

ISSN 2518-170X (Online),  
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ  
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ  
Satbayev University

# Х А Б А Р Л А Р Ы

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## ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ  
НАУК РЕСПУБЛИКИ  
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## N E W S

OF THE ACADEMY OF SCIENCES  
OF THE REPUBLIC OF  
KAZAKHSTAN  
Satbayev University

**SERIES**  
**OF GEOLOGY AND TECHNICAL SCIENCES**

**2 (452)**  
**MARCH – APRIL 2022**

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

*NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.*

*Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.*

*НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.*

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**«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».**

**ISSN 2518-170X (Online),**

**ISSN 2224-5278 (Print)**

Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген № **KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *геология, мұнай және газды өңдеудің химиялық технологиялары, мұнай химиясы, металдарды алу және олардың қосындыларының технологиясы.*

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

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**«Известия НАН РК. Серия геологии и технических наук».**

**ISSN 2518-170X (Online),**

**ISSN 2224-5278 (Print)**

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан № **KZ39VPY00025420**, выданное 29.07.2020 г.

Тематическая направленность: *геология, химические технологии переработки нефти и газа, нефтехимия, технологии извлечения металлов и их соединений.*

Периодичность: 6 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

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**News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.**

**ISSN 2518-170X (Online),**

**ISSN 2224-5278 (Print)**

Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420**, issued 29.07.2020.

Thematic scope: *geology, chemical technologies for oil and gas processing, petrochemistry, technologies for extracting metals and their connections.*

Periodicity: 6 times a year.

Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© National Academy of Sciences of the Republic of Kazakhstan, 2022

Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

*NEWS of the National Academy of Sciences of the Republic of Kazakhstan*  
**SERIES OF GEOLOGY AND TECHNICAL SCIENCES**  
**ISSN 2224-5278**

Volume 2, Number 452 (2022), 49-57

<https://doi.org/10.32014/2022.2518-170X.159>

UDC 550.8.052

**B. Almatova<sup>1</sup>, B. Khamzina<sup>2</sup>, A. Murzagaliyeva<sup>2\*</sup>, A. Abdygalieva<sup>2</sup>,  
A. Kalzhanova<sup>1</sup>**

<sup>1</sup>Aktobe Regional University named after K. Zhubanov, Aktobe, Kazakhstan;

<sup>2</sup>West Kazakhstan Agrarian and Technical University named after Zhangir Khan, Uralsk, Kazakhstan.

E-mail: [a7ok\\_86@mail.ru](mailto:a7ok_86@mail.ru)

**NATURAL SORBENTS AND SCIENTIFIC DESCRIPTION  
OF THEIR USE**

**Abstract.** Oil pollution, both in terms of scale and toxicity, is a general planetary danger. Oil and petroleum products cause poisoning, death of organisms and soil degradation. Natural self-purification of natural objects from oil pollution is a long process, especially in conditions where a low temperature regime persists for a long time. The solution of the cleaning problem the soil cover from oil pollution, the development of new and improvement of existing technologies for the restoration of oil-contaminated lands is among the priorities.

Diatomites are organic sedimentary rocks, the basis of which are the remains and fragments of unicellular diatomite algae. Many of their deposits are widely represented in the Republic of Kazakhstan, the Russian Federation, China, the USA, Canada and other countries. In the methods of acid, alkaline and salt treatment, the process is aimed at weakening the microstructure of the sorbent, increasing porosity and specific surface layer.

At the same time, chemical treatment contributes to a change in the features of the crystal structure, an increase in ion-exchange properties in accordance with the change in the composition of variable cations and the appearance of new active centers. Development of an invention for cleaning oil sludge and smeared soil without using a large volume of scarce fertilizer, replacing it with other plant organic residues, reduce the consumption of materials for cleaning, reduce the cost and accelerate it.

**Key words:** natural sorbent, diatomite, rock, oil waste, polluted soil.

**Б. Алматова<sup>1</sup>, Б. Хамзина<sup>2</sup>, А. Мурзагалиева<sup>2</sup>, А. Абдыгалиева<sup>2</sup>,  
А. Калжанова<sup>1</sup>**

<sup>1</sup>Қ. Жұбанов атындағы Ақтөбе өңірлік университеті, Ақтөбе, Қазақстан;

<sup>2</sup>Жәңгір хан атындағы Батыс Қазақстан аграрлық техникалық университеті, Орал, Қазақстан.

Email: *a7ok\_86@mail.ru*

## **ТАБИҒИ СОРБЕНТТЕР ЖӘНЕ ОЛАРДЫ ҚОЛДАНУДЫҢ ҒЫЛЫМИ НЕГІЗДЕМЕСІ**

**Аннотация.** Мұнайдың ластануы, ауқымы жағынан да, уыттылығы жағынан да планетарлық қауіпті болып табылады. Мұнай және мұнай өнімдері улануды, организмдердің өлімін және топырақтың тозуын тудырады. Табиғи объектілерді мұнаймен ластанудан табиғи өзін-өзі тазартуы ұзақ процесс, әсіресе төмен температуралық режим ұзақ уақыт сақталатын жағдайларда тым баяу жүреді. Сондықтан мұнаймен ластанған топырақты қалпына келтіру мәселесі өте өзекті.

Топырақ жамылғысын мұнаймен ластанудан тазарту мәселесін шешу, мұнаймен ластанған жерлерді қалпына келтірудің жаңа технологияларын әзірлеу және қолданыстағы технологияларды жетілдіру басым бағыттардың бірі.

Диатомиттер шығу тегі органикалық тұнбалы жыныстарды білдіреді, олардың негізін бір жасушалы диатомитті балдырлардың қалдықтары мен сынықтары құрайды. Олардың көптеген кен орындары Қазақстан Республикасында, Ресей Федерациясында, Қытайда, АҚШ-та, Канада мен басқа елдерді ұсынылған. Табиғи сорбенттердің маңызды ерекшеліктерінің бірі – оларды әртүрлі өңдеу әдістерін қолдану арқылы модификациялау және белсендіру. Мысалы: термиялық, қышқылдық, тұзды және т.б. әдістерді айтуға болады. Қышқылдық, сілтілік және тұзды өңдеу әдістерінде процесс сорбенттің микроқұрылымын әлсіретуге, кеуектілігін және меншікті беттік қабатын үлкейтуге бағытталған. Сонымен қатар химиялық өңдеу кристалды құрылымдағы ерекшеліктерді өзгертуге, ауыспалы катиондардың құрамының өзгеруіне сәйкес ион алмасу қасиеттерінің жоғарылауына және жаңа белсенді орталықтардың пайда болуына әсер етеді. Тапшы тыңайтқыштың үлкен көлемін пайдаланбай, оны басқа өсімдік органикалық қалдықтарымен алмастыра отырып, мұнай шламы мен сыланған топырақты тазарту үшін өнертабыс жасау, тазартуға арналған материалдар шығынын азайту, оны арзандату және жеделдету.

**Түйін сөздер:** табиғи сорбент, диатомит, тау жынысы, мұнай қалдықтары, ластанған топырақ.

**Б. Алматова<sup>1</sup>, Б. Хамзина<sup>2</sup>, А. Мурзагалиева<sup>2</sup>, А. Абдыгалиева<sup>2</sup>,  
А. Калжанова<sup>1</sup>**

<sup>1</sup>Актюбинский региональный университет им. К. Жубанова,  
Актобе, Казахстан;

<sup>2</sup>Западно-Казахстанский аграрно-технический университет  
имени Жангир хана, Уральск, Казахстан.

E-mail: *a7ok\_86@mail.ru*

## **ПРИРОДНЫЕ СОРБЕНТЫ И НАУЧНОЕ ОБОСНОВАНИЕ ИХ ПРИМЕНЕНИЯ**

**Аннотация.** Нефтяное загрязнение как по масштабам, так и по токсичности представляет собой общепланетарную опасность. Нефть и нефтепродукты вызывают отравление, гибель организмов и деградацию почв. Естественное самоочищение природных объектов от нефтяного загрязнения – длительный процесс, особенно в условиях, где долгое время сохраняется пониженный температурный режим. Поэтому исключительную актуальность приобретает проблема рекультивации нефтезагрязненных почв.

Решение проблемы очистки почвенного покрова от загрязнений нефтью, разработка новых и совершенствование существующих технологий восстановления нефтезагрязненных земель относится к числу приоритетных.

Диатомиты представляют собой органические осадочные породы, основу которых составляют остатки и обломки одноклеточных диатомитовых водорослей. Многие из их месторождений широко представлены в Республике Казахстан, Российской Федерации, Китае, США, Канаде и других странах. Одной из важных особенностей природных сорбентов является их модификация и активация с использованием различных методов обработки. Например: термические, кислотные, соленые и т.д. В методах кислотной, щелочной и солевой обработки процесс направлен на ослабление микроструктуры сорбента, увеличение пористости и удельного поверхностного слоя. При этом химическая обработка способствует изменению особенностей кристаллической структуры, повышению ионообменных свойств в соответствии с изменением состава переменных катионов и появлению новых активных центров. Разработка изобретения для очистки нефтешлама и замазученного грунта без использования большого объема дефицитного удобрения, заменив его другими растительными органическими остатками, снизить расход материалов на очистку, удешевить и ускорить ее.



**Ключевые слова:** природный сорбент, диатомит, горная порода, нефтяные отходы, загрязненная почва.

**Introduction.** Currently, diatomite, bentonite clay soils of Kazakhstan, zeolites, shungites are widely used as natural sorbents.

In this article, the physical and chemical properties of the Utesai project are studied.

By studying the physical and chemical properties of diatomite of the Utesai project, it is the preparation of rational adsorbents used for refining petroleum products based on raw materials.

In accordance with this goal, the following tasks are defined:

- determination of the structural properties of natural and activated diatomite, i.e. the total volume of porosity, the radius of the pore, and the specific surface layer;

- cleaning of diesel fuel from natural and activated diatomite;

- preparation of a sorbent by introducing additives to the activated mineral diatomite, application as an adsorbent and analysis of reaction products. Information on methods of modification of natural mineral sorbents has been collected. The great practical importance of natural minerals is considered new adsorption-active materials and natural sorbents and rational technologies for their effective use in industry.

Diatomite is a siliceous sedimentary rock of light, pale and yellowish color, more than half of the total composition of which is formed by diatomic algae shells; Paleogene – most common among Neogene and quaternary formations. (Almatova B.G. 2017).

**Sequence of application, granularity, phase and chemical composition, surface topography, diatomite morphology.**

The unique properties of silica, which form the basis of many natural dispersed powders, i.e. diatomites, trepels, dieselgurs, etc. (Astakhov V.A. et.al, 1971), as well as the properties of artificial microcrystalline, such as aerosil, white ash, stimulate the study of their structure to create new building materials, predict the operational properties of products, increase energy efficiency of construction and reduce environmental damage. The thermal conductivity of dispersed systems is largely determined by the properties of the grain by the composition of the particles .

The use of modern laboratory equipment allows you to independently organize nanostructured dispersed systems, correctly present the results of research, taking into account the tendency to form structures and clusters (Astakhov V.A. et.al, 1971),.

Diatomites are organic sedimentary rocks of origin, the basis of which is the

remains and fragments of single-celled diatomite algae. Many of their deposits are widely represented in the Republic of Kazakhstan, the Russian Federation, China, the United States, Canada and other countries (Almatova B.G. et.al, 2003). A special role is played by modified diatomites, which are not available on the territory of the Republic of Kazakhstan and the Russian Federation, and are used in the form of amorphous silicon dioxide in VSP fillers in Europe and North America.

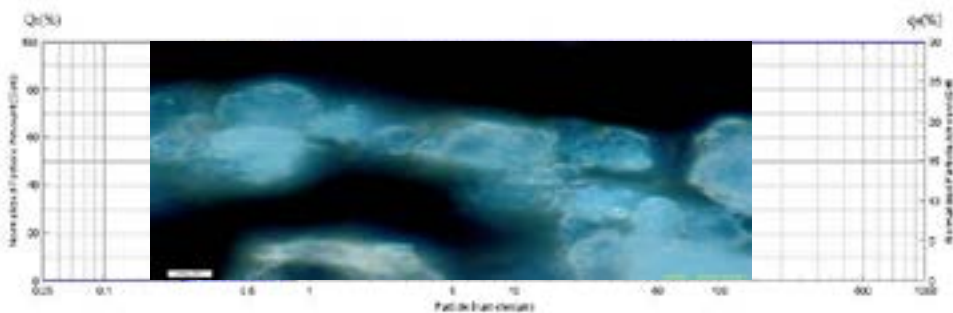
The Republic of Kazakhstan is rich in mineral resources, including significant reserves of diatomite intended for open-pit mining and use as a raw material for the production of amorphous silicon dioxide in the construction industry. Natural diatomites of the Utesai, flat and Kyrgyz deposits of Aktobe region of the Republic of Kazakhstan were chosen as the objects of research. They were sedimentary rocks, slightly cemented, grayish-yellow in color, easily broken, turning into an ultradisperse powder with a discharge density of  $\sim 300 - 500 \text{ kg/m}^3$ .

In this section, the structural characteristics of some natural diatomites at the projects of Aktobe region of the Republic of Kazakhstan were studied .

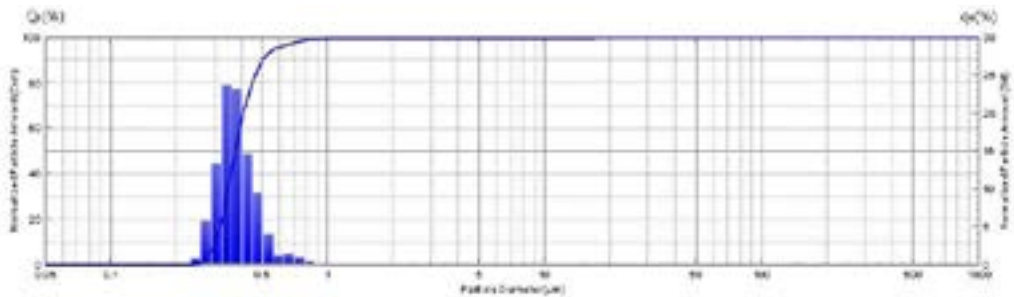
**Materials and methods of research. Granularity composition of natural diatomites.** At the initial stages of the study, the shape, size and surface of the dispersed microcrystalline were studied using the olymusgx-71 inverted microscope. Analysis of microscopes of the obtained samples showed that the particles of dispersed silica have a porous structure, the particles merge into aggregates (clusters) and then form large agglomerates. This applies to all types of microcracks involved in the study, so an example is a microscopy of amorphous silicon dioxide in Figure 1.

Figure 1.– Amorphous silicon dioxide particles.

The granularity composition of the studied diatomites was determined on the Shimadzu SALD-3101 instrument with a measuring range of 50 NMM. Crushing of the studied material in an ultrasound field with a frequency of 42 kHz and a power of 40 W was carried out. Figure 3.2 shows histograms of granularity analysis of Diatomites of the Utesai, flat and Kyrgyz deposits.



a)



б)

a) Utesay; b) Zhalpak

Figure 2 – Granular composition of dispersed powders of natural diatomites.

It should be noted that the linear dimensions of almost all dispersed particles are in the range of 0.250 – 1 micron, which is typical for organic rocks (Astakhov V.A. et.al, 1971),. The granularity characteristics of these diatomites in the deposits of the Republic of Kazakhstan differ slightly from each other. The minimum value of the upper dimension limit is ~ 500 Nm, which is typical for flat-field dispersed powders. The excavated diatomite samples represent an ultra-fast gray-yellow powder obtained by cementing the rocks of the corresponding deposits. The granularity composition of the dispersed material made in this way is shown in.

Table 1.– Composition of diatomite particles

Size, microns	Composition of diatomite particles in deposits, %		
	Utesai	Zhalpak	Kyrgyz
0,260	0,890	2,885	1,026
0,291	5,770	13,138	6,178
0,325	13,407	20,307	13,444
0,362	23,774	27,364	23,075
0,404	23,191	23,215	22,481
0,451	14,573	9,292	14,311
0,504	9,551	3,373	9,565
0,563	4,028	0,051	4,418
0,628	1,319	-	1,780
0,701	1,497	0,062	1,712
0,783	0,963	0,106	1,074
0,834	0,499	0,039	0,556
0,975	0,192	0,004	0,210
1,089	0,087	-	0,095

Table 2. Mass chemical composition of the natural sample of diatomite of the utesay deposit Results and discussion.

Field name	The composition of the components, drunk. %														
	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	FeO	MnO	MgO	CaO	K <sub>2</sub> O	Na <sub>2</sub> O	SO <sub>3</sub>	P <sub>2</sub> O <sub>5</sub>	H <sub>2</sub> O <sup>-</sup>	H <sub>2</sub> O <sup>+</sup>	Additives
Шүкүрөй 1/1	64,12	9,50	0,80	7,05	0,28	0,65	0,00	1,25	1,33	1,64	0,32	0,28	6,47	5,31	0,39
Шардара 2/1	61,30	5,59	0,90	10,58	0,56	1,26	0,04	2,12	1,07	1,78	0,37	0,72	6,86	1,37	4,46
Шардара 3/1	50,53	7,66	0,80	8,17	0,28	4,09	0,16	6,00	1,06	2,57	0,31	0,75	7,14	2,60	8,18

Table 3. Granulometric analysis of the natural sample of diatomite of the utesay deposit

Field name	Composition of the fraction, %						
	0,001 мм кем	0,001-0,005 мм	0,005-0,01 мм	0,01-0,05 мм	0,05-0,10 мм	0,10-0,25 мм	0,25-0,50 мм
Өтөсай 1/1 кен орны	47,88	46,05	5,42	0,65	-	-	-
Өтөсай 2/1	37,11	37,51	15,23	10,15	2,66	-	-
Өтөсай 3/1	25,90	50,09	16,03	5,32	-	-	-

Thermographic analysis was carried out to characterize the studied natural diatomite samples. The thermogram of the above-mentioned samples is shown in figures 1-3. As shown in the figures, heating of natural diatomite samples of the utesay -1 utesay -2, -3 utesay deposits leads to three endothermic effects.

In the range of 150-190 OS, the first endothermic effect passes, and weakly bound adsorbed water is separated from the main mass. As we all know, adsorbed water is completely removed from montmorillonite in the range of 50-200°C.

Between 585 and 640°C, a secondary endothermic effect is observed and strongly bound crystal water is released from bentonite.

And the third endothermic effect is observed in the range of 900-925°C. and is characterized by destruction of the mineral lattice. An analysis of the nature of the distribution of natural diatomite particles by size showed that 99% have linear dimensions: 0.260 – 0.783 microns (Utesai project); 0.260 – 0.504 microns (flat project); 0.260 – 0.789 microns (Kyrgyz project). The particle size distribution is close to the Gauss values – for dispersed materials of the Utesai, flat and Kyrgyz deposits, the size values are close to each other and range from ~ 0.350-0.410 microns. Thus, the powders of the studied diatomites represent an ultradisperse granular system consisting of particles of submicrometric size.

**Conclusion.** According to the results of the study, diatomite samples can be used to clean petroleum products.

25-30% diatomite is used to clean residual oil with natural diatomite. It is

a low-cost, profitable, environmentally friendly, unlimited natural material in solving environmental problems.

**Information about the authors:**

**Almatova Bayan Gazizovna** – Candidate of Technical Sciences, Aktobe Regional University named after K. Zhubanov, Republic of Kazakhstan, Aktobe, e-mail: *baian.73@mail.ru*; <https://orcid.org/0000-0002-1680-4682>;

**Khamzina Bayan Elemesovna** – PhD, Head of the Higher School of “Oil, Gas and Chemical Engineering”, West Kazakhstan Agrarian and Technical University named after Zhangir Khan, Republic of Kazakhstan, Uralsk, e-mail: *bayanh@mail.ru*; <https://orcid.org/0000-0002-8947-0492>;

**Murzagaliyeva Alma Askarovna** – Senior lecturer of the higher school “Oil, Gas and Chemical Engineering”, Master of Technical Sciences, West Kazakhstan Agrarian and Technical University named after Zhangir Khan, Republic of Kazakhstan, Uralsk, e-mail: *alma\_7121972@mail.ru*; <https://orcid.org/0000-0001-8339-0590>;

**Abdygalieva Ainagul Kadyrovna** – Senior lecturer of the higher school “Oil, Gas and Chemical Engineering”, Master of Technical Sciences, West Kazakhstan Agrarian and Technical University named after Zhangir Khan, Republic of Kazakhstan, Uralsk, e-mail: *ainagul\_132@mail.ru*; <https://orcid.org/0000-0002-2674-5268>;

**Kalzhanova Assemgul Bakytovna** – Master of Technical Sciences, Aktobe Regional University named after K. Zhubanov, Republic of Kazakhstan, Aktobe, e-mail: *a7ok\_86@mail.ru*; <https://orcid.org/0000-0002-1885-0367>.

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## CONTENTS

<b>A.U. Abdullaev, Sh.S. Yusupov, L.Yu. Shin, A.V. Rasulov, Y.Zh. Yessenzhigitova</b> HYDROGEOSEISMOLOGICAL PRECURSORS SUSAMYR EARTHQUAKE 1992.....	6
<b>N.A. Abdimutalip, A.K. Kurbaniyazov, G. Toychibekova, G. Koishieva, G. Shalabaeva, N. Zholmagambetov</b> INFLUENCE OF CHANGES IN THE LEVEL OF SALINITY OF THE ARAL SEA ON THE DEVELOPMENT OF ECOSYSTEMS.....	17
<b>Zh.K. Aidarbekov, S.A. Istekova</b> CLASSIFICATION OF GEOPHYSICAL FIELDS IN THE STUDY OF GEOLOGICAL AND STRUCTURAL FEATURES OF THE ZHEZKAZGAN ORE DISTRICT.....	33
<b>B. Almatova, B. Khamzina, A. Murzagaliyeva, A. Abdygalieva, A. Kalzhanova</b> NATURAL SORBENTS AND SCIENTIFIC DESCRIPTION OF THEIR USE.....	49
<b>Zh.A. Baimuratova, M.S. Kalmakhanova, SH.S.Shynazbekova, N.S. Kybyraeva, J.L. Diaz de Tuesta, H.T. Gomes</b> MnFe <sub>2</sub> O <sub>4</sub> /ZHETISAY COMPOSITE AS A NOVEL MAGNETIC MATERIAL FOR ADSORPTION OF Ni(II).....	58
<b>Ye.Z. Bukayev, G.K. Mutalibova, A.Z. Bukayeva</b> A NEW TECHNOLOGY FOR MANUFACTURING POLYMER-CEMENT COMPOSITION FROM LIMESTONE-SHELL MINING WASTE.....	73
<b>A.Zh. Kassenov, K.K. Abishev, A.S. Yanyushkin, D.A. Iskakova, B.N. Absadykov</b> RESEARCH OF THE STRESS-STRAIN STATE OF HOLES WITH NEW BROACH DESIGNS.....	89
<b>J.Kh. Khamroyev, K. Akmalaiuly, N. Fayzullayev</b> MECHANICAL ACTIVATION OF NAVBAHORSK BENTONITE AND ITS TEXTURAL AND ADSORPTION CHARACTERISTICS.....	104

<b>A.N. Kopobayeva, G.G. Blyalova, A. Bakyt, V.S. Portnov, A. Amangeldikyzy</b> THE NATURE OF RARE EARTH ELEMENTS ACCUMULATION IN CLAY LAYERS AND COALS OF THE SHUBARKOL DEPOSIT.....	117
<b>A. Leudanski, Y. Apimakh, A. Volnenko, D. Zhumadullayev, N. Seitkhanov</b> CALCULATION OF FLOTATOR'S AERATOR FOR SEPARATION OF GROUND PLASTICS.....	131
<b>Zh.T. Mukayev, M.M. Ulykpanova, Zh.O. Ozgeldinova, B.E. Kenzheshova, A.B. Khamitova</b> CONTENT OF COPPER IN DESERT SOILS AND PLANTS OF EAST KAZAKHSTAN REGION.....	149
<b>G. Sapinov, A. Imashev, Z. Mukhamedyarova</b> CURRENT STATE OF THE PROBLEM OF MINING INDUCED SEISMICITY AND PROSPECT OF USING SEISMIC MONITORING SYSTEMS.....	161
<b>V.G. Stepanets, V.L. Levin, G.K. Bekenova, M.S. Khakimzhanov, K.S. Togizov</b> ACCESSORY COPPER ORE MINERALS AS A KEY ISSUE IN UNDERSTANDING THE GENESIS OF THE MAYATAS META-CARBONATITE ORES (ULYTAU, CENTRAL KAZAKHSTAN).....	172
<b>S.A. Syedina, L.S. Shamganova, N.O. Berdinova, G.B. Abdikarimova</b> MULTIVARIANT GEOMECHANICAL ESTIMATION OF THE DESIGN PARAMETERS' STABILITY OF SLOPE AND BENCH IN SOUTH SARBAI MINE.....	192
<b>S.A. Tarikhazer, I.I. Mardanov</b> INDICATORS OF ECOGEOMORPHOLOGICAL RISK FOR THE PURPOSE OF SUSTAINABLE DEVELOPMENT OF MOUNTAIN TERRITORIES.....	204
<b>Zh.T. Tleuova, D.D. Snow, M.A. Mukhamedzhanov, E.Zh. Murtazin</b> ASSESSMENT OF THE IMPACT OF HUMAN ACTIVITY ON GROUNDWATER STATUS OF SOUTH KAZAKHSTAN.....	217



<b>Ye.A. Tseshkovskaya, A.T. Oralova, E.I. Golubeva, N.K. Tsoy, A.M. Zakharov</b>	
DUST SUPPRESSION ON THE SURFACES OF STORAGE DEVICE OF TECHNOGENIC MINERAL FORMATIONS.....	230
<b>B.T. Uakhitova, L.I. Ramatullaeva, M.K. Imangazin, M.M. Taizhigitova, R.U. Uakhitov</b>	
ANALYSIS OF INJURIES AND PSYCHOLOGICAL RESEARCHES OF WORKERS IN THE MELTING SHOPS OF THE AKTUBINSK FERRALOYS PLANT.....	242
<b>G.T. Shakulikova, S.M. Akhmetov, A.N. Medzhidova, N.M. Akhmetov, Zh.K. Zaidemova</b>	
IMPROVING THE DESIGN OF INCLINED WELLS AS THE BASIS FOR THE DEVELOPMENT OF HARD-TO-RECOVER HYDROCARBON RESERVES.....	259
<b>K.T. Sherov, M.R. Sikhimbayev, B.N. Absadykov, T.K. Balgabekov, A.D. Zhakaba</b>	
STUDY OF TEMPERATURE DISTRIBUTION DURING ROTARY TURNING OF WEAR-RESISTANT CAST IRON.....	271

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**ISSN 2518-170X (Online),**

**ISSN 2224-5278 (Print)**

Редакторы: *М.С. Ахметова, А. Ботанқызы, Д.С. Аленов, Р.Ж. Мрзабаева*

Верстка на компьютере *Г.Д.Жадыранова*

Подписано в печать 19.04.2022.

Формат 70x90<sup>1/16</sup>. Бумага офсетная. Печать – ризограф.

11,5 п.л. Тираж 300. Заказ 2.