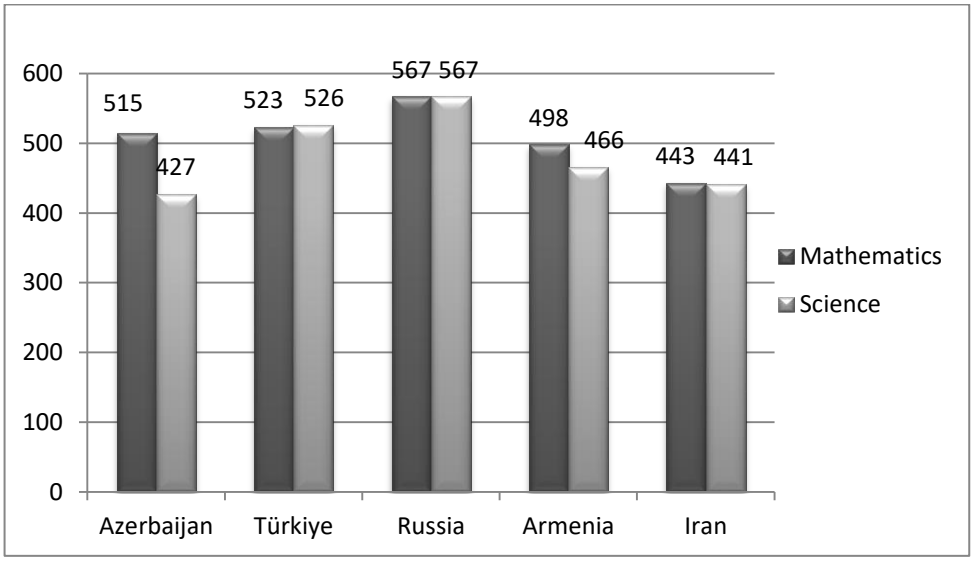


Fig. 5. Statistical data of Azerbaijan and neighboring countries on TIMSS 2019 assessment (grade 4) (prepared by the author)

It should be noted that from the neighboring countries, Russia took part in both studies, and Türkiye took part in one study (2013). In the ICILS 2018 study, which took place with the participation of 13 countries, in addition to Russia, only Kazakhstan participated in the CIS region (Figure 6).

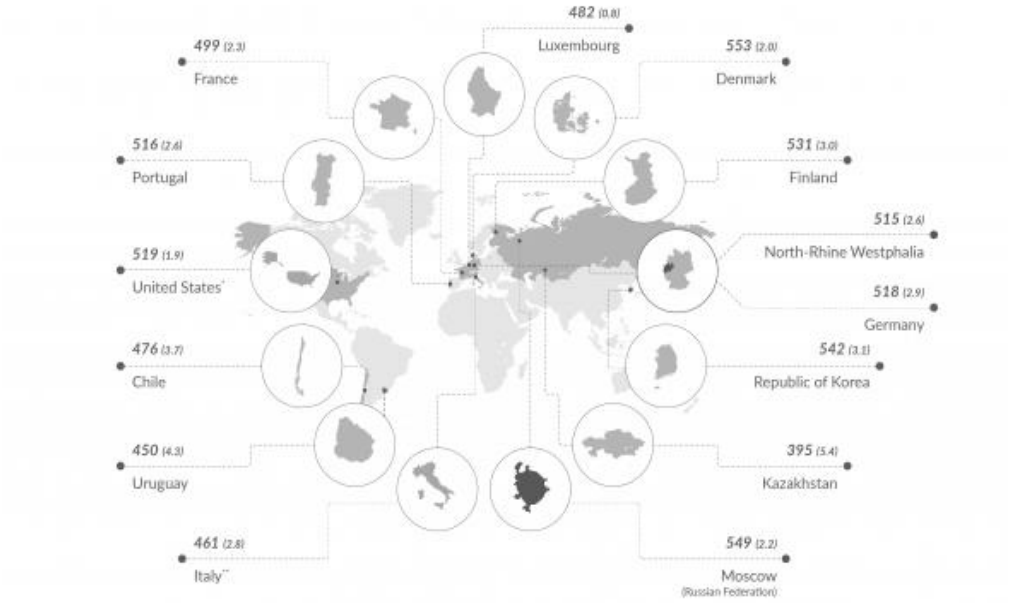


Fig. 6. Countries participating in the ICILS 2018 study and information literacy indices [13]

Key findings from the ICILS 2018 study are:

1. Young people cannot acquire digital skills by using digital devices alone, as they need to demonstrate functional working knowledge of these tools;
2. It is not enough to provide only ICT equipment to improve the digital skills of students or teachers, as there is a need for education in this area;
3. There is a digital divide related to the socio-economic status of students, as the information literacy index of students with poor socioeconomic status is quite low.

CONCLUSION

The results of all these studies once again reveal the necessity of Azerbaijan's development in this field. In the future, taking into account that the innovative development of the field of science will indirectly depend on young scientists and researchers, in order to improve the scientific research work in the country, stimulating the activity of scientific research centers and student scientific societies in higher education institutions, including in the direction of the development of science both in the field of ICT and in general in secondary schools It is very important to educate the youth.

Only in this way, Azerbaijan will be able to achieve great success in the field of science in a short period and the higher education and scientific research institutions operating in our country can raise their ranks in the international rating lists. Because the world's prestigious higher education institutions such as Massachusetts Institute of Technology, Harvard, Oxford, and Cambridge University are in the first ranks not only in terms of the quality of education, but also in terms of their contributions and contributions to world science.

AKNOWLEDGEMENTS

I express my gratitude to the rector of Azerbaijan State University (UNEC), doctor of economic sciences, Professor Mr. Adalat Muradov, for the publication of this research work in the "Young Researcher" journal of Azerbaijan National Academy of Sciences (ANAS) Young Scientist and Specialist Council.

REFERENCES

1. https://president.az/az/articles/view/51299
2. https://www.taxes.gov.az/az/post/1566
3. Muradov, A.S. Economy of Azerbaijan / A.S.Muradov, E.R.Bagirzade – Baku: East-West, – 2021. – 208 p.
4. "Measuring the Information Society Report 2014" / – Geneva: Switzerland, – 2014. – p. 40.
5. "Measuring the Information Society Report 2015" / – Geneva: Switzerland, – 2015. – p. 46.
6. "Measuring the Information Society Report 2015" / – Geneva: Switzerland, – 2015. – p. 46.
7. Vinkler, P. The Evaluation of Research by Scientometric Indicators / P.Vinkler. – 2010. – p. 80.
8. https://www.scimagojr.com/countryrank
9. https://www.oecd.org/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20PDF.pdf
10. http://timssandpirls.bc.edu/pirls2016/international-results/pirls/about-pirls-2016/
11. https://timss2019.org/reports/about/
12. https://timss2019.org/reports/achievement/#math-4
13. https://www.iea.nl/studies/iea/icils/2018

RƏQƏMSAL İQTİSADİYYATA KEÇİD DÖVRÜNDƏ ELMİN İNNOVATİV İNKİŞAF PERSPEKTİVLƏRİ

A.R. Rəhimli

Məqalədə Dördüncü Sənaye İnqilabı dövründə İnformasiya-Kommunikasiya Texnologiyalarının və rəqəmsal iqtisadiyyatın inkişafı istiqamətində atılan addımlar, dövlət idarəetməsinin səmərəliliyinin, informasiya təhlükəsizliyinin və vətəndaşların yaşayış səviyyəsinin yüksəldilməsi məqsədilə görülmüş işlər araşdırılaraq, beynəlxalq statistik göstəricilər ətraflı təhlil edilib. Həmçinin Azərbaycan Respublikasının Prezidenti tərəfindən təsdiq edilən "Azərbaycan 2030: sosial-iqtisadi inkişafa dair Milli Prioritetlər" sənədində XXI əsrin tələblərinə uyğun təhsilin əhəmiyyətinə uyğun olaraq, ölkənin beynəlxalq qiymətləndirmələrdə, Beynəlxalq elm reytinqi və İKT-nin İnkişafı İndeksində ölkəmizin mövqeyi ətraflı öyrənilib. Rəqəmsal transformasiya sahəsində idarəetmənin təkmilləşdirilməsi haqqında Azərbaycan Respublikası Prezidentinin Fərmanında qeyd olunan müddəalara uyğun olaraq ölkəmizdə elmin inkişafı istiqamətində son illər ərzində qarşıya qoyulan hədəflərin gələcəkdə mümkün ola biləcək nəticələri ilə yanaşı bu istiqamətdə bir sıra təkliflər verilib. Bununla yanaşı məqalədə PISA (Beynəlxalq Şagirdlərin Qiymətləndirilməsi Proqramı), PIRLS (Beynəlxalq Oxu Savadlılığının Tədqiqi Proqresi), TIMSS (Beynəlxalq Riyaziyyat və Elm Tədqiqatında Trendlər) və ICILS (Beynəlxalq Kompüter və İnformasiya Savadlılığı Tədqiqatı) tədqiqatları, habelə rəqəmsal texnologiyaların inkişafı fonunda müasir elmin tətbiq etdiyi yanaşmalar barədə məlumatlar da yer alır.

Açar sözlər: *İnformasiya-Kommunikasiya Texnologiyaları, innovasiya, təhsil.*

ПЕРСПЕКТИВЫ ИННОВАЦИОННОГО РАЗВИТИЯ НАУКИ ПРИ ПЕРЕХОДЕ К ЦИФРОВОЙ ЭКОНОМИКЕ

А.Р. Рагимли

В статье рассматриваются шаги, предпринятые для развития информационно-коммуникационных технологий и цифровой экономики в период Четвертой промышленной революции, проделанная работа по повышению эффективности государственного управления, информационной безопасности и уровня жизни граждан, подробно анализируется международная статистика. Также в документе «Азербайджан 2030: Национальные приоритеты социально-экономического развития», утвержденном Президентом Азербайджанской Республики, в соответствии с важностью образования в соответствии с требованиями XXI века, подробно изучено положение нашей страны в международных оценках, Международном научном рейтинге и Индексе развития ИКТ в соответствии с требованиями XXI века. В соответствии с положениями Указа Президента Азербайджанской Республики о совершенствовании управления в сфере цифровой трансформации, в этом направлении был внесен ряд предложений, наряду с возможными результатами, поставленных в последние годы целей для развития науки в нашей стране. Кроме того, в статье рассматриваются исследования PISA (Международная программа оценки учащихся), PIRLS (Международная программа исследований грамотности чтения), TIMSS (Международные тенденции научных исследований в области математики и естественных наук) и ICILS (Международные исследования компьютерной и информационной грамотности), а также на фоне развития цифровых технологий информация о подходах, применяемых современной наукой.

Ключевые слова: *Информационно-Коммуникационные Технологии, инновации, образование.*

YOUNG RESEARCHER
Scientific&practical journal

Volume IX

2023
№3

BAKU – 2023

Director of the publishing house: *Sabuhi Gahramanov*
Computer developer: *Ramil Azizov*
Graphic design: *Shalale Mammad*

Format 60x84 1/8
Volume 20 p.p.
Print run 200

Address: Istiglaliyyat, Baku city