

J. Teczke¹, Zh. Shugaipova²

¹Cracow University of Economics, Poland;

²Karaganda Economic University of Kazpotreboyz, Kazakhstan
(E-mail: dzheyn.byutiful@mail.ru)

Ecological consequences as a result of non-rational use of mineral resources in the Republic of Kazakhstan

The article deals with the problems of inefficient use of natural resources during their extraction. The demand for minerals is steadily growing, the demand for them is determined primarily by demographic growth. Currently active development of minerals in Kazakhstan is under way. At the same time, there is a threat of their depletion, and pollution of the environment during the extraction of minerals can lead to irreversible consequences. The article raises the issue of the need to create as many enterprises as possible processing waste. The main problem with this is the absence of a state waste management system, which includes monitoring, storage, processing, recycling of industrial and domestic waste. Contamination of continental and oceanic waters by hydrocarbons is currently one of the main types of pollution of the hydrosphere by a modern civilized society. Sea and river currents, movements of air masses spread harmful pollution over long distances. Thus, the problem of environmental protection from the local, regional becomes a national or international. Kazakhstan, being a full-fledged member of the UN, should use international cooperation as a key to effective implementation of state environmental policy.

Keywords: extraction of minerals, pollution, environment, waste, protection of natural resources.

Since the beginning of the XX century society has come to the conclusion that the surrounding environment also needs protection, and it is impossible uncontrollably and unreasonably spend her resources. From that time, the concept of environmental protection began to develop. Originally it meant the safety and the protection from destruction and complete extermination of certain types of animals and plants, and from the destruction of unique objects or areas of wildlife. In the 30-ies of the XX century, it was supplemented by the protection of natural resources in connection with the threat of depletion of mineral resources, forests, water and other resources.

Starting from the 1950s and 1960s, the concept of environmental protection includes, besides the listed ones, also protection of nature from industrial and transport emissions, sewage, pesticides, radioactive waste and other pollution. Each state is engaged in solving environmental problems in its territory, carrying out environmental protection measures, spending considerable material and financial resources on them. However, pollution of the atmosphere, seas, rivers and oceans is not limited to state borders. Sea and river currents, movements of air masses spread harmful pollution over long distances, and many other countries that are not related to these pollutants are forced to deal with issues of environmental protection [1].

Large nature protection actions demand big expenses, and for separately taken country are burdensome. In such cases, several countries join their efforts and jointly carry out such activities, which makes it possible to significantly reduce the cost of work and speed up their implementation.

Each country adopts its own laws on regulating protection, use and restoration of natural resources and monitors their implementation. Regional authorities and administrations, ministries, departments and state committees make decisions, orders, instructions on the use of national laws on nature protection, determine the responsibility of officials and citizens for the exact execution of them. In environmental protection, also take an active part the economic services, law enforcement agencies and public organizations.

Since the Bronze Age, man has systematically extracted minerals, expanding their range and, at the same time, increasing the volume of production. At the beginning of the development of civilization man used only 4 metals: gold, silver, copper and iron. Nowadays he draws from the depths of more than 200 types of raw materials and fuel. The main role in the composition of natural resources (flora and fauna, water, land, mineral resources) belongs to the mineral resources of the subsoil (about 70 % of the volume of consumed natural resources). The demand for minerals is steadily growing, and the demand for them is determined primarily by demographic growth.

The scale of development of mineral resources in the former USSR was characterized by the following data: the country provided about 28 % of the world mining production (the USA about 23 %). Before the collapse in the USSR, it had occupied the leading place in the world for the extraction of oil, coal, iron and

manganese ore and other minerals and about 6.5 billion tons various minerals were mined annually. The volume of mining was doubled about every ten years.

More than 40% of all capital investments were directed to the mineral raw materials complex, about 20% of employees were employed in it. At present the resource potential of the republic becomes the most significant. The most important feature of the consumption of mineral resources in an industrial society is the high rate of extraction of minerals. By the 90th years of the 20th century, with an increase in the world population by about 2.5 times, annual production increased by more than 12 times [2].

The most rapidly had developed the production of oil, gas, coal, iron ore, at the same time we could see the expenses of ores of nonferrous, rare, precious metals, chemical raw materials. If we consider the scale and rate of development of mineral resources, we can see the following:

- firstly, the high rates of extraction of all types of minerals ensured the possibility of a gradual increase in the production of products necessary for the national economy and the population of the country;
- secondly, the increase in production was accompanied by a decrease in the quality of new reserves, their reductions in the relevant areas, the complication of mining conditions and increased production costs.

Kazakhstan possesses huge reserves of mineral raw materials and is included in this index among the five leading countries of the world. Among 186 countries in the world, Kazakhstan ranks the first place in reserves of tungsten, barium, chromite, silver, the second place in reserves of zinc, the third place for manganese and molybdenum, the fourth place for copper, the fifth place for uranium, the sixth place for gold, the seventh for iron ore, the eighth tin and nickel, the ninth for coal and gas, the thirteenth place for oil. One third of the world's reserves of chromite, one-fourth - of uranium and manganese, one-tenth - of iron ore are concentrated inside the belly of Kazakhstan. Huge stocks of fuel and energy resources. There are quite large deposits of phosphorites, asbestos, rare metals, salts, raw materials which are suitable for the production of building materials. Thus, for the accelerated development of all industries, the Republic of Kazakhstan has sufficient mineral and raw materials resources. In many ways, the country's welfare will depend on the rational use of mineral resources [3]. The riches of the subsoil led to a rapid development of the extractive industry. Old and new cities were actively expanding. Inhuman and predatory attitude of government to the natural resources of the RK in the 70-90's led to the ecological crisis in the republic, which was catastrophic in some regions.

There was a tendency to maximize profits from the use of natural resources in the current consumer attitude towards nature and its resources. The interests of nature conservation, as a rule, were not priority at the same time and were ignored. These problems have remained to this day.

The irrational use of raw materials leads to their premature depletion and pollution of the natural environment. Due to waste heaps, dumps, quarries, boreholes, storage facilities huge areas of land are being surrendered. In the exploration, development and exploitation of deposits of carbohydrate raw materials, the adjacent territories. For example, around each drilling rig in a radius of 500-800 m, vegetation is destroyed by 70-80 %. Due to the unsatisfactory solution of environmental safety issues in the development of oil and gas fields, as well as the use of outdated technologies in their operation on an area of more than 1.3 million hectares, technogenic pollution in the form of oil spills of more than tens of thousands of tons was allowed in the Atyrau region. Sootiness of soil on some oil fields reaches a thickness of up to 10 m.

The Caspian oil-producing region has more than 4.3 million hectares of disturbed lands, including 1.5 million hectares of technology-related zones, 1.9 million hectares of degraded pastures, 0.6 million hectares of oil-polluted and 0.3 million hectares of land with radioactive contamination. When oil is processed, the loss of light hydrocarbons is about 1% of the total oil production. The huge mass of reservoir and mine waters in the Atyrau region is dumped on the relief in the territory of oil fields [4].

The imperfection of technological processes leads to the fact that only 1.5 – 2 % of the huge amount of natural resources seized for production purposes are converted to the final product. The basic mass of it goes into production and household waste. Only about 5% of solid domestic waste in Kazakhstan is subject to utilization and incineration. Industrial waste, including toxic waste, has been decomposed and stored in various storage tanks, often without compliance with relevant environmental standards and requirements. As a result of that, soil, groundwater, surface waters of many regions are subject to intense pollution. The basic mass of solid household waste without component separation is exported and stored in open dumps, the 97 % of them do not comply with the environmental and sanitary legislation of the Republic of Kazakhstan. Their placement and installation were carried out without projects and environmental impact assessment [5].

The main problem is concluded that in RK there is no state control system of waste which includes monitoring, storage, processing, utilization of industrial and household wastes. In the territory of RK more

than 20 billion tons of industrial and consumption waste are saved up. At the same time the tendency of their increase is observed.

Hydrocarbon contamination is the result of many factors associated with oil production, its transportation by tankers and the use of petroleum products of fuel and lubricants. In the oil-producing, oil-refining and petrochemical complex, pollution begins with exploratory drilling and the construction of oil and gas wells.

The main sources of pollution in the construction of wells: exhausts of diesel engines of drilling rigs, degassers of drilling mud, storage tanks for bulk powder materials, slurry barns with industrial and technological waste, and circulating systems. In many cases, the drilling rigs do not carry out measures to protect soil and water from pollution. As a consequence, the adjacent land is contaminated with drilling mud and petroleum products. Then there is a washout of these harmful substances with melt water on the adjoining land and reservoirs. The process of soil contamination is exacerbated by the content in it of highly mineralized reservoir and waste water pumped to maintain pressure in productive layers and absorbing horizons [6].

Industrial waste drilling in barns or heaps at the drilling site requires subsequent evacuation and placement of them in a specially designated area under the sludge storage. At the same time special importance is gained by questions of assessment of the polluting ability of waste. This determines the amount and toxicity of pollutants in groundwater. The main and most powerful contaminant in drilling operations is drilling mud. For its preparation, up to two dozens of chemical reagents are used, many of which do not have the maximum permissible concentrations established by the Ministry of Health of the Republic of Kazakhstan. Well construction and the associated accumulation of drilling wastes differ from other types of production by the dispersal of drilling facilities, the heterogeneity of waste characteristics and their variation over time.

Morally outdated equipment and methods of economic activity increase the environmental hazard. The transition to new technological methods gives rise to new problems. For example, environmental pollution is observed when repairing wells. In this case, hundreds of downhole lifts of downhole equipment are carried out. Previously, the well is pumped with industrial water until complete degassing. However, in practice this washing does not remove completely the film of oil products from the inner and outer surfaces of pipes and equipment. As a result, when the latter is lifted to the work site, the downhole fluid draining from them pollutes the site, creates a fire hazard situation in the space around the wellhead. At the same time, the amount of liquid aggressive waste requiring burial increases. In fact, for all the old fields, the produced reservoir and wash water for decades have been thrown out on the evaporation fields [7].

Prevention of such a powerful negative impact on the environment under the conditions of intensification of hydrocarbon processing processes can only be achieved with an increase in the level of integrated use of hydrocarbon raw materials, that is, the full recovery of a useful part of resources and the delivery of waste to a reasonable minimum.

Contamination of continental and oceanic waters by hydrocarbons is currently one of the main types of pollution of the hydrosphere by a modern civilized society. The fact that there are sea areas where oil tankers are allowed to dump water after washing tanks, tramples on all the basics of oceanography. This problem is particularly acute in estuary areas where, despite the abundance of fish, which cannot be eaten because of the unpleasant taste that oil gives it. In addition, the action of hydrocarbons disturbs the ecological equilibrium of enclosed seas.

Invariably, the factors described in the form of the below listed sources of pollution bring the greatest costs for the restoration after them of a minimum balance in the atmosphere of our ecology [8].

Table

Source of pollution

Source of pollution	Million t in a year	Share in %
1	2	3
<i>Transportation:</i>	2,13	34,9
-ordinary traffic	1,83	30,0
-disasters	0,3	4,9
-carry in gout by rivers	1,9	31,1
- ingress of atmospheric pollution	0,6	9,8

Continuation of table

1	2	3
-natural sources	0,6	9,8
-industrial waste	0,3	4.9
-city waste	0,3	4.9
-waste from coastal oil refineries	0,2	3.3
<i>Extraction of oil on the high seas:</i>	0,08	1.3
-conventional operations	0,08	0.3
-accidents	0,06	1.0
The total pollution:	6,11	100

The main air pollution is connected with emissions from the enterprises of nonferrous metallurgy, power system, ferrous metallurgy, an oil and gas complex and transport. The reality of threats from pollution of atmospheric air affects deterioration in health of the population and degradation of the environment. The problem of atmospheric air pollution is inherent mainly in large cities and industrial agglomerations, where about half of the country's population lives.

The reasons for the high level of air pollution in the cities are obsolete production technologies at enterprises of mineral raw material complex, inefficient purification facilities, poor quality of used fuel, weak use of renewable sources and unconventional energy sources. Admittedly that industrial production is the most polluting air. Sources of pollution are thermal power plants, which together with smoke emit sulfur dioxide and carbon dioxide into the air; metallurgical enterprises, especially non-ferrous metallurgy, which emit nitrogen oxides, hydrogen sulphide, chlorine, fluorine, ammonia, phosphorus compounds, particles and compounds of mercury and arsenic into the air; chemical and cement plants. Harmful gases enter the air as a result of burning fuel for industry, heating homes, transport, burning and processing of domestic and industrial waste. The main harmful impurities of pyrogenic origin are the following:

1) Carbon monoxide - obtained with incomplete combustion of carbonaceous substances. It is a compound that reacts actively with constituent parts of the atmosphere and contributes to a rise in temperature on the planet, and the creation of a greenhouse effect

2) Sulphurous anhydride is released during combustion of sulfur-containing fuel or processing of sulphurous ores.

3) Sulfuric anhydride is formed during the oxidation of sulfur dioxide. The final product of the reaction is an aerosol or a solution of sulfuric acid in rainwater, which acidifies the soil, exacerbates the diseases of the human respiratory tract.

4) Hydrogen sulfide and carbon disulphide. They enter the atmosphere separately or together with other sulfur compounds. The main sources of emissions are the enterprises for the production of artificial fibers, sugars, coke chemical, oil refining, as well as oil fields.

5) Nitrogen oxides. The main sources of emissions are enterprises that produce nitrogen fertilizers, nitric acid and nitrates, aniline dyes, nitro compounds, viscose silk, celluloid.

6) Fluorine compounds. Sources of pollution are the enterprises for the production of aluminum, enamels, glass, ceramics, steel, phosphoric fertilizers.

7) Compounds of chlorine. Enter the atmosphere from chemical plants producing hydrochloric acid, chlorine-containing pesticides, organic dyes, hydrolytic alcohol, bleach, soda.

The main reason for the significant deterioration in the environmental situation in our country is the lack of a sustainable mechanism that takes into account the level of excess of MPC and MPE. This affects the economy of sources polluting the environment, as well as basic (starting) environmental and economic standards that determine the types of economic, moral punishment or encouragement. The state, for the purpose of protecting the environment, must include a set of environmental measures carried out in accordance with state laws and international agreements for the benefit of present and future generations.

In many respects, the country's welfare depends on the rational use of mineral resources. Rational use and protection of mineral resources in our republic is ensured by the following conditions:

- state ownership of all types of natural resources, which allows them to be integrated and planned to use them and preserve the wealth of subsoil for future generations;

- provision of the national economy with mineral raw materials with minimum socially necessary costs;
- introduction of progressive low-waste and non-waste production to reduce the level of harmful impact on the environment of mining industries.

It should be noted that in the period from 1995 to the present, the Government of the Republic of Kazakhstan has approved a number of delegated legislation, regulating relations in the sphere of subsoil use and carrying out oil operations. Currently, subsoil use issues in Kazakhstan are regulated by the Decree of the President of the Republic of Kazakhstan (which has the force of law), introduced in January 1996, on «Subsoil and Subsoil Use» [9].

According to the Article 47 of the Republic of Kazakhstan Law «On Subsoil and Subsoil Use», the protection of subsoil and the environment includes a system of legal, organizational, economic, technical and other measures aimed at providing a number of goals, including: health and life of the population; preservation of natural landscapes and reclamation of disturbed lands, as well as rational and integrated use of minerals. It should be noted that in accordance with this Law and the Constitution of the Republic, all minerals, including minerals, are in state ownership. However, the state does not have the right to conduct administrative cases on revealed violations in subsoil use, as well as there is no right to punishment for violations committed, and this all reduces the effectiveness of their activities.

Understanding that the success of socio-economic transformations depends to a large extent on the environmental policy in the country, was reflected in government decisions and in the approved main goal of a long-term environmental strategy is harmonization of interaction between society and the environment, and the creation of an environmentally friendly living environment. To achieve this goal, four priority areas have been selected:

- creation of environmentally safe environment;
- balanced use of natural resources;
- preservation of diversity of flora and fauna;
- ecological education [10].

At present, activities on international environmental conventions and agreements aimed at resolving priority problems have been significantly strengthened. Kazakhstan is a permanent participant in international forums for the protection of the environment, and actively develops agreements on a bilateral basis and level. Being a full-fledged member of the UN, Kazakhstan on the basis of global partnership, should use international cooperation in accordance with the current legislation. The principles of sustainable development, laid down in 1992 in Rio de Janeiro and confirmed at the World Summit in Johannesburg in 2002, should become the basis of policy and partnership in international relations, given that Kazakhstan is gaining increasing recognition in the world community.

It is believed that life on Earth exists about 5 billion years and there is no reason to fear that it will not survive, at least as much, if we do not destroy it ourselves. International cooperation in the field of environmental protection and rational nature management, improving the environmental situation in different regions is an objective necessity for all countries of the world. The development of international cooperation in the protection of nature facilitates the universality of many aspects of nature management and the development of common principles of action to achieve the desired goals. The transition to environmentally safe and careful use of resources is now becoming one of the priority areas of Kazakhstan's development strategies [11].

References

- 1 Hotelling H. The Economics of Exhaustible Resources / H.Hotelling // Journal of Political Economy. — 1931. — Vol. 39. — No. 2. — P. 137–175. [Электронный ресурс]. — Режим доступа: <http://www.jstor.org>.
- 2 Тонкопий М.С. Экология и экономика природопользования / М.С. Тонкопий. — Алматы: Экономика, 2003 — 592 с.
- 3 Программа по развитию минерально-сырьевого комплекса в Республике Казахстан на 2010–2014 годы. Утверждена постановлением Правительства Республики Казахстан от 31 декабря 2010 г. № 1530. [Электронный ресурс]. — Режим доступа: egov.kz/cms/ru/law/list/P1300001002.
- 4 Сихимбаев М.Р. Экономический механизм рационального недропользования в Республике Казахстан. — Саарбрюккен, Германия: Издательское дело Палмариума, 2012. — 171с.
- 5 Сихимбаев М.Р. Направления рационального использования природных ресурсов Республики Казахстан на примере угледобывающей промышленности // Международный журнал прикладных и фундаментальных исследований. — М.: Изд-во ИД «Академия Естествознания», 2016. — № 4(3). — С. 620–623.

- 6 Сихимбаев М.Р. Гармонизация экологии и экономики в условиях глобализации / М.Р. Сихимбаев. — Караганда: Изд-во КЭУК, 2012. — 401 с.
- 7 Рамад Ф. Основы прикладной экологии / Ф.Рамад. — Л.: Гидрометеиздат, 1981. — 576 с.
- 8 Тиетенберг Т. Экономика окружающей среды и природных ресурсов / Т.Тиетенберг. — М.: ОЛМА-ЛТЕСС, 2001. — С. 591.
- 9 Закон Республики Казахстан «О недрах и недропользовании» от 24 июня 2010 года № 291-IV (обновленный, с изм. на 11.07.2017). [Электронный ресурс]. — Режим доступа: <http://www.online.zakon.kz>.
- 10 Концепция развития геологической отрасли Республики Казахстан до 2030 года. Утверждена постановлением Правительства Республики Казахстан от 13 августа 2012 г. № 1042. [Электронный ресурс]. — Режим доступа: adilet.zan.kz/rus/docs/P12000010427.
- 11 Экологический кодекс Республики Казахстан от 09.01.2007 N 212-3 (с изм. и доп. по состоянию на 01.01.2018 г.). [Электронный ресурс]. — Режим доступа: <http://www.online.zakon.kz>.

Я.Течке, Ж.Шугаипова

Қазақстан Республикасында минералды-шикізат ресурстардың тиімсіз пайдаланудың нәтижесінде пайда болатын экологиялық салдар

Мақалада пайдалы қазбаларды игерген кездегі олардың тиімсіз пайдаланудың мәселелері баяндалды. Пайдалы қазбалардағы мұқтаждық ұдайы өсуде, пайдалы қазбаларға деген сұраныс демографиялық өсумен анықталады. Қазіргі таңда Қазақстанда пайдалы қазбалар белсене игеріліп жатыр. Осымен бірге осы пайдалы қазбалардың сарқылу қауіпі төніп тұрғанымен бірге пайдалы қазбаларды игерген кезде қоршаған ортаның ластануы қайтымсыз салдарға апарып соға алады. Авторлар қоқыстарды қайта өндіретін кәсіпорындардың мүмкіндігінше көп санын ұйымдастыру туралы мәселесін көтереді. Сонымен бірге құрамына өнеркәсіптік және тұрмыстық қоқыстарды бақылау (мониторинг жасау), сақтау, қайта өндіру, кәдеге жарату үдерістері енгізілген қоқыстарды басқаратын мемлекеттік жүйенің болмағаны енеді. Қазіргі таңда құрлық және мұхит сулардың көміртектен ластанғаны заманауи өркениетті қоғамы гидросфераға ететін ластанулардың негізгі түрі болып танылады. Теңіз және өзен ағындары, ауалық массалардың қозғалысы зиянды ластануларды үлкен арақашықтарға таратады. Сөйтіп, қоршаған ортаны сақтау мәселесі жергілікті мәселелерден жалпы мемлекеттік немесе халықаралық мәселелерге айналып бара жатыр. БҰҰ-ның толық құқылы мүшесі бола тұра, Қазақстан мемлекеттік экологиялық саясатты тиімді жүргізу мақсатымен халықаралық ынтымақтастықты кілт ретінде пайдалану тиіс.

Кілт сөздер: пайдалы қазбаларды игеру, ластау, қоршаған орта, қоқыстар, пайдалы қазбаларды сақтау.

Я.Течке, Ж.Шугаипова

Экологические последствия в результате нерационального использования минерально-сырьевых ресурсов в Республике Казахстан

В статье освещены проблемы неэффективного использования природных ресурсов при их добыче. Потребности в полезных ископаемых неуклонно растут, спрос на них определяется, прежде всего, демографическим ростом. В настоящее время ведется активное освоение полезных ископаемых Казахстана и существует угроза их истощения, а загрязнение окружающей среды при их добыче может привести к необратимым последствиям. В статье поднимается вопрос о необходимости создания как можно большего количества предприятий, перерабатывающих отходы. Главной проблемой при этом является отсутствие государственной системы управления процессом переработки отходов, включающей мониторинг, хранение, переработку, утилизацию промышленных и бытовых отходов. Загрязнение континентальных и океанических вод углеводородами является в настоящее время одним из основных видов загрязнения гидросферы современным цивилизованным обществом. Морские и речные течения, движения воздушных масс распространяют вредные загрязнения на большие расстояния. Таким образом, проблема охраны окружающей среды из местной, региональной превращается в общегосударственную либо международную. Казахстан, являясь полноправным членом ООН, должен использовать международное сотрудничество в качестве ключа к эффективному проведению государственной экологической политики.

Ключевые слова: добыча полезных ископаемых, загрязнение, окружающая среда, отходы, охрана природных ресурсов.

References

- 1 Hotelling, H. (1931). The Economics of Exhaustible Resources. *Journal of Political Economy*, Vol. 39, 2, 137–175. Retrieved from <http://www.jstor.org>.
- 2 Tonkopi, M.S. (2003). *Ekologiya i ekonomika prirodopolzovaniia [Ecology and economics of nature management]*. Almaty: Ekonomika [in Russian].
- 3 Programma po razvitiu mineralno-syrevoho kompleksa v Respublike Kazakhstan na 2010–2014 hody. Utverzhdena postanovleniem Pravitelstva Respubliki Kazakhstan ot 31 dekabria 2010 hoda № 1530 [Program for the development of the mineral and raw materials complex in the Republic of Kazakhstan for 2010 - 2014. Approved by the Decree of the Government of the Republic of Kazakhstan dated December 31, 2010 No. 1530]. *egov.kz*. Retrieved from egov.kz/cms/ru/law/list/P1300001002 [in Russian].
- 4 Sikhimbayv, M.R. (2012). Ekonomicheskii mekhanizm ratsionalnogo nedropolzovaniia v Respublike Kazakhstan [Economic mechanism of rational subsoil use in the Republic of Kazakhstan]. Saabruken, Deutschland / Germany: Publisher: Izdatelskoe delo Palmariuma [in Russian].
- 5 Sikhimbayv, M.R. (2016). Napravleniia ratsionalnogo ispolzovaniia prirodnykh resursov Respubliki Kazakhstan na primere uhledobvyvaiushchei promyshlennosti [Directions of rational use of natural resources of the Republic of Kazakhstan on the example of coal mining industry]. *Mezhdunarodnyi zhurnal prikladnykh i fundamentalnykh issledovaniy – International Journal of Applied and Fundamental Research*, 4(3), 620–623. Moscow: Izdatelstvo ID «Akademiia Estestvoznaniia» [in Russian].
- 6 Sikhimbayv, M.R. (2012). Harmonizatsiia ekologii i ekonomiki v usloviakh globalizatsii [Harmonization of ecology and economy in the conditions of globalization]. Karaganda: KEUK [in Russian].
- 7 Ramad, F. (1981). *Osnovy prikladnoi ekologii [Foundations of Applied Ecology]*. Leningrad: Hidrometeoizdat [in Russian].
- 8 Tietinberg, T. (2001). *Ekonomika okruzhaiushchei sredy i prirodnykh resursov [Environmental and Natural Resource Economics]*. Moscow: OLMA-LESS [in Russian].
- 9 Zakon Respubliki Kazakhstan «O nedrakh i nedropolzovaniy» ot 24 iyunia 2010 hoda № 291-IV [The Law of the Republic of Kazakhstan «On Subsoil and Subsoil Use» of June 24, 2010 No. 291-IV]. *online.zakon.kz*. Retrieved from <http://www.online.zakon.kz> [in Russian].
- 10 Kontseptsii razvitiia heolohicheskoi otrasli Respubliki Kazakhstan do 2030 hoda. Utverzhdena postanovleniem Pravitelstva Respubliki Kazakhstan ot 13 avhusta 2012 hoda № 1042 [Concept of development of the geological industry of the Republic of Kazakhstan until 2030 Approved by the Decree of the Government of the Republic of Kazakhstan dated August 13, 2012 No. 1042]. *adilet.zan.kz*. Retrieved from adilet.zan.kz/rus/docs/P12000010427 [in Russian].
- 11 Ekologicheskii kodeks Respubliki Kazakhstan ot 09.01.2007 N 212-3 [Ecological Code of the Republic of Kazakhstan from 09.01.2007 N 212-3]. *online.zakon.kz*. Retrieved from <http://www.online.zakon.kz> [in Russian].