

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

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ  
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ  
Satbayev University

# Х А Б А Р Л А Р Ы

---

---

## ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ  
НАУК РЕСПУБЛИКИ  
КАЗАХСТАН  
Satbayev University

## N E W S

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

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

**3 (453)**  
**MAY – JUNE 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.*

### Бас редактор

**ЖҰРЫНОВ Мұрат Жұрынұлы**, химия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, Қазақстан Республикасы Ұлттық Ғылым академиясының президенті, АҚ «Д.В. Сокольский атындағы отын, катализ және электрохимия институтының» бас директоры (Алматы, Қазақстан) **Н = 4**

### Ғылыми хатшы

**АБСАДЫКОВ Бахыт Нарикбайұлы**, техника ғылымдарының докторы, профессор, ҚР ҰҒА жауапты хатшысы, А.Б. Бектұров атындағы химия ғылымдары институты (Алматы, Қазақстан) **Н = 5**

### Редакциялық алқа:

**ӘБСАМЕТОВ Мәліс Құдысұлы** (бас редактордың орынбасары), геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, «У.М. Ахмедсафина атындағы гидрогеология және геоэкология институтының» директоры (Алматы, Қазақстан) **Н = 2**

**ЖОЛТАЕВ Герой Жолтайұлы** (бас редактордың орынбасары), геология-минералогия ғылымдарының докторы, профессор, Қ.И. Сатпаев атындағы геология ғылымдары институтының директоры (Алматы, Қазақстан) **Н = 2**

**СНОУ Дэниел**, Ph.D, қауымдастырылған профессор, Небраска университетінің Су ғылымдары зертханасының директоры (Небраска штаты, АҚШ) **Н = 32**

**ЗЕЛЬТМАН Реймар**, Ph.D, табиғи тарих мұражайының Жер туралы ғылымдар бөлімінде петрология және пайдалы қазбалар кен орындары саласындағы зерттеулердің жетекшісі (Лондон, Англия) **Н = 37**

**ПАНФИЛОВ Михаил Борисович**, техника ғылымдарының докторы, Нанси университетінің профессоры (Нанси, Франция) **Н = 15**

**ШЕН Пин**, Ph.D, Қытай геологиялық қоғамының тау геологиясы комитеті директорының орынбасары, Американдық экономикалық геологтар қауымдастығының мүшесі (Пекин, Қытай) **Н = 25**

**ФИШЕР Аксель**, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) **Н = 6**

**КОНТОРОВИЧ Алексей Эмильевич**, геология-минералогия ғылымдарының докторы, профессор, РФА академигі, А.А. Трофимука атындағы мұнай-газ геологиясы және геофизика институты (Новосибирск, Ресей) **Н = 19**

**АГАБЕКОВ Владимир Енокович**, химия ғылымдарының докторы, Беларусь ҰҒА академигі, Жаңа материалдар химиясы институтының құрметті директоры (Минск, Беларусь) **Н = 13**

**КАТАЛИН Стефан**, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) **Н = 20**

**СЕЙТМҰРАТОВА Элеонора Юсуповна**, геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА корреспондент-мүшесі, Қ.И. Сатпаев атындағы Геология ғылымдары институты зертханасының меңгерушісі (Алматы, Қазақстан) **Н = 11**

**САҒЫНТАЕВ Жанай**, Ph.D, қауымдастырылған профессор, Назарбаев университеті (Нұр-Сұлтан, Қазақстан) **Н = 11**

**ФРАТТИНИ Паоло**, Ph.D, Бикокк Милан университеті қауымдастырылған профессоры (Милан, Италия) **Н = 28**

---

**«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/>

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2022

---

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Мұратбаев көш., 75.

### **Главный редактор**

**ЖУРИНОВ Мурат Журинович**, доктор химических наук, профессор, академик НАН РК, президент Национальной академии наук Республики Казахстан, генеральный директор АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского» (Алматы, Казахстан) **Н = 4**

### **Ученый секретарь**

**АБСАДЫКОВ Бахыт Нарикбаевич**, доктор технических наук, профессор, ответственный секретарь НАН РК, Институт химических наук им. А.Б. Бектурова (Алматы, Казахстан) **Н = 5**

### **Редакционная коллегия:**

**АБСАМЕТОВ Малис Кудысович**, (заместитель главного редактора), доктор геологоминералогических наук, профессор, академик НАН РК, директор Института гидрогеологии и геоэкологии им. У.М. Ахмедсафина (Алматы, Казахстан) **Н = 2**

**ЖОЛТАЕВ Герой Жолтаевич**, (заместитель главного редактора), доктор геологоминералогических наук, профессор, директор Института геологических наук им. К.И. Сатпаева (Алматы, Казахстан) **Н=2**

**СНОУ Дэниел**, Ph.D, ассоциированный профессор, директор Лаборатории водных наук университета Небраски (штат Небраска, США) **Н = 32**

**ЗЕЛЬТМАН Реймар**, Ph.D, руководитель исследований в области петрологии и месторождений полезных ископаемых в Отделе наук о Земле Музея естественной истории (Лондон, Англия) **Н = 37**

**ПАНФИЛОВ Михаил Борисович**, доктор технических наук, профессор Университета Нанси (Нанси, Франция) **Н=15**

**ШЕН Пин**, Ph.D, заместитель директора Комитета по горной геологии Китайского геологического общества, член Американской ассоциации экономических геологов (Пекин, Китай) **Н = 25**

**ФИШЕР Аксель**, ассоциированный профессор, Ph.D, технический университет Дрезден (Дрезден, Берлин) **Н = 6**

**КОНТОРОВИЧ Алексей Эмильевич**, доктор геолого-минералогических наук, профессор, академик РАН, Институт нефтегазовой геологии и геофизики им. А.А. Трофимука СО РАН (Новосибирск, Россия) **Н = 19**

**АГАБЕКОВ Владимир Енокович**, доктор химических наук, академик НАН Беларуси, почетный директор Института химии новых материалов (Минск, Беларусь) **Н = 13**

**КАТАЛИН Стефан**, Ph.D, ассоциированный профессор, Технический университет (Дрезден, Берлин) **Н = 20**

**СЕЙТМУРАТОВА Элеонора Юсуповна**, доктор геолого-минералогических наук, профессор, член-корреспондент НАН РК, заведующая лабораторией Института геологических наук им. К.И. Сатпаева (Алматы, Казахстан) **Н=11**

**САГИНТАЕВ Жанай**, Ph.D, ассоциированный профессор, Назарбаев университет (Нурсултан, Казахстан) **Н = 11**

**ФРАТТИНИ Паоло**, Ph.D, ассоциированный профессор, Миланский университет Бикокк (Милан, Италия) **Н = 28**

---

**«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/>

© Национальная академия наук Республики Казахстан, 2022

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

### **Editorial chief**

**ZHURINOV Murat Zhurinovich**, doctor of chemistry, professor, academician of NAS RK, president of the National Academy of Sciences of the Republic of Kazakhstan, general director of JSC “Institute of fuel, catalysis and electrochemistry named after D.V. Sokolsky» (Almaty, Kazakhstan) **H = 4**

### **Scientific secretary**

**ABSADYKOV Bakhyt Narikbaevich**, doctor of technical sciences, professor, executive secretary of NAS RK, Bekturov Institute of chemical sciences (Almaty, Kazakhstan) **H = 5**

### **E d i t o r i a l b o a r d:**

**ABSAMETOV Malis Kudysovich**, (deputy editor-in-chief), doctor of geological and mineralogical sciences, professor, academician of NAS RK, director of the Akhmedsafin Institute of hydrogeology and hydrophysics (Almaty, Kazakhstan) **H=2**

**ZHOLTAEV Geroy Zholtaevich**, (deputy editor-in-chief), doctor of geological and mineralogical sciences, professor, director of the institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) **H=2**

**SNOW Daniel**, Ph.D, associate professor, director of the laboratory of water sciences, Nebraska University (Nebraska, USA) **H = 32**

**ZELTMAN Reymar**, Ph.D, head of research department in petrology and mineral deposits in the Earth sciences section of the museum of natural history (London, England) **H = 37**

**PANFILOV Mikhail Borisovich**, doctor of technical sciences, professor at the Nancy University (Nancy, France) **H=15**

**SHEN Ping**, Ph.D, deputy director of the Committee for Mining geology of the China geological Society, Fellow of the American association of economic geologists (Beijing, China) **H = 25**

**FISCHER Axel**, Ph.D, associate professor, Dresden University of technology (Dresden, Germany) **H=6**

**KONTOROVICH Aleksey Emilievich**, doctor of geological and mineralogical sciences, professor, academician of RAS, Trofimuk Institute of petroleum geology and geophysics SB RAS (Novosibirsk, Russia) **H = 19**

**AGABEKOV Vladimir Enokovich**, doctor of chemistry, academician of NAS of Belarus, honorary director of the Institute of chemistry of new materials (Minsk, Belarus) **H = 13**

**KATALIN Stephan**, Ph.D, associate professor, Technical university (Dresden, Berlin) **H = 20**

**SEITMURATOVA Eleonora Yusupovna**, doctor of geological and mineralogical sciences, professor, corresponding member of NAS RK, head of the laboratory of the Institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) **H=11**

**SAGINTAYEV Zhanay**, Ph.D, associate professor, Nazarbayev University (Nursultan, Kazakhstan) **H = 11**

**FRATTINI Paolo**, Ph.D, associate professor, university of Milano-Bicocca (Milan, Italy) **H = 28**

---

**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.

**A.M. Serikbayeva<sup>1\*</sup>, M.S. Kalmakhanova<sup>1</sup>, H.T. Gomes<sup>2</sup>,  
B.B. Shagraeva<sup>3</sup>, N.T. Shertaeva<sup>3</sup>**

<sup>1</sup>M.KH. Dulati Taraz Regional University, Taraz, Department of Chemistry and Chemical Engineering, Taraz, Kazakhstan;

<sup>2</sup>Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Bragança, Portugal;

<sup>3</sup>South Kazakhstan State Pedagogical University, Shymkent Department of Chemistry, Shymkent, Kazakhstan.

E-mail: ali\_2006.82@mail.ru

**METHODS OF PREPARATION AND PHYSICO-CHEMICAL  
CHARACTERISTICS OF ORGANIC MODIFIED CLAYS WITH  
GRAFTED ORGANOALOXIDES**

**Abstract.** The main sources of many environmental problems associated with the formation of wastewater are industrial enterprises that release water streams containing pollutants. Wastewater treatment is a complex task that requires a combination of different methods to achieve maximum efficiency. Increasing the efficiency of removing heavy metals, nutrients, anionic pollutants and organic compounds from liquid media is one of the most acute environmental problems. In recent years, the danger of environmental pollution with toxic metal ions as a result of wastewater discharge from electroplating, mining and battery industries has been growing. Natural and modified clays have a large surface area and a high ion exchange capacity, which allows them to be used as effective adsorbents for the removal of heavy metals from wastewater. In this regard, scientific interest is growing in the creation of new environmentally friendly technical solutions and inexpensive materials (adsorbents and /or catalysts) based on clays. Their use as an adsorbent and catalyst for wastewater of the chemical industry is an urgent and priority task. Adsorbents or catalysts were prepared during the purification of environmentally hazardous compounds in wastewater. The clay was thoroughly washed, heated 80°C.

With a stirrer for several days before the organic compound was absorbed for drying and application of the organic compound. Various analyses were used to describe adsorbents, such as infrared spectroscopy (IR), X-ray diffraction (X-ray diffraction), differential thermal analysis (DTA), element analysis, etc. Clay-based materials were obtained from natural clays and evaluated during wastewater treatment using model pollutants in aqueous solutions.

Natural clays were collected from Aktobe deposits in the region of Kazakhstan.

It was found that the modified samples exhibit higher sorption properties compared to enriched clay.

**Key words:** organoclaynes; kaolinite, thermal analysis, intercalated grafting, dimethyl sulfoxide-DMSO, natural clay, modified clay.

**А.М. Серикбаева<sup>1\*</sup>, М.С. Калмаханова<sup>1</sup>, Х.Т. Гомес<sup>2</sup>, Б.Б. Шаграева<sup>3</sup>,  
Н.Т. Шертаева<sup>3</sup>**

## **ОРГАНОАЛОКСИДТЕРМЕН ЕГІЛГЕН, ОРГАНИКАЛЫҚ ТҮРЛЕНДІРІЛГЕН САЗДАРДЫ АЛУ ТӘСІЛДЕРІ ЖӘНЕ ФИЗИКАЛЫҚ-ХИМИЯЛЫҚ СИПАТТАМАЛАРЫ**

<sup>1</sup>М.Х. Дулати атындағы Тараз өңірлік университеті, «Химия және химиялық технология» кафедрасы, Тараз, Қазақстан;

<sup>2</sup>Тауларды зерттеу орталығы, Instituto Politécnico de Bragança, Браганса, Португалия;

<sup>3</sup>Оңтүстік Қазақстан мемлекеттік педагогикалық университеті, Химия кафедрасы, Шымкент, Қазақстан.

E-mail: ali\_2006.82@mail.ru

**Аннотация.** Ағынды сулардың пайда болуымен байланысты көптеген экологиялық проблемалардың негізгі көздері – ластаушы заттары бар су ағындарын шығаратын өнеркәсіптік кәсіпорындар. Ағынды суларды тазарту – бұл максималды тиімділікке қол жеткізу үшін әртүрлі әдістерді біріктіруді қажет ететін күрделі міндет. Сұйық ортадан ауыр металдарды, коректік заттарды, анионды ластағыштарды және органикалық қосылыстарды алып тастау тиімділігін арттыру ең өткір экологиялық проблемалардың бірі болып табылады. Соңғы жылдары гальваникалық, тау-кен және аккумулятор өнеркәсібінің ағынды суларын ағызу нәтижесінде қоршаған ортаны улы металл иондарымен ластау қаупі артып келеді. Табиғи және модификацияланған саздардың беткі қабаты үлкен және ион алмасу қабілеті жоғары, бұл оларды ағынды сулардан

ауыр металдарды кетіру үшін тиімді адсорбенттер ретінде пайдалануға мүмкіндік береді. Осыған байланысты жаңа экологиялық таза техникалық шешімдер мен саз негізіндегі арзан материалдарды (адсорбенттер және/немесе катализаторлар) жасауға ғылыми қызығушылық артып келеді. Оларды химия өнеркәсібінің ағынды суларын тазарту үшін адсорбент және катализатор ретінде пайдалану өзекті және басым міндет. Адсорбенттер немесе катализаторлар ағынды сулардағы экологиялық қауіпті қосылыстарды тазарту кезінде алынды. Сазбалшық мұқият жуылып, органикалық қосылысты кептіру және қолдану үшін органикалық қосылыс сіңгенге дейін бірнеше күн бойы араластырғышпен 80°C дейін қыздырылды. Адсорбенттерді сипаттау үшін инфрақызыл спектроскопия (ИҚС), рентгендік дифракция (X-ray diffraction), дифференциалды термиялық талдау (DTA), элементтерді талдау және т.б. сияқты әртүрлі талдау әдістері қолданылды.

Табиғи саздар Қазақстан өңіріндегі Ақтөбе кен орындарынан жиналды.

Модификацияланған үлгілердің байытылған балшықпен салыстырғанда жоғары сорбциялық қасиеттері бар екендігі анықталды.

**Түйін сөздер:** органоглиндер, каолинит, термиялық талдау, интеркалирленген егу, диметилсульфоксид-ДМСО, табиғи саз, түрлендірілген саз.

**А.М. Серикбаева<sup>1\*</sup>, М.С. Калмаханова<sup>1</sup>, Х.Т. Гомес<sup>2</sup>, Б.Б. Шаграева<sup>3</sup>,  
Н.Т. Шергаева<sup>3</sup>**

<sup>1</sup>Таразский региональный университет им. М.Х. Дулати. Кафедра «Химия и химическая технология», Тараз, Қазақстан;

<sup>2</sup>Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Bragança, Portugal;

<sup>3</sup>Южно-Казахстанский государственный педагогический университет, Кафедра химии, Шымкент, Казахстан.

E-mail: ali\_2006.82@mail.ru

## **СПОСОБЫ ПОЛУЧЕНИЯ И ФИЗИКО-ХИМИЧЕСКИЕ ХАРАКТЕРИСТИКИ ОРГАНИЧЕСКИХ МОДИФИЦИРОВАННЫХ ГЛИН С ПРИВИТЫМИ ОРГАНОАЛОКСИДАМИ**

**Аннотация.** Основными источниками многих экологических проблем, связанных с образованием сточных вод, являются промышленные предприятия, выпускающие водные потоки, содержащие загрязняющие вещества. Очистка сточных вод представляет собой сложную задачу, которая требует сочетания различных методов для достижения максималь-



ной эффективности. Повышение эффективности удаления тяжелых металлов, питательных веществ, анионных загрязняющих веществ и органических соединений из жидких сред является одной из наиболее острых экологических проблем. В последние годы растет опасность загрязнения окружающей среды ионами токсичных металлов в результате сброса сточных вод гальванических, горнодобывающих и аккумуляторных производств. Природные и модифицированные глины имеют большую площадь поверхности и высокую ионообменную емкость, что позволяет использовать их в качестве эффективных адсорбентов для удаления тяжелых металлов из сточных вод. В связи с этим растет научный интерес к созданию новых экологически безопасных технических решений и недорогих материалов (адсорбентов и / или катализаторов) на основе глин. Их использование в качестве адсорбента и катализатора для сточных вод химической промышленности является актуальной и приоритетной задачей. При очистке экологически опасных соединений в сточных водах были приготовлены адсорбенты или катализаторы. Глину тщательно промывали, прогревали 80<sup>0</sup>С мешалкой несколько дней до выпитывания органического соединения для сушки и внесения органического соединения. Для описания адсорбентов использовались различные анализы, такие как инфракрасная спектроскопия (ИКС), рентгенодифрактометрический анализ (X-ray diffraction), дифференциальный термический анализ (DTA), анализ элементов и т. д.

Материалы на основе глины были получены из природных глин и оценены при очистке сточных вод с использованием модельных загрязнителей в водных растворах.

Природные глины были собраны месторождений Актобе в области Казахстана.

Установлено, что модифицированные образцы проявляют более высокие сорбционные свойства по сравнению с обогащенной глиной.

**Ключевые слова:** органоглины, каолинит, термический анализ, интеркалированная прививка, диметилсульфоксид-ДМСО, природная глина, модифицированная глина.

**Introduction.** Water purification is still a necessary technology in many industries, as water pollution and environmental pollution have become major environmental problems worldwide. It is an indisputable fact that unstable development paths create enormous pressure on water resources, affecting their quality and availability, and the ability to support the growing demand for fresh water is questioned (Sis et. al 2014). Water, indeed, is also a key resource for industrial and production processes (e.g. heating, cooling,

cleaning, flushing), but the wastewater that is generated can cause damage to the environment when it is discharged without any treatment (Liu et. al 2016). Industrial pollutants in water usually include heavy metals and/or huge amounts of organic an pollutant, the removal of which is indeed mandatory, but requires the use of complex and expensive processes (Shen et. al 2015).

The complexity and cost of treatments are much more relevant in the case of very strict disposal limits, low concentrations of pollutants and/or difficult-to-remove pollutants. Traditional methods proposed for this purpose, such as ion exchange, precipitation, electro dialysis, reverse osmosis, ultrafiltration, flocculation, bio sorption, adsorption, etc. ( Li et. al 2014) in some cases are not effective for the treatment of complex and complicated contaminated wastewater or are too expensive. The sorption properties of kaolinite (Okada et. al 2007). lead to application in the areas of retention of heavy metals and radionuclides (Sari et. al 2007). Intercalation of metal captions or organic compounds is very difficult to carry out due to its very low cation exchange capacity (CBS) (Gupta et. al 2008) Adsorption usually occurs on the outer crystalline surface of kaolinite, while CBS occurs as a result of protonation/deprotonating and isomorphic replacement of Al by Si in tetrahedral sheets (Theng B.K., 1974). Artisanal activities for processing lead from used batteries cause a lot of problems with environmental pollution in Kazakhstan. Such activity leads to contamination with lead (as well as arsenic and antimony) both ground and surface waters used for drinking and irrigation of agricultural crops. The sorption capacity of kaolinite and clay minerals in general can be increased by modifying their surfaces with organic ligands, which give Lewis-based functionality to materials (Grim R.E., 1953).

The development of hybrid organic-organic matrices has aroused great interest due to their growing application in several fields, such as nanotechnology, environmental engineering and clay sciences (Reimbaeva et. al 2020). The most important methods used to produce organo-clays are (i) intercalation reactions (using the method of soft displacement of the guest or impregnation of organic fragments), (ii) covalent grafting, for example, with organosilane (Dennis et. al 2001) or alcohols such as n-alkanols, diols, long-chain glycol monoesters, etc. and (iii) replacement of exchange cations with organic molecules (Tunney et. al 2008). This latter method is widely used for smectites, but usually results in a small organic content when applied to kaolinite due to its very low COS value.

Based on these data, new organoglinous systems in which clay is modified with dimethyl sulfoxides are evaluated in this work. Application multi-purpose characterization of the approach of X-ray powder diffraction, X-ray diffraction, thermal analysis, measurements, TGA-DTA, IR spectroscopy, and elemental

analysis. The ultimate goal is to determine the best operating conditions, taking into account the chemical nature of polyamine, to obtain an organo-clay system characterized by high adsorption capacity of heavy metals and selectivity in wastewater treatment.

**Experimental. Material and Solid Synthesis.** Natural clay from the Aktobe deposit in Kazakhstan, Dimethyl sulfoxide (C<sub>2</sub>H<sub>6</sub>OS), distilled water (H<sub>2</sub>O), dioxin(C<sub>4</sub>H<sub>4</sub>O<sub>2</sub>), isopropanol (C<sub>3</sub>H<sub>8</sub>O), ES-6120 heated magnetic stirrer, vacuum oven, spiral refrigerator, chemical pump, thermometer, analytical scales, stoppers, tripod, three-necked flask round-bottomed, Bunsen flask, varonka, laboratory sieves-№.0.063, filter paper, measuring cylinder. The analysis was taken within the following limits of the measuring systems of the device: DTA = 250 μV, DTG = 500 μV, TG= 500 μV, T = 500 μV.

**Synthesis of magnetic materials. The method of obtaining organo kleis.** Due to the suitable adsorption properties of clay minerals, the increase in adsorption capacity can be improved by increasing the porosity of the clay material after chemical and physical treatment. To modify clay minerals, Aktobe natural clay was crushed into powder in a mill and sorted through a sieve of size №.0.063, 12 g. of kaolinite 12l. was washed with distilled water. Then 60 ml. Dimethyl sulfoxide and 5 ml. H<sub>2</sub>O (dist.) were added to the mixture. water. The suspension was kept under magnetic stirring for 5 days at a temperature of 80°C. Then, the mixture was left for 2.5 days at room temperature. The resulting material was recovered after two series of washing-centrifugation using first dioxane 100 ml, then isopropanol 100 ml. The product was finally dried at a temperature of 50°C for 1 day.

**Characterization.** Composite characterization at various stages of preparation was performed as follows: Radiographs of kaolinite and modified organocaolinite were obtained for X-ray diffractometric analysis carried out on an automated diffractometer DRONE-3 with SIKKA radiation, a β-filter. Diffractogram shooting conditions: U=35 kV; I=20 mA; shooting θ-2θ; detector 2 deg/min. Equipped with an X-ray energy dispersion spectrometer, it was used to characterize the morphology of clay particles and perform point elemental analysis. Infrared transmission (IR) spectra were recorded using KBr granules on an IR spectrometer with a detector and analyzed using OPUS software. Thermogravimetric derivative analyses were performed on a derivatograph of the company “MOM” - Budapest (Hungary). The method used is based on the recording by the device of changes in the thermochemical and physical parameters of a substance that can be caused when it is heated. The thermochemical state of the sample is described by the curves: T (temperature), DTA (differential thermoanalytical), TG (thermogravimetric) and DTG (differential thermogravimetric), the latter curve is a derivative of the TG function. DTA- DTG- TG-.

**Results and discussion.** Table 1 shows the content of elements in natural clays. The results show that natural clay mainly consists of Si and Al. As it was noted, the amount of iron oxide in the Aktobe clay sample is rich in silicon (25.93%) and aluminum (20.10%), while the content of alkalis and alkaline earth elements is low.

Table1. Elemental composition of natural clays

Natural clay Aktobe	The analysis of all elements is performed. Element weight (%)											
	O	Na	Mg	Al	Si	S	Cl	K	Ca	Ti	Fe	Итого
	52,32	0,21	0,07	20,10	25,93	0,06	0,31	0,24	0,10	0,25	0,42	100,01
	Results in % connections.											
	O	Na2O	MgO	Al2O3	SiO2	SO3	Cl	K2O	CaO	TiO2	FeO	Итого
	-	0,29	0,11	39,34	58,31	0,16	0,33	0,31	0,14	0,45	0,57	100,01

(Figure 1).-The results of the elemental composition of natural clay were obtained using EMP analysis

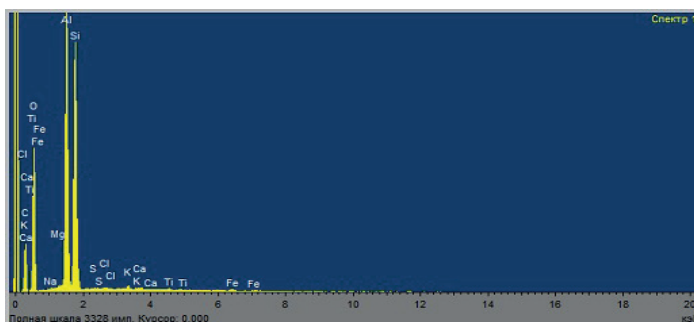


Figure 1. Elemental composition of natural clay Aktobe

**X-ray diffractometric analysis.** Diffractograms of a sample of natural clay were carried out on an automated diffractometer DRON-3 with SIKA radiation, a  $\beta$ -filter. Conditions for shooting diffractograms: U=35 kV; I=20 mA; shooting  $\theta$ -2 $\theta$ ; detector 2 deg/min (Fig. 2.).

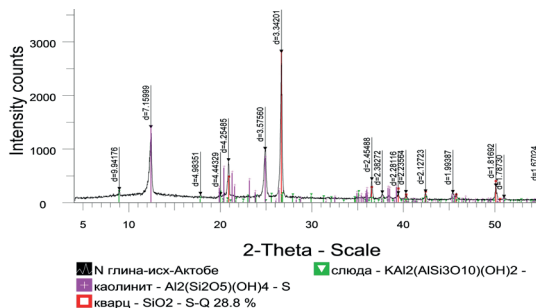


Figure 2. Diffractogram of a sample of natural clay Aktobe.

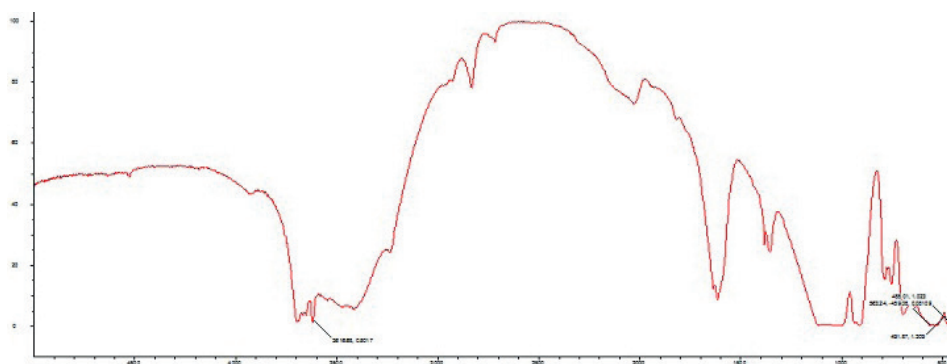
X-ray phase analysis on a semi-quantitative basis was performed using diffractograms of powder samples using the method of equal attachments and artificial mixtures. Quantitative ratios of crystal phases were determined. The interpretation of diffractograms was carried out using data from the ICDD card file: a database of powder diffractometric data PDF2 (Powder Diffraction File) and diffractograms of minerals pure from impurities. Shooting conditions: Diffractometer DRONE-3.0; accelerating voltage - 35 kV; anode current - 20 mA. To determine the quantitative ratio of the crystalline phases of alumina, the samples were subjected to X-ray diffractometric analysis. Possible impurities with a low content and unambiguous identification due to the presence of only 1-2 diffraction reflexes, the absence or poor crystallization of chemical composition data are presented in Table 2.

Table 2. Results of semi-quantitative X-ray phase analysis of Aktobe clay

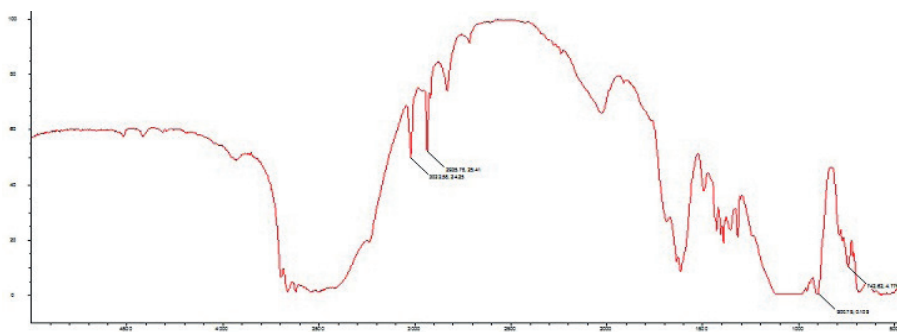
Mineral	Formula	Concentration, %
kaolinite	$\text{Al}_2(\text{Si}_2\text{O}_5)(\text{OH})_4$	68,9
quartz	$\text{SiO}_2$	28,8
mica	$\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$	2,3

The result of the analysis established that the sample of the studied Aktobe clay belongs to the group of layered silicates - kaolinite  $\text{Al}_2(\text{Si}_2\text{O}_5)(\text{OH})_4$ , with a low amount of muscovite admixture  $\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$ . All the above diffraction peaks belong only to the above phases. Characteristic diffraction reflexes allowing identification of the phases present are noted.

**Results of FTIR spectroscopy.** The natural clays of the Aktobe deposit were studied by FTIR spectroscopy. FTIR spectra of all compounds were recorded in solid form in tablets with KBr.



a)



b)

Figure 3. FTIR- spectrum of a sample of natural clay a) Aktobe  
Spectrum of modified clays b) DMSO/Aktobe

The FTIR spectra of unmodified kaolinite (NMK) and kaolinite with DMSO modifications are shown in Figure 3. The spectrum of FTIR showed unmodified that the OH bending band at 937 cm<sup>-1</sup> was easily attributed to Al-OH. A strong band centered at 1126 cm<sup>-1</sup> represented the Si-O stretching vibration together with vibrations of 563 and 488 cm<sup>-1</sup>, which indicated Si-O-Al and Si-O-Si bending vibrations, respectively, which were typical for tetrahedral Si-O. The bands at 3616 and 1518 cm<sup>-1</sup> were attributed to the stretching and bending vibrations of OH molecular water, respectively (Yariv et. al 2007). The band of 1475 cm<sup>-1</sup> was attributed to the presence of carbonate (Lothenbach et. al 1997).t Appeared in the spectrum of FTIR NMK. These bands are associated with the main kaolinite. For modified DMSO kaolinite, peaks at 3222 and 2935 cm<sup>-1</sup> were attributed to stretching fluctuations of -CH<sub>2</sub> and -CH<sub>3</sub>, respectively, indicating the presence of a long alkyl chain in kaolinite (Shichang et. al 2008 and Garcí'a-Lo'peza D., Gobernado-Mitre et. al 2005). Bands in 3616 and 1518 cm<sup>-1</sup> were attributed to the disappearance of molecular water OH. This indicated a complete exchange of basal cations with the removal of water molecules (et. al 1995).

**Results of thermal analysis (DTA and TGA).**Results of thermal analysis (DTA and TGA) of the sample prepared clay from Aktobe. The analysis was carried out in an air environment, in the temperature range from 20 to 1000°C. The heating mode of the furnace is linear (dT/dt = 10 degrees/min), the reference substance is calcined Al<sub>2</sub>O<sub>3</sub>. For clarity, the shooting conditions of the sample sample was strictly 200 mg, with the sensitivity of the scales - 100 mg. The sample and the reference substance for analysis were placed in ceramic crucibles. As a result of dynamic heating of these samples, the curves DTA, DTG and TG noted manifestations caused by the occurrence of various types of reactions in the system. Among them are processes associated with the

release of H<sub>2</sub>O and hydroxyls into the atmosphere during the decomposition of clay minerals, reactions with CO<sub>2</sub> emissions as a result of the combustion of organic matter, as well as during the destruction of calcite. The first thermal manifestation is caused by the removal of sample particles dislocated along broken bonds from the adsorbed water system. It should be noted that on the DTA curve, the indicated reaction (at ~90°C) is not clearly traceable due to the low content of the amount of molecular water in the powder sample (1.125% of the initial mass of the tested substance), Table-3. Information about this dehydration on the DTA curve is hidden by the background of thermal interference (20-300°C), unrelated to the composition of the sample. Aktobe natural clay in conditions of continuous heating up to 1000°C left on the curves DTA, TG and TG manifestations caused by decomposition reactions of thermally active components. On the DTG curve, these processes were indicated by peaks at 50 and 490°C, and on the DTA line they were formed by endothermic peaks in the vicinity of 90 and 510°C and one exothermic effect in the region of 900°C, Figure 4.

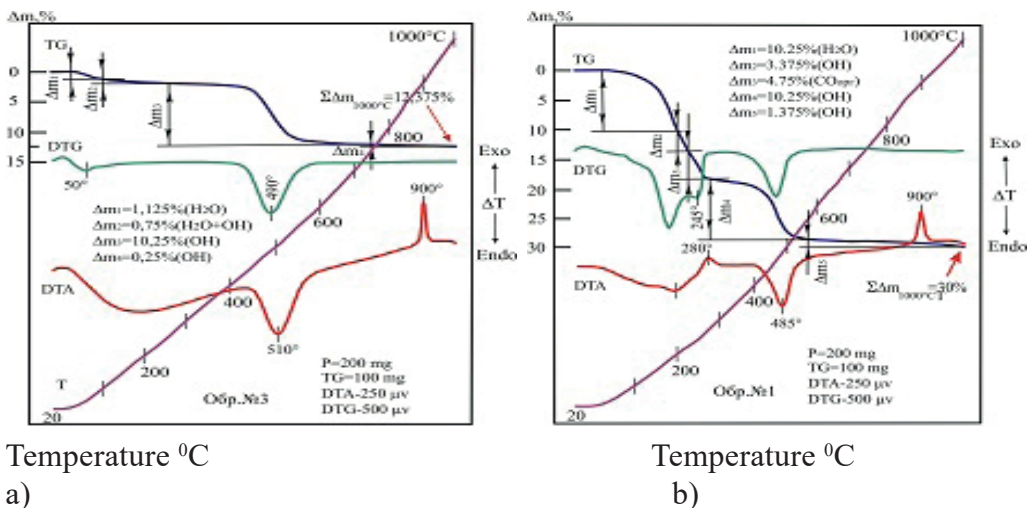


Figure 4. Derivatogram of a sample of natural clay a) Aktobe derivitogram of modified clays b) DMSO/Aktobe

The concentration of kaolinite in the sample was calculated based on its stoichiometric formula -  $[\text{Al}_2(\text{Si}_2\text{O}_5)(\text{OH})_4]$ . The obtained content of this component (38.9%) is slightly lower than the value that X-ray phase analysis (XFA) gives for kaolinite - 68.9%. This discrepancy can be explained by the deficiency of hydroxyl inclusions in the crystal lattice in some part of kaolinite. This disadvantage of OH groups could originally have been in the kaolinite of the original sample or was formed during the preparation of the sample.

Therefore, the difference between the amount of kaolinite according to the results of X-ray phase and thermal analyses (68.9%-38.9% = 30%) should be attributed to degraded kaolinite. This degraded mineral is still somehow fixed by X-ray diffraction determination, however, thermal analysis sees in it only a substance that includes mechanically bound water ( $\Delta m_1$ ) and hydroxyl inclusions ( $\Delta m_2$ ), with a low potential of electrical bonds, i.e. displaced from the octahedral grid of kaolinite. In the studied sample, as a concomitant clay mineral, a hydrosilicate was found, which loses hydroxyl water ( $\Delta m_5$ ) in the amount of 1.375% of the initial mass of the sample in the interval 580-1000°C. According to the results of this weight loss, the amount of this mica formation in the sample corresponds to 8.6%. Along with the calculated clay minerals, quartz was found in the test sample, which, at 500°C, usually leaves a weakly pronounced endothermic effect on the DTA curve associated with the polymorphic transition of this silicon oxide from the  $\alpha$  state to  $\beta$ . Since this manifestation coincided with the dissociation of kaolinite in temperature, this effect is not traced on the DTA curve. And only when re-shooting the baked clay, the indicated curve indicated a weak effect, according to the intensity of which (and according to the residual principle) the following quartz content in the sample was calculated - < 20%. The organic inclusion in the sample is traced by the exothermic peak of the DTA curve in the range of 225-275°C. The thermal effect is formed as a result of the oxidation of CO<sub>org</sub> to the level of CO<sub>2</sub>, which, when it exits the system, leaves a clearly defined downward descending peak at 245°C on the thermogravimetric (DTG-) curve. Within the limits of the combustion temperatures, the thermogravimetric (TG-) curve indicated a weight loss step corresponding to 4.75% of the sample mass. This value corresponds to the concentration of organic matter in the test substance.

Table 3. Thermogravimetric indications natural and modified Aktobe clay within 20-1000°C

Thermogravimetric readings	Weight Loss Sequence	The amount of weight loss, in %	Volatile components of the heated sample	Temperature range of the decomposition stage, °C
Natural clay Aktobe	$\Delta m_1$	1.125	H <sub>2</sub> O	20-100
	$\Delta m_2$	0.75	OH	100-255
	$\Delta m_3$	10.25	OH	255-745
	$\Delta m_4$	0.25	OH	745-1000
	$\Sigma \Delta m_{1000^\circ\text{C}}$	12,375	H <sub>2</sub> O, OH	20-1000
Modified Aktobe Clay (DMSO)	$\Delta m_1$	10,25	H <sub>2</sub> O	20-200
	$\Delta m_2$	3,375	OH	200-225
	$\Delta m_3$	4,75	CO <sub>2</sub>	225-275
	$\Delta m_4$	10,25	OH	275-580
	$\Delta m_5$	1,375	OH	580-1000
	$\Sigma \Delta m_{1000^\circ\text{C}}$	30	H <sub>2</sub> O, OH, CO <sub>2</sub>	20-1000



Two other reactions - in the temperature ranges of 510 and 900°C are characteristic of the destruction of the clay mineral - kaolinite. The first of them is associated with the release of constitutional water (OH) from the silicon-oxygen framework, the second is due to the destruction of the kaolinite crystal lattice. The amount of this mineral in the sample is determined by the content of hydroxyl water set by the thermogravimetric (TG) curve. In our case, the loss of water during dehydration of kaolinite corresponds to the value of  $\Delta m_3$  equal to 10.25%, Table-3. Taking into account the stoichiometric formula of kaolinite and the indicated weight loss, the amount of this mineral in the sample is 38.9%, Table-4. One of the components of the sample, when heated, left the most spectacular manifestations on the DTA curve, in the intervals of 275 -580 and 875-930°C, Figure-4 (b). This is an endothermic peak at 485°C and an exothermic peak at 900°C. Similar manifestations are characteristic of the thermal destruction of kaolinite. The content of this clay mineral in the sample, according to the amount of emissions from the hydroxyl water system in the range of 275 -580°C (Table-3), is 38.9% (Table-4).

Table 4. Composition natural and modified clay Aktobe

№	Composition- Aktobe clay according to DTA- and DTG	nature.Aktobe clay is used according to DTA and DTG definitions in %	Modified Aktobe clay according to DTA- and DTG data
1	Quartz	<20	<20
2	Hydrosluda	>7	8.6
3	Kaolinite	38,9	38,9
4	Kaolinite degraded	<30	<30
5	Organic Compound (CO)	-	4,75

In the composition of the Aktobe clay there is also another kaolinite, which has a highly dehydrated structure. According to their methodological capabilities, such anhydrous systems are not registered by thermal analysis. It remains to accept the fact that along with the diagnosed kaolinite (38.9%), degraded (dehydrated kaolinite) is also present in the sample. Other mineral inclusions in the sample included hydrosludes and quartz. The hydroslude in the sample composition is above 7% Quartz, calculated according to the residual principle, corresponds to <20%, Table-4. Some differences in the contents of the components in the compared analyses (ex. Aktobe clay and Aktobe mod. clay), can be caused by the method of preparation of Aktobe mod. clay. Modified Aktobe clays under dynamic heating from 20 to 1000 °C revealed a series of effects caused by the destruction of minerals and thermally active chemical compounds in its composition.

**Conclusions.** The natural clay of Aktobe was modified using DMSO To change the interlayer spatial gallery of natures. Aktobe clay was influenced by

the type of organomodifiers used. The prepared modified Aktobe clay can be arranged according to its spatial gallery in the order: (DMSO-K >) The results obtained showed that the DMSO modifier can be considered as a more suitable modifier for modifying natures. Aktobe clay, while it had the highest degree of intercalation. Based on the results of the thermal analysis characteristics of a number of natural kaolinite and taking into account the dehydroxylation temperature of the primordial clay (usually 580°C), it is possible to predict the nature of the organocles obtained by modification of kaolinite. In particular, a clear distinction can be made between materials obtained by intercalation of organic molecules in the interlayer spaces of kaolinite and materials obtained by their intercalation followed by covalent grafting onto the inner surfaces of kaolinite. The characteristic vibrational characteristics of organoclays were confirmed by thermal analysis data and X-ray diffraction pattern.

**Information about authors:**

**Serikbayeva Aizhan Mukhammedaliyevna** – 2<sup>nd</sup> year PhD student, Department “Chemistry and chemical technology”, Taraz Regional University named after M.Kh. Dulaty, Tole bi 61, Taraz, Kazakhstan. +77713279950, ali\_2006.82@mail.ru <https://orcid.org/0000-0002-8204-7851>;

**Kalmakhanova Marzhan Seitovna** – PhD, Senior researcher, Taraz Regional University named after M.Kh. Dulaty, Tole bi 61, Taraz, Kazakhstan. +77076216142. marjanseitovna@mail.ru, <https://orcid.org/0000-0002-8635-463X>;

**Hélder Teixeira Gomes** – Adjunct professor at the Department of Chemical and Biological Technology, Instituto Politécnico de Bragança (IPB), Bragança, Portugal. +273303110, htgomes@ipb.pt, <https://orcid.org/0000-0001-6898-2408>;

**Shagraeva Bibigul Bekenovna** – head of the Department” chemistry”, candidate of Chemical Sciences, Associate Professor South Kazakhstan State Pedagogical University, Baitursynova 13, Shymkent, Kazakhstan. +77014632964, bibi-0305@mail.ru, <https://orcid.org/0000-0002-9606-8709>;

**Shertayeva Nailya Turdygalievna** – candidate of Chemical Sciences, Associate Professor of the Department of “Chemistry” South Kazakhstan State Pedagogical University, Baitursynova 13, Shymkent, Kazakhstan. +77712863617, nailyaximik@mail.ru, <https://orcid.org/0000-0001-6446-4953>.

**REFERENCES**

Dennis H.R., Hunter D.L., Chang D., Kim S., White J.L., Cho J.W., Paul D.R., (2001) Effect of melt processing conditions on the extent of exfoliation in organo-clay-based nanocomposites. *Polymer*, 42: 9513-9522. [doi.org/10.1016/S0032-3861\(01\)00473-6](https://doi.org/10.1016/S0032-3861(01)00473-6).

Fenandes C., Catrinescu, C.P., (2007) Castilho, *Appl. Catal*, 318: 108–120. DOI:10.1016/j.apcata.2006.10.048.

García-Lo'peza D., Gobernado-Mitre I., Fernández J.F., Merino J.C., Pastor J.M. (2005) *Polymer*, 46: 2758–2765. DOI:10.1016/j.ejpe.2014.08.009.

Grim R.E., (1953) *Clay Mineralogy*. McGraw-Hill Book Co., Inc., New York.

Groisman L., Rav-Acha C., Gerstl Z. & Mingelgrin U. (2004) Sorption of organic compounds of varying hydrophobicities from water and industrial wastewater by long- and short-chain organo-clays. *Applied Clay Science*. 24: 159-166. doi.org/10.1180/claymin.2014.049.4.03.

Gupta S.S., Bhattacharyya K.G., (2008) Immobilization of Pb(II), Cd(II) and Ni(II) ions on kaolinite and montmorillonite. *Journal of Environmental Management*, 87: 46-58. DOI:10.1016/j.jphpro.2009.11.040.

Letaief S. & Detellier C. (2008) Interlayer grafting of glycidol (2,3-epoxy-1-propanol) on kaolinite. *Canadian Journal of Chemistry*, 86: 1-6. doi.org/10.1139/v07-130.

Li X., Zhou H., Wu W., Wei S., Xu Y., Kuang Y., (2015) Studies of heavy metal ion adsorption on chitosan/sulphydryl-functionalized graphene oxide composites. *J. Colloid Interface Sci*, 448: 389–397. DOI: 10.1016/j.jcis.2015.02.039.

Liu X., Hicher P., Muresan B., Saiyouri N., Hicher P.Y., (2016) Heavy metal retention properties of kaolin and bentonite in a wide range of concentration and different pH conditions. *Appl. Clay Sci*, 119: 365–374. doi.org/10.1016/j.envres.2014.12.0144.

Lothenbach B., Furrer G., Schulin R., (1997) Immobilization of heavy metals by polynuclear aluminium and montmorillonite compounds. *Environmental Science and Technology*, 31: 1452-1462. DOI:10.1021/ES960697H.

Matusik J., W'cisłó A. (2014) Enhanced heavy metal adsorption on functionalized nanotubular halloysite interlayer grafted with aminoalcohols. *Appl. Clay Sci*, 100: 50–59. DOI:10.1016/j.cdc.2017.06.006.

Mercier L., Detellier C., (1995) Preparation, characterization and applications as heavy metals sorbents of covalently grafted thiol functionalities on the interlamellar surface of montmorillonite. *Environmental Science and Technology*, 29: 1318-1323 doi.org/10.1021/es00005a026.

Okada T., Ehara Y., Ogawa M., (2007) Adsorption of Eu<sup>3+</sup> to smectites and fluorotetrasilicic mica. *Clays Clay Miner*, 55: 348–353. DOI:10.3390/polym11050897.

Reimbaeva S.M., Massalimova B.K., Kalmakhanova M.S. (2020) New pillared clays prepared from different deposits of Kazakhstan. *Volume*, 31: 607-611. doi.org/10.1016/j.matpr.2020.07.532.

Sari A., Tuzen M., Citak D. & Soylak M. (2007) Equilibrium, kinetic and thermodynamic studies of adsorption of Pb(II) from aqueous solution onto Turkish kaolinite clay. *Journal of Hazardous Materials*, 149: 283-291. DOI: 10.1016/j.jhazmat.2007.03.078.

Shen C., Chen C., Wen T., Zhao Z., Wang X., Xu A., (2015) Superior adsorption capacity of g-C<sub>3</sub>N<sub>4</sub> for heavy metal ions from aqueous solutions. *J. Colloid Interface Sci*, 456: 7–14. DOI: 10.1016/j.jcis.2015.06.004.

Shichang L., Wei Z., Song L., Wenfang S., (2008) Eur. Polym, 44: 1613–1619 doi.org/10.1016/j.ejpe.2014.08.009.

Sis H., Uysal T. (2014). Removal of heavy metal ions from aqueous medium using kuluncak (malatya) vermiculites and effect of precipitation on removal. Appl. Clay Sci, 95: 1–8. DOI:10.1016/j.clay.2014.03.018.

Theng B.K.G., (1974) The Chemistry of Clay Organic Reactions. Adam Hilger, London. Tonle' I.K., Diaco T., Ngameni E. & Detellier C. (2007) Nanohybrid kaolinite-based materials obtained from the interlayer grafting of 3-aminopropyl triethoxysilane and their potential use as electrochemical sensors. Chemistry of Materials, 19: 6629-6636. doi.org/10.1180/claymin.2014.049.4.03.

Tunney J.J., Detellier C., (1993) Interlamellar covalent grafting of organic units on kaolinite. Chemistry of Materials, 5: 747-748. doi.org/10.1021/cm00030a002.

Yariv S., (2002) Introduction to organo-clay complexes and interactions, in: Organo-clay complexes and interactions (S. Yariv & H. Cross, editors). Marcel Dekker Inc., New York, Pp: 39-112. doi.org/10.1180/claymin.2014.049.4.03.

## МАЗМҰНЫ-СОДЕРЖАНИЕ-CONTENTS

<b>R.A. Abdulvaliyev, M.N. Kvyatkovskaya, L.M. Imangalieva, A.I. Manapova</b> KAOLINITE RAW MATERIALS OF KAZAKHSTAN AND THE METHOD OF THEIR BENEFICIATION.....	6
<b>A.E. Abetov, Sh.B. Yessirkepova, J. Curto Ma</b> GRAVITY FIELD TRANSFORMS AT THE EXPLORATION FOR HYDROCARBON FIELD IN THE SOUTHERN PART OF THE USTYURT REGION.....	17
<b>E.B. Abikak, B.K. Kenzhaliev</b> DEVELOPMENT OF AN INTEGRATED TECHNOLOGY INTENDED TO PROCESS PYRITE SLAG USING CHEMICAL PRE-ACTIVATION.....	32
<b>R.Zh. Abuova, D.K. Suleyev, G.A. Burshukova</b> STUDY OF DAMPING PROPERTIES OF ALLOYED STEELS WITH CERAMIC-METALLIC NANOSTRUCTURED COATING FOR CRITICAL PARTS.....	52
<b>N.R. Akhundova</b> CHANGE OF HYDRODYNAMIC PRESSURES IN THE WELLBORE OF INCLINED-HORIZONTAL WELLS DURING DRILLING MUD CIRCULATION.....	66
<b>M. Bissengaliev, R. Bayamirova, A. Togasheva, A. Zholbasarova, Zh. Zaydemova</b> ANALYSIS OF COMPLICATIONS ASSOCIATED WITH THE PARAFFINIZATION OF BOREHOLE EQUIPMENT AND MEASURES TO PREVENT THEM.....	76
<b>T.I. Espolov, A.G. Rau, N.N. Balgabayev, E.D. Zhaparkulova, Josef Mosiej</b> GEOLOGICAL STRUCTURE OF ALLUVIAL SEDIMENTS OF RIVER TERRACES AND ENERGY EFFICIENCY OF IRRIGATION SYSTEMS.....	89

<b>Y.M. Kalybekova, A.K. Zauirbek, I.S. Seitasanov, U.Q. Onglassyn*</b> INCREASING WATER PRODUCTIVITY IN IRRIGATION WITH REGARD TO GEOLOGY AND HYDROGEOLOGICAL CONDITIONS.....	101
<b>Z.S. Kenzhetaev, T.A. Kuandykov, K.S. Togizov, M.R. Abdraimova, M.A. Nurbekova</b> SELECTION OF RATIONAL PARAMETERS FOR OPENING AND DRILLING OF TECHNOLOGICAL WELLS UNDERGROUND URANIUM LEACHING.....	115
<b>R.A. Kozbagarov, K.K. Shalbayev, M.S. Zhiyenkozhayev, N.S. Kamzanov, G.T. Naimanova</b> DESIGN OF CUTTING ELEMENTS OF REUSABLE MOTOR GRADERS IN MINING.....	128
<b>T.A. Kuandykov, T.D. Karmanov, E.I. Kuldeyev, K.K. Yelemessov, B.Z. Kaliev</b> NEW TECHNOLOGY OF UNCOVER THE ORE HORIZON BY THE METHOD OF IN-SITU LEACHING FOR URANIUM MINING.....	142
<b>E. Orymbetov, G.E. Orymbetova, A.E. Khussanov, T.E. Orymbetov, B.E. Orymbetov</b> SECTIONING OF PETROLEUM GAS ADSORPTION DRYING.....	155
<b>A.M. Serikbayeva, M.S. Kalmakhanova, H.T. Gomes, B.B.Shagraeva, N.T.Shertaeva</b> METHODS OF PREPARATION AND PHYSICO-CHEMICAL CHARACTERISTICS OF ORGANIC MODIFIED CLAYS WITH GRAFTED ORGANOALOXIDES.....	166
<b>Zh. Zhantayev, D. Talgarbayeva, A. Kairanbayeva, D. Panyukova, K Turekulova</b> COMPLEX PROCESSING OF EARTH REMOTE SENSING DATA FOR PREDICTION OF LANDSLIDE PROCESSES ON ROADS IN MOUNTAIN AREA.....	181
<b>S.A. Istekova, A.K. Issagaliyeva, M.M. Aliakbar</b> BUILDING THE ONLINE GEOLOGICAL AND GEOPHYSICAL DATABASE MANAGEMENT SYSTEM FOR HYDROCARBON FIELDS IN KAZAKHSTAN.....	198

<b>R.E. Lukpanov, A.S. Yenkebayeva, D.V. Tsygulyov, Y.Y. Sabitov, D.S. Dyusseminov</b> ASSESSMENT OF ASH-STORAGE COOLECTOR STABILITY USING GEOSYNTHETIC REINFORCEMENT ELEMENTS BY TRAY TESTING AND NUMERICAL MODELING.....	212
<b>T.K. Salikhov, D.K. Tulegenova, Zh.G. Berdenov, R.S. Sarsengaliyev, T.S. Salikhova</b> STUDY OF THE SOIL COVER OF ECOSYSTEMS OF THE CHINGIRLAUS DISTRICT OF THE WESTERN KAZAKHSTAN REGION ON THE BASIS OF THE APPLICATION OF GIS TECHNOLOGIES.....	226
<b>A.R. Fazylova, G. Balbayev, B. Tultayev</b> SYSTEM OF SHORT-TERM FORECASTING OF WIND TURBINE OUTPUT POWER CONSUMPTION.....	243
<b>O.G. Khaitov, A.A. Umirzokov, E.N. Yusupkhojaeva, S.P. Abdurakhmonova, N.G. Kholmatova</b> ASSESSMENT OF THE DENSITY OF THE WELL GRID IN THE SOUTHEASTERN PART OF THE BUKHARA-KHIVA REGION.....	253
<b>K.T. Sherov, S.O. Tussupova, A.V. Mazdubay, M.R. Sikhimbayev, B.N. Absadykov</b> INCREASING DURABILITY OF THERMO-FRICTION TOOLS BY SURFACING.....	265

## **Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan**

For information on Ethics in publishing and Ethical guidelines for journal publication see <http://www.elsevier.com/publishingethics> and <http://www.elsevier.com/journal-authors/ethics>.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see <http://www.elsevier.com/postingpolicy>), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct ([http://publicationethics.org/files/u2/New\\_Code.pdf](http://publicationethics.org/files/u2/New_Code.pdf)). To verify originality, your article may be checked by the Cross Check originality detection service <http://www.elsevier.com/editors/plagdetect>.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайтах:

**[www.nauka-nanrk.kz](http://www.nauka-nanrk.kz)  
<http://www.geolog-technical.kz/index.php/en/>  
ISSN 2518-170X (Online),  
ISSN 2224-5278 (Print)**

Редакторы: *М.С. Ахметова, А. Ботанқызы, Р.Жәлиқызы, Д.С. Аленов*  
Верстка на компьютере *Г.Д.Жадьранова*

Подписано в печать 15.06.2022.  
Формат 70x90<sup>1/16</sup>. Бумага офсетная. Печать – ризограф.  
17,5 п.л. Тираж 300. Заказ 3.