SCIENTIFIC AND ORGANISATIONAL REPORT

of the department "Fluid and Gas Mechanics" for 2023

Topic: Development of theoretical and applied bases of non-stationary, non-equilibrium processes arising from the combined flow of heterogeneous systems.

In the reporting period, research works were carried out in accordance with the schedule.

Three works are envisaged on the theme, which were successfully completed during the reporting period, important theoretical and practical bases in the investigated direction were developed, models were built and research in the direction of development of applied research bases was carried out.

Work 1. Investigation of the influence of consolidation in porous media on the formation of fractal structures in porous media.

Within the framework of this research work the issues of fractal structures formation at fluid filtration under the conditions of soil consolidation occurring in reservoirs under the action of rock pressure were investigated. The researches on development of significant theoretical and practical bases in this direction were carried out.

Work 2: Investigation of interaction conditions at different densities in porous medium in order to regulate non-equilibrium effects during displacement.

All systems subjected to various kinds of influences, including in the process of fluid filtration, change their characteristics and acquire a state of non-equilibrium with a certain energy. Taking this into account, physical and chemical transformations occurring in separate zones of porous medium were investigated in relation to oil production processes, consequences of phase transformations and pressure changes were studied in order to regulate such states during displacement, features of interaction at different density ratios in porous medium were theoretically and experimentally investigated. Models are constructed and applications are justified.

Work 3. Investigation of influence of mutual diffusion in solutions on nonequilibrium state under filtration process.

It is established that flow rate fluctuations at mutual displacement of fluids with different mineralization have oscillatory character in time. It is substantiated that these changes are caused by the influence of physicochemical properties and the direction of diffusion of the displacing liquid.

It was also shown that these conditions, obtained from the results of experimental and theoretical studies, are important tasks in regulating the flow velocity in porous media.

During the reporting period, eight articles were published and one article was accepted for publication. Five of the eight articles were published in the WoS, Scopus database. The following works can be noted:

1. Azizaga Kh. Shakhverdiev, Geylani M. Panahov, Renqi Jiang & Eldar M. Abbasov (2022) High efficiency in-situ CO2 generation technology: the method for improving oil recovery factor // Petroleum Science and Technology, DOI: 10.1080/10916466.2022.2157010 (**Web of Science, Scopus**).

2. Geylani M. Panahov, Eldar M. Abbasov, Babek N. Sultanov Control of capillary instability under hydrodynamic impact on the reservoir // Nafta-Gaz 2023, no. 2, pp. 71–83, DOI: 10.18668/NG.2023.02.01 (**Web of Science**).

3. Geylani Panahov, Parviz Museibli, Babek Sultanov Effect of soil consolidation on the fractality of the filtration law // 84-94, JAME, volume 28, number 1 (2023). 10.59441/ijame-2023-0008 (**Scopus**).

4. Abbasov E.M., Panahov G.M., Salmanova G.M. Phase transformatıons ın pıpelıne gas transportatıon and methods to prevent emergıng complıcatıons // Baku Mathematical Journal, 2023, Vol. 2, No 1, pp. 77-87. https://doi.org/10.32010/j.bmj.2023.07

5. G.M. Panahov, E.M. Abbasov, V.J. Balakci / Modellıng the growth of a colmatage agent for reservoır sweep ımprovement under water floodıng / ANAS Transactions, Earth Sciences, Special Issue / 2023, 109- 112; DOI: 10.33677/ggianasconf2023030002 (**Scopus**)

6. Abbasov E.M., Huseynov V.G., Jafarova U.F., Nasibova S.İ. İn situ gas generation in dispersed sustems to control structure formation // Trans.Natl. Acad. Sci. Azerb. Ser. Phys.-Tech. Math. Sci. Mechanics, 42 (8), 3-16 (2022).

7. Бахтизин Р.Н., Панахов Г.М., Аббасов Э.М. Регулирование течением флюидов в пористых средах с учетом электрокинетических эффектов // Нефтегазовое дело, №5, 2023 (**РИНЦ**).

8. İbrahim J. Mamedov An ınvestıgatıon of the dıffusıon effect on the hydrodynamıc parameters ın the fluıd's mutual dısplacement // Pamukkale University Journal of Engineering Sciences (**Web of Science**) (çapa qəbul olunub).

During the reporting period 6 theses were published and there were 6 presentations at scientific conferences.

Corresponding member of ANAS, prof. Geylani Panahov took part in the international conferences "Innovative Technologies in Oil and Gas Production" dedicated to the 95th anniversary of Academician Azad Khalil oglu Mirzajanzadeh in ASOIU and in the international conference of young scientists, teachers, graduate students and specialists of oil and gas industry "Development of oil and gas fields and modelling of technological processes" (24-27 August 2023, Ufa, Bashkortostan, Russia) as an invited speaker at the plenary session. Corresponding Member of ANAS, Professor Geylani Panahov was elected a member of the organising committee of the eighth International Scientific Conference "Actual Problems of Applied Mathematics and Information Technologies" Al-Khorezm-2023, dedicated to the 105th anniversary of the National University of Uzbekistan and 1240th anniversary of Musa-al-Khorezmi with the report "Porous Media during in-situ Gas Generation".

On 27 and 29 September, researchers of the department took part in scientific sessions and international conferences dedicated to the 95th anniversary of Academician Azad Mirzajanzadeh at the Institute of Mathematics and Mechanics and ASOIU.

Associate Professor Eldar Abbasov made a report on "Non-equilibrium effects in the flow of gas-liquid systems and methods of their regulation" at the international conference in ASOIU.

Employees of the department took part in the International Scientific and Practical Conference "Heydar Aliyev and Azerbaijani Oil Strategy: Breakthroughs in Oil and Gas Geology and Geotechnologies" dedicated to the 100th anniversary of the birth of Heydar Aliyev, the national leader of the Azerbaijani people, held at the Oil and Gas Institute. Employees of the department also took part in the international conference "Modern

Problems of Mathematics and Mechanics" dedicated to the 100th Anniversary of national leader Heydar Aliyev. Prof. Geylani Panahov and Eldar Abbasov also took part in the opening of the scientific auditorium at USOTU named "Azerbaijan" in connection with the contribution of Azerbaijani scientists to the development of science and education in Bashkortostan. At the opening ceremony, Prof. Geylani Panahov expressed gratitude on behalf of the scientific staff to all persons who contributed to this work. He also gave an interview to the state television of Bashkortostan, in which he noted important aspects of scientific and technical co-operation between Baku and Ufa scientists.

The next day, 27 September, the Institute's staff took part in the unveiling of Azad Mirzajanzadeh's bas-relief at the Institute of IPTER (VNIISPTneft), where academician Azad Mirzajanzadeh held annual scientific seminars. In the conference hall of the Academy of Sciences of Bashkortostan there were meetings with the president and other staff of the Academy and participation in the sections of the conference. Professor BEA. Geylani Panahov was awarded a diploma of the Academy of Sciences of Bashkortostan for his merits in the development of Azerbaijani-Bashkir scientific and technical relations.

Photo 1. Prof. Geylani Panahov and Associate Professor Eldar Abbasov at the unveiling of the bust of Academician Azad Mirzajanzadeh in the “Azerbaijan” auditorium of Ufa State Petroleum Technical University

Photo 2. Prof Geylani Panahov's speech at the unveiling of the bas-relief of Academician Azad Mirzajanzadeh

Doctor of Philosophy in Mechanics Perviz Museibli and researcher Ibragim Mammadov participated in the XXVI Republican Scientific Conference "Doctoral Students and Young Researchers".

Volume 43, No. 7 of ANAS Transactions (Mechanics issue) has been published and is being prepared for publication in volume 43, No. 8.

Corresponding Member of ANAS, Prof. Geylani Panahov supervised the work of 3 thesis students and 2 master students.

In the reporting period under the supervision of Prof. Geylani Panahov and Associate Professor Eldar Abbasov the master students of the department Zuleikha Sadygova and Sevinj Nasibova completed their research and successfully defended their theses.

Corresponding member of ANAS, professor Geylani Panahov, associate professor Eldar Abbasov and associate professor Afat Yuzbashieva taught various disciplines for masters and bachelors in IMM and BSU.

Corresponding Member of ANAS, Professor Geylani Panakhov and Associate Professor Eldar Abbasov were elected members of the editorial board of the journal “Liquid and gaseous energy resources” of Extrica publishing house (Ufa).

Dr. Parviz Museibli teaches undergraduate students at Azerbaijan Engineering University.

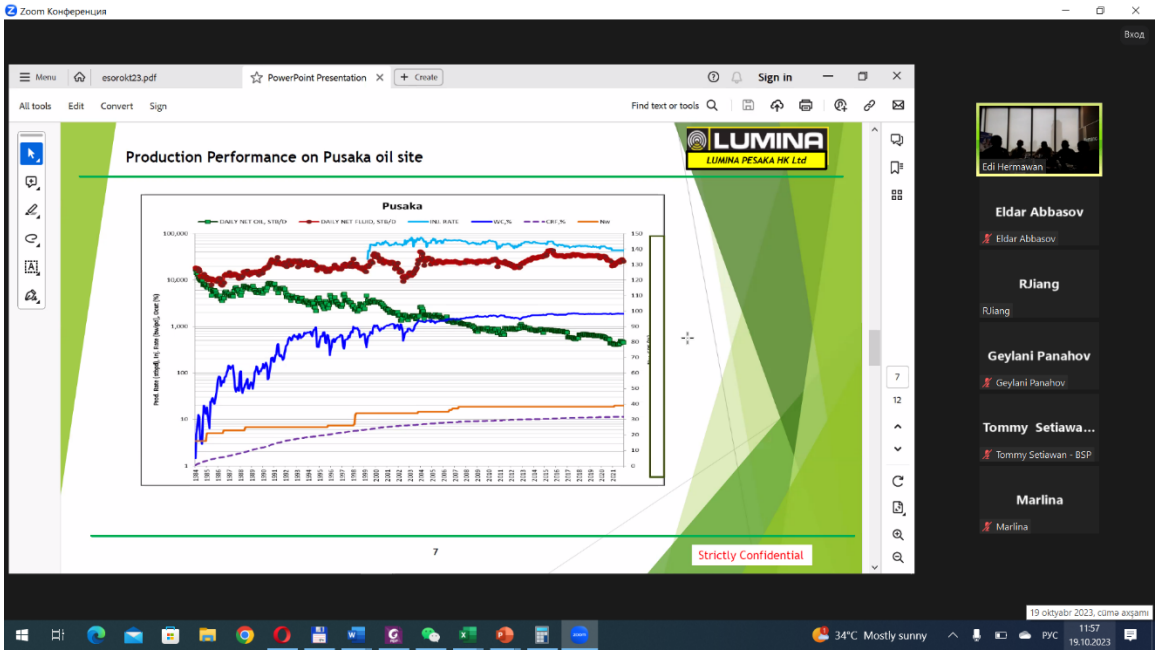
During the reporting period under the supervision of Professor Geylani Panahov, doctoral student Babek Sultanov completed his thesis and conducted its preliminary discussion.

During the reporting period, the researchers of the department conducted field studies at the fields of "Binagady Oil Company" (production wells No. 152968, 212933, 222944, 232954, 232619 and 152960) and "Karasu Oil Company" (production wells No. 1104, 1091).

Photo 3. Implementation of scientific results - Binagady Oil Company, Bakı ş.

Photo. 4. Field testing of the technology - Karasu Oil Company, Shirvan.

Within the framework of cooperation in the reporting period the colleagues of the department Prof. Geylani Panahov and Associate professor Eldar Abbasov together with the Chinese scientific centre GCC Group Corp. held an online presentation of the innovative technology created in the department at the meeting with the specialists of the Indonesian oil producing company Petronas. The oil company approved the research results and noted the possibility of their application at the Pusaka field on Kalimantan Island in Eastern Indonesia.



Şək. 5 Online presentation at Petronas

MOST IMPORTANT RESULTS

research results obtained in the Department of Fluid and Gas Mechanics in 2023 according to the scientific and organisational report

Theme: "Development of theoretical and applied bases of non-stationary, non-equilibrium processes manifested in the co-flow of heterogeneous systems".

Having shown the importance of taking into account in filtration processes the formation of fractal structures as a result of compaction of reservoirs under the action of rock pressure, practical solutions on the basis of their regulation were developed.

Authors: Corresponding Member of ANAS, Professor Geylani Panahov;
Candidate of Technical Sciences, Associate Professor Eldar Abbasov;

Published articles:

1. Azizaga Kh. Shakhverdiev, Geylani M. Panahov, Renqi Jiang & Eldar M. Abbasov (2022) High efficiency in-situ CO_2 generation technology: the method for improving oil recovery factor, Petroleum Science and Technology, DOI: 10.1080/10916466.2022.2157010 (Web of Science, Scopus).

2. Geylani M. Panahov, Eldar M. Abbasov, Babek N. Sultanov, Control of capillary pumping of oil recovery factor, Petroleum Science and Technology, DOI: 1080/.1080/. Sultanov Control of capillary instability under hydrodynamic impact on the reservoir // Nafta-Gaz 2023, no. 2, pp. 71-83, DOI: 10.18668/NG.2023.02.01 (Web of Science).

3. Geylani Panahov, Parviz Museibli, Babek Sultanov Effect of soil consolidation on the fractality of the filtration law 84-94, JAME, volume 28, number 1 (2023). 10.59441/ijame-2023-0008 (Scopus).

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Corresponding Member of ANAS, Professor Geylani Panahov