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

«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ

ҚАЙЫРЫМДЫЛЫҚ ҚОРЫ HALYK CHARITY FOUNDATION

«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ
«ХАЛЫҚ» ЖҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF
KAZAKHSTAN
«Halyk» Private Foundation

SERIES

OF GEOLOGY AND TECHNICAL SCIENCES

6 (462)

NOVEMBER – DECEMBER 2023

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. Webof 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.

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

«ҚР ҰҒА» РҚБ 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/

«Известия РОО «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 соеденений.*

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/

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/

NEWS of the National Academy of Sciences of the Republic of Kazakhstan
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224–5278
Volume 6. Number 462 (2023), 208–217
https://doi.org/10.32014/2023.2518-170X.360

UDC 556.1

© M. Turlybekova[1*], G. Seitova[1], E. Bilisbekkyzy[1], A. Tokanbayev[1], S. Kaldybayeva[2], 2023
[1]Zhetysu State University named after I. Zhansugurov, Taldykorgan, Kazakhstan;
[2]Al-Farabi Kazakh National University, Almaty, Kazakhstan.
E-mail: m_turlybekova78@mail.ru

EVALUATION OF THE EFFICIENCY AND USE OF A COMPLEX FROM NATURAL MINERAL SORBENTS

Turlybekova M.R. — Candidate of Technical Sciences. lecturer of educational programs in technical and natural sciences. Zhetysu University named after I. Zhansugurov. Taldykorgan, Kazakhstan
E-mail: *m_turlybekova78@mail.ru*, *https://orcid.org/0000-0001-8591-0051;*
Seitova G.A. — Master of Agricultural Chemistry and Soil Science, Senior lecturer, Zhetysu State University named after I. Zhansugurov, Taldykorgan, Kazakhstan
E-mail: guldana-talgat@bk.ru, *https://orcid.org/0000-0002-8359-8794;*
Bilisbekkyzy E. — Master of engineering and technology in 6M073100 Life safety and enviromental protection, Zhetysu State University named after I.Zhansugurov, Taldykorgan, Kazakhstan
E-mail: Enlik_9193@mail.ru, *https://orcid.org/0000-0002-6290-4000;*
Tokanbayev A.Y. — Master of science 6M060800-Ecology, Zhetysu State University named after I. Zhansugurov, Taldykorgan, Kazakhstan
E-mail: *tokanbaev_ashat@mail.ru*, *https://orcid.org/0000-0003-1210-3368;*
Skaldybayeva S. — PhD, Associate Professor at Al-Farabi Kazakh National University, Almaty, Kazakhstan
E-mail: *sayle_78_78@mail.ru*, *http://orcid.org/0000-0001-7839-6066.*

Abstract. In the article the authors tried to create an effective technology for obtaining a complex from natural adsorbents based on bentonite clay and zeolite, which allows to achieve high degree of purification from drinking and waste water pollution. Mechanism of thermal activation was used in order to increase the adsorption capacity of sorbents during heat treatment, which is due to removal of adsorbed and constitutional water, that is, an increase in total porosity. Close to thermal activation is the method of hydrothermal modification of natural sorbents, it is treatment in water vapor at high temperatures and pressure. Dissolution of small particles of a substance and their precipitation on the surface of larger ones occur in hydrothermal treatment, which causes change in the specific surface area and increase of the sorption volume of pores. Since the composition of natural adsorbents includes metal hydroxides, which undergo various phase transitions during hydrothermal treatment often leading to amorphization of the mineral structure, which is accompanied by increase of their activity. The equilibrium adsorption capacity of water of natural bentonite clay

and zeolite was experimentally found out at various zeolite temperatures and water vapor pressures for use in an adsorption system. The adsorption equilibrium model corresponds to the experimental data with a permissible margin of error. Separate correlations were obtained for adsorption and desorption processes, as well as one correlation for modeling both processes. The isothermal heat of water adsorption on bentonite clay and zeolite was calculated depending on the adsorption capacity. During the experiments, the quality of water was improved, in accordance with the sanitary and hygienic standardized requirements that meet human safety criteria.

Keywords: adsorbents, purification, bentonite clay, zeolite, dispersed impurities

© М.Р. Турлыбекова[1*], Г.А. Сеитова[1], Е. Билисбеккызы[1], А.Е. Токанбаев[1], С.Т. Калдыбаева[2], 2023

[1] І. Жансүгіров атындағы Жетісу университеті, Талдықорған, Қазақстан;
[2] Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан.
E-mail: m_turlybekova78@mail.ru

ТАБИҒИ МИНЕРАЛДЫ СОРБЕНТТЕР КЕШЕНІН ПАЙДАЛАНУ ТИІМДІЛІГІН БАҒАЛАУ

М.Р. Турлыбекова — техника ғылымдарының кандидаты. Техникалық және жаратылыстану ғылымдары бойынша білім беру бағдарламаларының оқытушысы-дәріскері болып табылады. І. Жансүгіров атындағы Жетісу университеті. Талдықорған, Қазақстан
https://orcid.org/0000-0001-8591-0051;
Г.А. Сеитова — агрохимия және топырақтану магистрі, оқытушы-дәріскері, Жетісу мемлекеттік университеті. И. Жансүгірова, Талдықорған, Қазақстан
E-mail: guldana-talgat@bk.ru, *https://orcid.org/0000-0002-8359-8794;*
Е. Білісбекқызы — 6М073100 Қоршаған ортаны қорғау және өмір тіршілік қауіпсіздігі мамандығы бойынша инженерия және технология магистрі, Жетісу мемлекеттік университеті. И. Жансүгірова, Талдықорған, Қазақстан
E-mail: Enlik_9193@mail.ru, *https://orcid.org/0000-0002-6290-4000;*
А.Е. Токанбаев — ғылым магистрі 6М060800-Экология, Жетісу мемлекеттік университеті. И. Жансүгірова, Талдықорған, Қазақстан
E-mail: tokanbaev_ashat@mail.ru, *https://orcid.org/0000-0003-1210-3368;*
С.Т. Калдыбаева — доцент м. а., техника ғылымдарының кандидаты, Қазақ ұлттық университеті. Әл-Фараби, Алматы, Қазақстан
E-mail: *sayle_78_78@mail.ru*, *http://orcid.org/0000-0001-7839-6066.*

Аннотация. Мақалада авторлар бентонит сазы мен цеолит негізіндегі табиғи адсорбенттерден кешен алудың тиімді технологиясын жасауға тырысты, бұл ауыз су мен ағынды сулардың ластануынан жоғары дәрежеде тазартуға мүмкіндік береді. Термиялық өңдеу кезінде сорбенттердің адсорбциялық қабілетін арттыру үшін, адсорбцияланған және судың құрамынның жойылуына, яғни жалпы кеуектіліктің артуына байланысты термиялық белсендіру механизмі қолданылды. Гидротермиялық өңдеу кезінде заттың ұсақ бөлшектері ериді және олардың үлкен беттеріне тұндырылады, бұл меншікті бетінің өзгеруіне және кеуектердің сорбциялық көлемінің ұлғаюына әкеледі. Табиғи адсорбенттердің құрамына

гидротермиялық өңдеу кезінде әртүрлі фазалық ауысулардан өтетін металл гидроксидтері кіреді, бұл көбінесе минерал құрылымының аморфизациясына әкеледі, бұл олардың белсенділігінің жоғарылауымен бірге жүреді. Табиғи бентонит сазы мен цеолит суының тепе-теңдік адсорбциялық қабілеті, цеолиттің әртүрлі температураларында және адсорбциялық жүйеде пайдалану үшін су буының қысымында эксперименталды түрде анықталды. Адсорбциялық тепе-теңдік моделі рұқсат етілген қателік шегі бар эксперименттік мәліметтерге сәйкес келеді. Адсорбция және десорбция процестері үшін бөлек корреляциялар, сондай-ақ екі процесті модельдеу үшін бір корреляция алынды. Бентонит сазы мен цеолиттегі судың адсорбциясының изотермиялық жылуы адсорбция сыйымдылығына байланысты есептеледі. Жүргізілген эксперименттер барысында адам қауіпсіздігі критерийлеріне жауап беретін санитарлық-гигиеналық нормаланған талаптарға сәйкес судың сапасы артты.

Түйін сөздер: адсорбенттер, тазарту, бентонит сазы, цеолит, дисперсті қоспалар

© М.Р. Турлыбекова[1*], Г.А. Сеитова[1], Е. Билисбеккызы[1], А.Е. Токанбаев[1], С.Т. Калдыбаева[2], 2023

[1]Жетысуский университет им. И. Жансугурова, Талдыкорган, Казахстан;
[2]Казазский национальный университет имени Аль-Фараби, Алматы, Казахстан.
E-mail: m_turlybekova78@mail.ru

ОЦЕНКА ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ КОМПЛЕКСА ИЗ ПРИРОДНЫХ МИНЕРАЛЬНЫХ СОРБЕНТОВ

М.Р. Турлыбекова — кандидат технических наук. Преподаватель является преподавателем образовательных программ по техническим и естественным наукам. Жетысуский университет имени И. Жансугурова. Талдыкорган, Казахстан
https://orcid.org/0000-0001-8591-0051;
Г.А. Сеитова — магистр агрохимии и почвоведения, старший преподаватель, Жетысуский государственный университет им. И. Жансугурова, Талдыкорган, Казахстан
E-mail: guldana-talgat@bk.ru, *https://orcid.org/0000-0002-8359-8794;*
Е. Білісбекқызы — магистр инженерии и технологии по специальности 6М073100 Безопасность жизнедеятельности и охрана окружающей среды, Жетысуский государственный университет им. И.Жансугурова, Талдыкорган, Казахстан
E-mail: Enlik_9193@mail.ru, *https://orcid.org/0000-0002-6290-4000;*
А.Е. Токанбаев — магистр наук 6М060800-Экология, Жетысуский государственный университет им. И.Жансугурова, Талдыкорган, Казахстан
E-mail: tokanbaev_ashat@mail.ru, *https://orcid.org/0000-0003-1210-3368;*
С.Т. Калдыбаева — и.о. доцента, кандидат технических наук, Казахский национальный университет им. Аль-Фараби, Алматы, Казахстан
E-mail: *sayle_78_78@mail.ru*, *http://orcid.org/0000-0001-7839-6066.*

Аннотация. В статье авторы предприняли попытку создать эффективную технологию получения комплекса природных адсорбентов на основе бентонитовой глины и цеолита позволяющих добиться высокой степени очистки питьевых и сточных вод от загрязнений. Для повышения адсорбционной способности

сорбентов при термообработке использовали механизм термической активации, что обусловлено удалением адсорбированной и конституционной воды, то есть увеличением общей пористости. Близко к термической активации стоит метод гидротермального модифицирования природных сорбентов — обработка в парах воды при высоких температурах и давлении. При гидротермальной обработке происходят растворение мелких частиц вещества и осаждение их на поверхности более крупных, что приводит к изменению удельной поверхности и увеличению сорбционного объема пор, так как в состав природных адсорбентов, входят гидроксиды металлов, которые при гидротермальной обработке претерпевают различные фазовые переходы, приводящие зачастую к аморфизации структуры минерала, которое сопровождается увеличением их активности. Экспериментально определена равновесная адсорбционная способность воды природного бентонитовой глины и цеолита, при различных температурах цеолита и давлении водяного пара для использования в адсорбционной системе. Модель адсорбционного равновесия соответствует экспериментальным данным с допустимым пределом погрешности. Получены отдельные корреляции для процессов адсорбции и десорбции, а также одна корреляция для моделирования обоих процессов. Рассчитана изотермическая теплота адсорбции воды на бентонитовой глине и цеолите, в зависимости от адсорбционной емкости. В ходе проводимых экспериментов повысилось качество воды, в соответствие с санитарно-гигиеническим нормируемым требованиями, отвечающими критериям безопасности человека.

Ключевые слова: адсорбенты, очистка, бентонитовая глина, цеолит, дисперсные примеси

Introduction

The relevance of this study is associated with increase in anthropogenic and technogenic impact of pollutants on the biosphere of the Republics and Kazakhstan and the whole world. The aquatic environment suffers more from the effect of ecotoxicity, being the final reservoir of most pollutants. Over the past 25–30 years, the structure of water use has changed, which resulted in a sharp growth of the social component of water use.

The share of household and drinking water supply increased from 11 % in 1980 to 28 % in 2019. In this regard, there is a real problem with the quality of drinking water determined by the pollution of natural water, its unsatisfactory purification at water supply stations, and secondary pollution in distribution networks. In the current situation, the most promising approach to providing the population of Kazakhstan with high-quality drinking water is the use of means and methods for additional purification and preparation of drinking water.

Currently, water treatment is becoming one of the most common technological processes in the world, including Kazakhstan. This proves the peculiarity of the relevance and the issue of reducing the cost of treatment technologies in the purification of drinking and waste water. In this regard, the use of natural sorbents, the deposits of which are available on the territory of Kazakhstan, seems very promising.

There are more and more reports in the literature about the effectiveness of using natural sorbents to remove from water dispersed impurities, heavy metals, oil and oil products, surfactants, dyes, radioactive contaminants, etc.

Over the years, the following scientific studies have been carried out on this issue:

- The theoretical foundations of development of technology for adsorption treatment of surface water for drinking purposes in different years in Kazakhstan were studied by well-known Kazakh scientists, such as A.A. Mussabekov (Novikov et al., 1998), L.M. Satayeva (Gildenskold et al., 1993), F.E. Altynbekov (Jetimov et al., 2015).

- Development of the technology for wastewater treatment from heavy metal ions and oil products using sorption-ion exchange material based on bentonite clays (Benom-M) in order to protect water bodies from pollution, was carried out by Russian scientists A.A. Fogel (Novikov et al., 2000), V.A. Somina (Jetimov et al., 2015), O.V. Sukhorukova (Makhorin et al., 1998).

- V.V. Ponomarev (Somina et al., 1997) studied and developed the technology of adsorbents for purification of vegetable oils based on diatomite and bentonite.

- P.A. Verfilyev, A.A. Yudakov, T.V. Ksenik (Sukhorukova et al., 1998; Komarova et al., 1998) investigated the methods of modification of natural aluminosilicates in order to obtain adsorbents for purification of water bodies from organic pollutants.

- Doctoral thesis of V.V. Kovalevsky (Ponomarev et al., 1997; Verfilyev et al., 1999) considered the structural features of carbonaceous matter and the physicochemical properties of the natural adsorbent of shungite breeds.

Today, when using natural adsorbents to remove these substances from water, the empirical approach dominates as a rule, which makes it difficult to carry out technological processes under optimal conditions, which is a global problem not only in Kazakhstan, but also on an international scale.

In this regard, it became necessary to develop innovative scientific bases for the use of natural adsorbents in water treatment, for which it was required to summarize the available information on their use, as well as to outline rational ways of their use in specific technological processes of water treatment.

Introduction of new effective technologies for obtaining a complex from natural adsorbents based on bentonite and zeolite made it possible to achieve a high degree of purification of drinking and waste water from heavy metals, dispersed impurities of oil and oil products, surfactants, dyes, radioactive contamination, etc. , increased water quality, in accordance with sanitary and hygienic standardized requirements that meet human safety criteria, thus we think the problems of drinking water supply and the rational use of local natural adsorbents will be solved .

The aim of the study: To develop a technology and experimentally evaluate the effectiveness of using a complex of natural mineral adsorbents for purification of drinking and waste water.

To achieve this aim, it is necessary to solve the following tasks:

1. To study the toxic and hygienic indicators of water that has been purified using a complex of natural mineral sorbents (NMS).

2. To study the physicochemical and biological effect of water that has been purified using a NMS complex.

3. Development and analysis of the theoretical foundations and methods for determining the effectiveness of a complex of natural mineral adsorbents in purification of drinking and waste water from chemical and microbiological pollutants.

Bentonite clay (Mukry deposit in the Zhetysu Region) is a natural clay mineral, hydroaluminosilicate, which has the property of swelling upon hydration (14-16 times). In a limited space for free swelling in the presence of water, a dense gel is formed that prevents further penetration of moisture. This property, as well as non-toxicity and chemical resistance, makes it indispensable in industrial production, construction and many other fields of application.

Natural occurring bentonites usually have pH 6–9.5 (for 5 % of aqueous suspension after settling for 1 hour) and contain less than 2 % sodium carbonate ; the total content of interchangeable sodium and calcium does not exceed 80 ml/100 g. There are two types of bentonites:

- calcium, with a low degree of swelling;
- sodium, with a high degree of swelling (swelling rate less than 7 ml/g or more than 12 ml/g).

Chemical formula: $AI_2 [Si_4O_{10}](OH)_2 \cdot nH_2O$

Chemical composition: SiO_2 -58.25 %; AI_2O_3 -14.27 %; Fe_2O_3 -4.37 %; FeO-0.5 %; Ti_2 O-0.36 %; CaO-2.07 %; MgO-3.67 %; P_2O_5 -0.18 %; S-0.14 %; K_2O-1.2 %; Na_2O-2.25 %; PPP-12.19 %

Zeolites (Maitobe deposit in the Zhetysu Region) are a large group of minerals similar in composition and properties, aqueous calcium and sodium aluminosilicates from the subclass of frame silicates , with a glassy or pearly luster , known for their ability to give and reabsorb water depending on temperature and humidity. The most common representatives of the zeolite group are natrolite, chabazite, heulandite, stilbite (desmin), mordenite , thomsonite , lomontite .

Result and discussion

We activated natural sorbents bentonite and zeolite, that is we modified to increase the physicochemical, catalytic and adsorption properties, for this purpose we used thermal activation methods, treated with 12 % hydrochloric acid and performed hydrothermal treatment.

During the heat treatment of the complex of bentonite clay and zeolite, the main attention was paid to determining the optimal activation temperature. The optimum activation temperature of diatomaceous earth is 300–400 °C until the loss of hydration water is 50–80 %, approximately the same temperature (250–300 °C) was proposed by Russian scientists Osokin A.P., Entin Z.B., Bakharev M.V., Sidenko I. L.

Mechanism of thermal activation was used to increase the adsorption capacity of sorbents during heat treatment, which was due to removal of adsorbed and constitutional water, that is, an increase in total porosity.

Close to thermal activation is the method of hydrothermal modification of natural sorbents, that is treatment in water vapor at high temperatures and pressure. Dissolution of small particles of a substance and their precipitation on the surface of larger ones occur during hydrothermal treatment, which leads to a change in the specific surface

and an increase in the sorption volume of pores. Since the composition of natural adsorbents includes metal hydroxides, which undergo various phase transitions during hydrothermal treatment, often leading to amorphization of the mineral structure, which is accompanied by an increase in their activity. With the help of thermal and hydrothermal treatments, it is possible to modify natural sorbents in a fairly wide range, giving them selectivity with respect to certain solutes; in our studies using this method we have to deal with high temperatures and pressures, which in itself is unsafe and requires complex hardware design.

The choice of bentonite clay of the Mukry deposit and zeolite of the Maitobe deposit in the Zhetysu Region *as adsorbents is* explained by the following. All *artificially prepared* adsorbents are scarce and expensive; therefore, their *use is economically viable* only under *the condition of repeated* use. *The need to restore the* adsorbent *complicates the* regeneration process, since capital and *operating costs are significant* . Therefore, *use of natural* (cheap and available) adsorbents with sufficiently *high adsorption* capacity, ability to mineralize water in *the processes of contact purification* and filtration has undoubted advantages.

Table 1 - Chemical composition of bentonite of the 7th horizon of the Mukry deposit

Chemical elements	SiO_2	TiO_3	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	C
Percentage, %	6.72	0.1	2.24	2.05	82.51	2.24	0.1	0.1	6.27

In the Mukry deposit 220 thousand tons of carbonate-siliceous-clay-zeolite rocks of the 7th lithological horizon with the sum of exchangeable cations 40–42 mg/100 g of dry matter, including exchangeable cations Ca - 32, Mg - 8, 8–9; Na - 0.3–0.4; K - 0.3–0.4 mg equiv./100 g of substance.

The chemical composition is characterized by predominance of biogenic calcium carbonate (97 %) in the presence of sulfate associated with aluminosilicate (~2 %) and chloride (-1 %); sulfate sulfur in the amount of 0.22 % gypsum and ferric iron - 0.91 %.

The carbonate-siliceous-argillaceous 7th horizon in the nature plays the role of a geochemical barrier in infiltration of atmospheric waters and distribution of matter during the capillary-pore rise of solutions.

The chemical composition of bentonite of horizon 7 is shown in fig. 1. The picture taken in “Irgetas” laboratory on a JSM -6390 LV scanning electron microscope in fig. one.

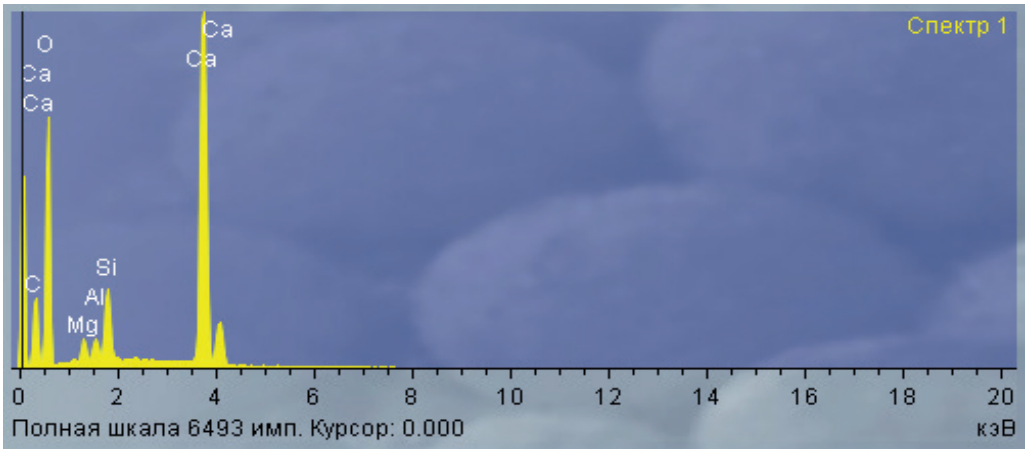

Fig. 1. Chemical composition of bentonite clay of the 7th horizon

The source of calcium can be the carbonate-siliceous horizon of the Mukry deposit, which forms the 7th horizon. As shown above, the carbonate-siliceous horizon consists mainly of loosened calcite, which plays the role of cement for siliceous formations represented by loosened opal, quartz, and zeolite. The relative content of calcite in many parts of horizon 7 exceeds 90 %.

To test the effectiveness of the complex, natural adsorbents were taken in different percentages, and an agglomerate was obtained: 1) zeolite (60 %) and bentonite (40 %), 2) zeolite (50 %) and bentonite (50 %), 3) zeolite (40 %) and bentonite (60 %). Subsequently, capsules with a diameter of 14–16 mm and a length of 15 mm were made from the resulting mixture, acid activation was carried out using 15% H_2SO_4 taken in the amount of 50 % of the air-dry sample, the processing time took 4 hours. Heat treatment was carried out in a muffle furnace at a temperature of 400 degrees to increase the overall porosity (Yudakov et al., 2001).

One of the most important characteristics of an adsorbent is determination of its porosity, which generally depends on its deposit. It is characterized by the total volume of all voids (pores) in the rock.

The concept of the surface of microporous adsorbents loses its physical meaning. An additional feature of microporous adsorbents is manifestation of molecular sieve action in cases where the size of entrances to micropores or cavities of the adsorbents is significantly smaller than the sizes of the micropores (Kovalevski et al., 1999).

If we compare the properties of finely porous and non-porous compounds, then dispersed forces play the main role in determining adsorption abilities. In most cases, they appear in finely porous compounds, increasing the quality of the filter element.

Bentonite clay and zeolite undergone to thermochemical treatment at a temperature of 950^0. The specific surface area of bentonite clay was 108 m^2/g. In the range of adsorption values from 0.1 to 0.5 mmol/g, the differential heats of zeolite adsorption are 1.5 times more than the heats of activated carbon in fig. 2.

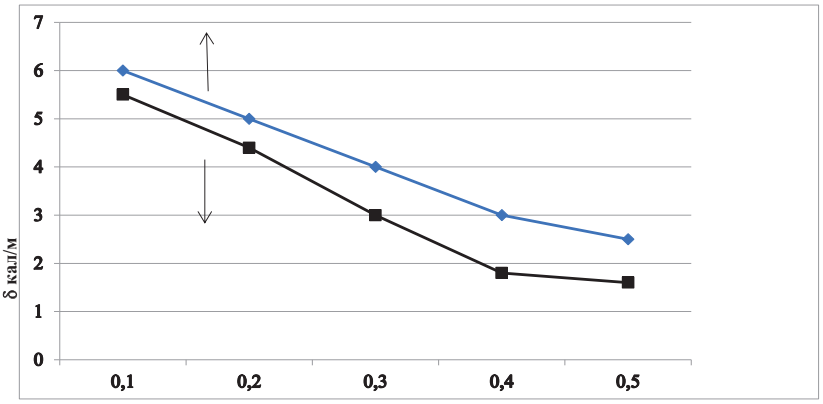

Fig 2. Increase in the adsorption of bentonite clay and ziolite at a temperature of 950^0

An increase in energy in micropores of bentonite clay leads to a sharp increase in adsorption vapors in the area of equilibrium pressure. With an increase in the energy of adsorption, interaction in the microcomponents of the complex of bentonite clay and zeolite causes growing of adsorption vapors in the rank of low equilibrium pressure.

Determination of porosity of the sorbent was carried out according to the following method. The test samples were boiled with distilled water for 1.5–2.0 hours and then weighed.

The density of the samples, water absorption and porosity were calculated according to the data in table 2, where: m_0 is the mass of the studied samples with suspension in water, g; m_1 - weight of wet samples, g; m_2 is the mass of dry samples, g; m_3 - weight of the suspension, g.

Table 2. Input data for calculation (complex of bentonite clay and zeolite)

No. of experience	Material name	m_0,g	m_1,g	m_2,g	m_3,g
1	Complex of zeolite (60 %) and bentonite clay (40 %)	10.0018	31.4312	19.0645	0.5923
2	Complex of zeolite (50 %) and bentonite clay (50 %)	9.6453	29.2576	16.7312	0.4627
3	Complex of zeolite (40 %) and bentonite clay (60 %)	9.9459	31.2057	18.1124	0.4134

The limits of the relative total error of the result, which is allowed, is 2.0; with a confidence level of 0.95. The results of the study are presented in table 3.

Table 3. Determination of porosity of a complex of bentonite clay and zeolite

Sample No.	Material name	Sample weight, g	Water absorbtion, %	Density, %	Porosity, %
1	Complex of zeolite (60 %) and bentonite clay (40 %)	21.2145	76.0690	43.8490	73.45
2	Complex of zeolite (50 %) and bentonite clay (50 %)	20.7124	77.7860	44.7296	73.91
3	Complex of zeolite (40 %) and bentonite clay (60 %)	19.9437	82.3320	45.6125	80.51

Conclusions

Mineral sorbents of various nature available in the domestic raw material base like zeolite and bentonite clay were selected for experimental study on the basis of analysis of technical and economic indicators.

The conditions for activation of NMS were empirically selected. The activity of NMS increased most significantly (by 35–57 %) after acid treatment with a mixture (1:1) of 10 % hydrochloric acid .

In model experiments on the use of natural mineral sorbents in the processes of water purification from pollution, significant differences were revealed in the efficiency of the considered sorbents, determined by their mineral composition, microstructure, sorption capacity, and the presence of catalytic activity.

The results of laboratory studies showed that NMS have pronounced sorption properties in relation to heavy metals, microbiological contaminants, and with an increase in the concentration in the zeolite complex to (3.1÷3.5) x10^4 cells/ml, the sorption effect becomes more efficient.

REFERENCES

Gildenskold R.S., Novikov, Yu.V., Vinokur I.L., Tlitman, S.I. (1993). Modern problems of city hygiene // Hygiene and Sanitation, 3; — 4–7.

Jetimov M., Idrisova A., Sarbasov Y., Shagataeva Z., Saduakasova R. (2015). Influence of the Complex of Natural Mineral Sorbents on Microbiological and Qualitative Measures of Water. International Journal of Emerging Trends in Engineering and Development. — Issue 5. — Vol.1. — Available online on. — *http://www.rspublication.com/ijeted/ijeted_index.htm*. — ISSN 2249–6149.

Jetimov M.A. (2015). Use of natural mineral sorbents for purification of drinking water from microbiological contaminants. Theoretical and applied issues of science and education, Tombov, January. — ISSN 978-5-906766-80-9. — Pp. 47–51/

Komarova L.F. (1998). Physical and chemical bases of application of natural and modified sorbents in water purification processes.//Chemistry and water technology. —1998. — T. 20. — No. 1. — Pp. 42–51.

Kovalevski V.V. (1999). About use of carbonaceous sorbents on the basis of natural mineral rocks for purification of drinking and waste waters// Mathematical conference. "Akvaterra". — p. 40.

Makhorin K.E., 1998. Active carbons and their application in water treatment// Chemistry and technology of water, — 2 (1); — Pp. 52–60.

Novikov M.G., Meltzer V.Z. (2000). On the choice of filter material // Water and Ecology, — 2. — Pp. 21–23.

Novikov Yu.V., Tulakin A.V., Tsyplakova G.V. (1998). Influence of corrosion and fouling products of pipelines on the quality of drinking water// Hygiene and Sanitation, — 2; — Pp. 8–11.

Ponomarev V.V. (1997). Purification of artesian water from manganese and iron ions with use of modified clinoptilolite //Chemistry and water technology. — -T. 19. — No. 5. — Pp. 493–505.

Somina B.A. (1997). Researches of possibility of application of new sorbent in water treatment// Chemistry and water technology. — No. 6. — Pp. 617–622.

Sukhorukova O.V. (1998). Coagulation, flotation, flocculation and filtering in technology of water treatment //Chemistry and water technology. — T.20. — No. 1. — Pp. 19–31.

Verfilyev P.A., Yudakov A.A., Ksenik T.V. (1999). Mineral raw materials. Natural sorbents. — M.: Geoinformmark CJSC. — P. 42.

Yudakov A.A., Ksenik T.V. (2001). Adsorbents, their receiving, properties and application. — Leningrad — Nauka. — P. 256.

CONTENTS

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). 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.geolog-technical.kz/index.php/en/
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Подписано в печать 15.12.2023.
Формат 70x90$^{1}/_{16}$. Бумага офсетная. Печать – ризограф.
19,0 п.л. Тираж 300. Заказ 6.

РОО «Национальная академия наук РК»
050010, Алматы, ул. Шевченко, 28, т. 272-13-19