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

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ
Satbayev University

ХАБАРЛАРЫ

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 (447)

MAY – JUNE 2021

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.

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«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Меншіктенуші: «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 және техникалық ғылымдар бойынша мақалалар жариялау.*
Мерзімділігі: жылына 6 рет.
Тиражы: 211 дана.
Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19, 272-13-18
http://www.geolog-technical.kz/index.php/en/

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

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«Известия НАН РК. Серия геологии и технических наук».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).
Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ39VPY00025420,** выданное 29.07.2020 г.
Тематическая направленность: *публикация статей по геологии и техническим наукам.*
Периодичность: 6 раз в год.
Тираж: 211 экземпляров.
Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19, 272-13-18
http://www.geolog-technical.kz/index.php/en/

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

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News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).
The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420,** issued 29.07.2020.
Thematic scope: *publication of papers on geology and technical sciences.*
Periodicity: 6 times a year.
Circulation: 211 copies.
Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19, 272-13-18, http://www.geolog-technical.kz/index.php/en/

© National Academy of Sciences of the Republic of Kazakhstan, 2021

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

NEWS
OF THE NATONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5227
Volume 3, Number 447 (2021), 59-64 **https://doi.org/10.32014/2021.2518-170X.63**

UDC 658.567.1

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ASSESSMENT OF LAND RESOURCE POTENTIAL AND SOLID WASTE RECYCLING METHODS

Abstract. This paper analyzes the environmental load exerted by the solid waste landfills of Turkistan and Kentau cities and the villages of the Sauran district of the Turkistan region. The data of morphological analysis of MSW composition stored in the territories of these landfills are presented. This paper aims to present the possibility of reducing the amount of some waste types deposited at landfills on the basis of their direct use as secondary raw materials for various purposes. The possibility of using solid waste components in greenhouses and other facilities construction has been shown by recycling plastic and glass bottles, as well as other industrial waste. On the basis of experimental data, it was concluded that with widespread introduction of waste recycling, by saving materials, it will make it possible to reduce the cost of economic facilities construction and to minimize the harmful impact of waste on environment.

Key words: solid waste landfills, Turkistan region, harmful impact, secondary raw materials, polyethylene terephthalate, recycling, building materials.

The actuality of the problem. Municipal solid waste (MSW) is one of the dangerous sources of environmental pollution [1-3]. The relevance of studying the solid waste landfills impact on the environment lies in the formation of negative processes of microbiological, sanitary-hygienic and sanitary-toxicological nature on the mentioned territories and in nearby residential areas. The environmental problems associated with these types of waste are still not fully resolved in all countries of the world [4-6]. The composition of MSW contains ecologically hazardous components of various natures. The qualitative and quantitative composition of generated waste is associated with the life standard of the population, with the development of infrastructure and types of production activities.

To solve the solid waste problems and an urgent task of its solving are to change the existing ways of handling them. Disposal of solid waste in landfills and rubbish dumps is widely practiced all over the world due to low capital and operating costs. As the analysis of statistical data has shown, more than 90% of solid waste in Kazakhstan is sent to storage or burial in landfills [7-8], which poses a threat to the environment. At present, the number of landfills in the republic exceeds 2,000, including 181 officially authorized solid waste landfills in the Turkistan region with project documents. At the same time, the number of unauthorized landfills is more than the number of landfills. Unfortunately, storage and disposal of solid waste in landfills remains the simplest and cheapest way to remove waste in Kazakhstan. This method does not provide environmental protection of the atmosphere, soil, surface and ground waters pollution, does not prevent, but, on the contrary, promotes the spread of rodents, insects and disease-causing microorganisms.

The negative impact of waste in landfills and rubbish dumps is due to the formation of biogas (methane content ≤60%), as well as leachate during heavy precipitation. A significant threat to the environment is posed by fires or smoke pollution, while especially toxic dioxins, furans and other substances are released into the atmosphere. Furans and dioxins contribute to disorganization of processes in the body, namely, they cause a disorder of tissue respiration, disrupt metabolic processes in the liver and other organs. By damaging the human immune system, these substances contribute to a number of dangerous diseases. In the affected organs under the action of dioxins, the bioactivation of mutagens, carcinogens, and neutrotoxic poisons already present in the body [9]. This leads not only to the creation of negative impacts on the natural environment objects, including the health of the population, but also to the irreversible loss of valuable secondary material and energy resources [10-12]. In this regard, it becomes necessary to minimize emissions of highly toxic substances into the atmosphere to concentrations not exceeding the values of international standards.

For environmental protection and rational integrated use of natural resources, the most acceptable and relevant are the following types of waste management: recycling, processing and disposal of waste. They obtain specific valuable marketable products. But these issues must be resolved in each case individually, taking into account the economic and technological capabilities of the region.

The aim of this study is the ecological and economic substantiation of ways to reduce the impact of solid waste on the environment both in the urban and agricultural areas of the Sauran (Turkistan region).

Objects and research methods.The research objects of polygons of Kentau and Turkistan cities, 10 polygons of villages in the Sauran district of the Turkistan region and sulfur-containing waste of SKZ-U LLP, sawdust, sintered lump and other residues of solid building materials. A crushing plant was used to treat the waste. While conducting research, we used the main methods, namely experiment and visual fixation. The ecological assessment of target landfill condition and solid waste was carried out in accordance with state regulations and methods.

GANK-4 gas analyzer was used in quarterly determination of the greenhouse atmospheric air content, ozone-depleting and other toxic emissions generated over landfill sites, at the border of the sanitary protection zone and in areas adjacent to the landfill.

Results and discussion. The inconstancy of harmful substances content was identified in field observations of the qualitative and quantitative composition of landfill gases in the atmospheric air directly on the territories of landfills, and in areas adjacent to them up to 1 km. The increased concentrations of greenhouse and toxic gases were observed in the surface air layer with intense smoke. The methane content exceeds the maximum permissible concentration (MPC) in urban landfills in Kentau and Turkistan more than 300 times and higher, in rural areas it shows 20-25 times. Exceeding the MPC values was also found for sulfur (IV) oxide ≥7 times (for the Kentau landfill), nitrogen oxides ≥ 25 (for the Turkistan city landfill).

The high concentrations of methanethiol (also known as methyl mercaptan) is turned up in the process of smoke pollution deserve serious attention. Based on the measurements, we established the presence of this carcinogenic and mutagenic substance in the atmospheric air above the landfills with smoke in the range of 0.007-0.015 mg / m^3 or more (the maximum one-time maximum permissible concentration is 0.0001 mg / m^3). Mercaptans affect the respiratory system and the central nervous system [13]. The qualitative composition and content of harmful gases formed during combustion and smoke pollution depended on the morphological composition of solid waste in landfills.

Awareness of the morphological composition of solid waste is a necessary indicator for characterizing the impact of landfill components on the environment, as well as for the selecting methods for protecting biological resources and the rational integrated use of waste as secondary raw materials. According to the Concept on Kazakhstan's transition to a "Green economy" adopted in May 2013, the share of recycled waste in the country should be 40% in 2030, and 50% by 2050 [14].

According to the transition to a "Green economy" from 2016, the disposal of mercury-containing lamps and devices, scrap metals, waste oils and liquids, batteries, waste electronic devices at landfills is prohibited. Since January 2019, a ban on the disposal of plastic, waste paper, cardboard and other paper waste, glass in landfills came into force. From January 1, 2021, there is a ban on the disposal of construction and food waste [14]. In connection with these prohibitions, it becomes necessary to find new ways of handling solid waste. The results of scientific research to address a number of existing problems associated with plastic and glass bottles, as well as with industrial solid waste are presented in the following part.

As can be seen from Table 1, the composition of municipal solid waste is unstable and varies depending on the season of the year. The amount of components in the total waste stream in urban landfills is very different from the composition of waste in rural landfills. The largest amount of food waste is generated in the summer-autumn period, which can be explained by an increase in the consumption of vegetables and fruits, as well as by preserving them for winter by canning. The increase in polymeric and glass materials in the composition of MSW in the summer-autumn period compared to the winter-spring period is associated with increased consumption of various drinks in hot summer months. The construction waste increases twice in connection with the intensified repair and construction work in summer and autumn months. The main amount of waste belongs to 4 and 5 hazard classes. The moisture content of waste in the summer months is not higher than 1%, in the autumn and winter months it depends on the amount of atmospheric precipitation and ranges from 10-15%.

Table 1 shows the average morphological composition of solid waste in urban and 10 rural landfills of the Turkistan region. Studies were conducted from November 2020 to January 2021.

Table 1 - Characteristics of the morphological composition of solid waste in urban and rural landfills

Components	Average content of MSW components in Kentau and Turkistan and 10 rural landfills of Sauran district by seasons of the year, %					
	Winter-Spring			Summer-Autumn		
	Village	Turkistan	Kentau	Village	Turkistan	Kentau
Food wastes	~10	≥25	~22	~9	~32	~ 30-40
Paper, cardboard	5...8	15...17	7...12	6...10	20...22	≤10
Wood pieces and sawdust	~0,2	2...3	0,5...1	~0,5	3...4	~2
Scrap Metal	≤ 1	≤ 3	до 1	≤ 2	≤ 3	1...3
Textile	5...6	4...5	3...5	4...7	4...5	2...4
Bones	5...10	5...8	3...7	5...15	5...10	2...5
Glass and various containers	3...5	7...10	5...7	10...12	10...15	14
Leather and Rubber	6...9	2...5	10...11	5...7	2...5	2...3
Stones, plaster, slate and other construction waste	≥5	≥10	≥8	≥10	≥20	≥10
Polymer products, including plastic bottles	~10	≥20	≥20	≥15	>25	~23
Wool and animal manure	10...25	2...3	5...10	~10	2...3	≤1

Morphological analysis shows that about 50% of solid waste is a potential secondary resource (Table 1). In all landfills, the content of polymer packaging materials, including plastic bottles, is growing every year. The involvement of such valuable components as paper, cardboard, glass, polymer materials, metals in the secondary circulation will lead to a significant reduction in the need for material and energy resources, as well as reduce their negative impact on the environment.

Disposal of organic waste, such as manure, poultry droppings, food waste, will make it possible to return carbon, nitrogen and other elements into the substances cycle. Organizing production of compost, vermicompost and other fertilizers-ameliorants based on waste will increase the fertility of degraded agricultural fields.

We have carried out a number of works aimed at using plastic and glass bottles and industrial waste without recycling. Photo-captured moments of waste collection and recycling are presented in Figure 1.

Figure 1.Recycling of plastic and glass bottles for building greenhouse walls and observation booth with an winterized field on the territory of Ecology Research Institute Area

Preliminary sorting of solid waste at the generation sources has been carried out to facilitate utilization, which facilitates the separate collection of various types of waste.

Figure 2 shows objects (greenhouse and a house) withused polymer and glass bottles built in the production territory of Ecology Research Institute (Turkistan, Nazarbayev St., 8) at AkhmetYassawi International Kazakh-TurkishUniversity. The remains of unusable cement, plastering materials and sulfur-containing sulfuric acid waste generated of building repairs and constructions were used to fill the bottles.

The principle of creating a warm floor with blocked-up glass and plastic bottles consists in an air gap that fills the cavity of the bottle and acts as a thermal barrier that does not allow cold to enter the room. Glass and plastic bottles prevent cold air from penetrating through the ground. To provide mechanical strength, plastic bottles were filled with sawdust and other waste, and durable glass bottles were used without filling. The bottles were placed in 3 rows in a prepared pit ~ 25 cm deep. A layer of sulfur-containing waste of sulfuric acid production was covered at the pit bottom and the thorough tamping and leveling was carried out. Seroperlite-containing waste has an insecticidal property, which prevents the termite and other insects accumulation. Crushed stone, screenings or sand can be used to create a compacted layer under the bottles instead of waste, rubble, screenings or sand. The pit bottom and each row of the stacked bottles were covered with a reinforcing mesh for stability and rigidity. Parallel rows of bottles joined neck to neck and bottom to bottom to reduce the headspace between bottles. Then the floor mounted from glass or plastic containers was leveled with a cement screed 5-7 cm high.

Figure 2. Greenhouse and cabin with MSW construction

During the greenhouse construction, plastic bottles were filled with shredded solid waste available to create strength. Then, to fasten the bottles, the pores between them were filled with a solution containing wood ash, slaked lime and ordinary table salt. The optimal way of laying is a chess order, the first row was laid only using cinder block bricks, in the upper rows the brick was alternated with plastic bottles (Figure 1). According to the estimated data, provided that plastic bottles are used instead ofbrickworks, a certain amount of cinder block bricks can be saved. In this facility, every 1000 plastic bottles allowed on average to reduce the consumption of cinder block bricks by 250 pieces.

Conclusions.

1. This paper establishes the plastic bottles applicability as the main material for winterization of walls and floors using the example of a greenhouse and a cabin built on the territory of the Ecology Research Institute at AkhmetYassawi International Kazakh-Turkish University. This approach made it possible to use low-cost construction material (plastic bottles) and avoid the need to look for solutions for the processing of not only these bottles, but also other industrial waste (sulfur-containing waste, sawdust, unusable plaster materials, cement and other residues of various waste) used to fill them.

2. Direct use of plastic bottles without recycling as a building material avoids the release of them into the environment and reduces waste amount. In addition, waste recycling will make it possible, with widespread introduction, to reduce the economic facility construction costs by saving materials.

3. At last this paper verifies the use of various solid waste types and industrial waste of regional origin as secondary raw materials will make it possible to make specific decisions on waste management, adapted to local social, economic and technical potentials.

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ҚАТТЫ ТҰРМЫСТЫҚ ҚАЛДЫҚТАРДЫ ҚАЙТА ҚӘДЕГЕ АСЫРУ ТӘСІЛДЕРІ МЕН ПОЛИГОНДАРДЫҢ РЕСУРСТЫҚ ӘЛЕУЕТІН БАҒАЛАУ

Аннотация. Бұл мақалада Түркістан, Кентау қалалары мен Түркістан облысының Сауран ауданындағы ауылдардың қатты тұрмыстық қалдықтар полигондарының қоршаған ортаға тигізетін экологиялық жүктемесі талданған. Осы полигондардың аумағында сақталған қатты тұрмыстық қалдықтар (ҚТҚ) құрамына морфологиялық талдаулардың мәліметтері келтірілген. Полигондарда жинақталған қалдықтардың кейбір түрлерін оларды әртүрлі мақсаттағы екінші реттік шикізат ретінде тікелей пайдалану негізінде азайту мүмкіндігі көрсетілген. Полиэтилентерефталат (ПЭТ) пен шыны бөтелкелерді, сондай-ақ басқа өндірістік қатты қалдықтар компоненттерін қайта өңдеу арқылы жылыжайлар мен басқа да нысандардың құрылысында пайдалану мүмкіндігі көрсетілген. Тәжірибелік мәліметтер негізінде қалдықтарды қайта өңдеуді кеңінен енгізе отырып, материалдарды үнемдеу арқылы шаруашылық құрылыс нысандарының шығындарын азайтуға және сонымен бірге қалдықтардың қоршаған ортаға зиянды әсерін барынша азайтуға мүмкіндік беретіндігі зерттелген.

Түйін сөздер: қатты тұрмыстық қалдықтар полигоны, Түркістан облысы, зиянды әсер, екіншілік шикізат, полиэтилентерефталат, қайта өңдеу, құрылыс материалдары.

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ОЦЕНКА РЕСУРСНОГО ПОТЕНЦИАЛА ПОЛИГОНОВ И СПОСОБЫ РЕЦИКЛИНГА ТВЕРДЫХ БЫТОВЫХ ОТХОДОВ

Аннотация. В статье проанализирована экологическая нагрузка, оказываемая полигонами твердых бытовых отходов городов Туркестан, Кентау и сел Сауранского района Туркестанской области на окружающую природную среду. Приведены данные морфологического анализа состава ТБО, складируемые на территориях этих полигонов. Показана возможность сокращения количеств депонируемых на полигонах некоторых видов отходов на основе их непосредственного использования в качестве вторичного сырья для различного назначения. Путем рециклинга ПЭТ и стеклянных бутылок, а также других производственных отходов показана возможность применения компонентов ТБО при строительстве теплиц и других объектов. На основе экспериментальных данных сделан вывод о том, что при широком внедрении рециклинг отходов позволит за счет экономии материалов удешевить строительство хозяйственных объектов и одновременно минимизировать вредное воздействие отходов на окружающую среду.

Ключевые слова: полигоны твердых бытовых отходов, Туркестанская область, вредное воздействие, вторичное сырье, полиэтилентерефталат, рециклинг, строительные материалы.

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

Редакторы: *М. С. Ахметова, Р. Ж. Мрзабаева, Д. С. Аленов*
Верстка на компьютере *В.С. Зикирбаева*

Подписано в печать 15.06.2021.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
4,6 п.л. Тираж 211. Заказ 3.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19