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PROCESSING AND RECYCLING OF MINING WASTE

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Annotation. In this scientific article, the authors determined the degree of suitability of industrial waste from enterprises and industries as secondary mineral resources and conducted their research using geological methods, including geochemical, mineralogical, petrographic, structural, lithological and others. In addition, using these methods, the authors combined waste with hydrogeological, engineering, geological, physico-mechanical studies. A complex of modern technological tests has been developed for the enrichment of industrial waste, pyrometallurgical and hydrometallurgical redistribution with wide involvement.

Technical and economic issues are the most important when planning the development of man-made deposits. They can be successfully solved with such a minimal industrial composition that ensures economical processing of man-made waste. The economic benefits of their development can be provided in two cases: a sharp increase in the cost of the components obtained and the use of a fundamentally new highly efficient technology for processing man-made raw materials.

Man-made wastes are most often solid mixed rocks of clay-sand-coarse-grained composition, which cannot be directly used for the manufacture of materials important for industry. The authors conducted special studies to find substitutes for traditional materials and obtain new types that can be widely used in the national economy, taking into account the huge reserves of unfractionated material and issues of their technological development.

Keywords: man-made waste, recycling, mineral raw materials, industrial waste, ecology, building materials.

Introduction. Waste from concentrators is a fine-grained homogeneous material from which various metals can be extracted, as well as Quartz, quartz-feldspar, feldspar, Mica, alumina and other concentrates. Waste from chemical and metallurgical production and thermal power plants is even more valuable for industrial use. The annual volume of processing of mining mass during the extraction of minerals is 10 billion tons. T. However, the existing technology of mining and enrichment of minerals leads to the fact that minerals account for only a relatively small part of this volume (for example, in the coal industry, 20%), the remaining mass falls into heaps, the degree of their disposal of which does not exceed 4%. Such dumps occupy tens of thousands of hectares and have a negative impact on the environment. In addition, the rocks that are peeled and associated extracted during the extraction of minerals contain various components that are valuable raw materials for the building materials industry. The biggest obstacle is getting an official permit to recycle valuable waste. To identify mineral formations as a certain type of secondary raw material, you must have a special document on hand confirming the possibility of using a particular object as a raw material base. At the heart of the secondary use of waste are two principles: the depletion of mineral resources and the development of new processing technologies [1]. At the production design stage, there is a positive foreign experience that man-made dumps contained in the field are considered as future natural resources, assessing the Deferred resource potential. That is, before the start of field development, each unit of useful component in the composition of future waste was already analyzed by the subsurface user for possible use. In the world, this is a common practice, and in Kazakhstan they are just beginning to consider such a proven approach. So far, the country has two incentive tools for the use of waste: waste placement and an increase in fees for environmental pollution, as well as fees for the placement of new waste storage facilities [2]. Companies implementing new projects know firsthand how difficult it is to develop a project, taking into account modern environmental and environmental legislation.

Research materials and methods. So, two methods for obtaining valuable components from man-made mineral formations have been worked out in practice, the integrated use of mineral raw materials and waste from its processing, which in the future can be retrained into "typical" technologies suitable for ubiquitous use. This direction is the most important in solving the problem of waste-free mining, since almost all mineral deposits are complex, that is, they contain not one, but several useful components [3-4]. For example, for the mining and chemical industry, the integrated use of Mineral Resources is carried out, on the one hand, with the maximum extraction of useful components in ores, the utilization of rocks and industrial waste to meet the needs of other sectors of the national economy and improving the technical and economic indicators of the industry, and on the other hand, with the replenishment of the mineral and raw material base of the industry due to the extraction of associated phosphates, sulfur and other useful components in the complex processing of ferrous and non-ferrous metal ores, natural gas, etc. (Table 1).

The domestic mining industry has accumulated extensive experience in the integrated use of Mineral Resources. Non-ferrous metallurgy enterprises have significant experience in the integrated use of raw materials. About half of the 70 chemical elements obtained at non-ferrous metallurgy enterprises are obtained: silver, bismuth, platinum, gold, sulfur, zinc, lead, copper, etc., which is a third of the total value of the resulting product. The total economic impact of complex processing of mineral raw materials is estimated at several tens of billions of tenge. According to the calculations of specialists, with relatively small labor and capital expenditures, the mobilization of available reserves will increase the potential of extractive industries by more than 25%. The problem of integrated use of raw materials is of great importance from an environmental and economic point of view. In many industries, 60-70% of the cost of production falls on the share of raw materials. The rational use of raw materials and the involvement of secondary resources in production is the most important national economic task and has been elevated to the rank of state policy. During the development of mineral deposits, large volumes of peeled rocks are sent to dumps that occupy a significant area. In addition, mining dumps are cheap and valuable raw materials that can be used in construction, land use and other industries. The complex use of raw materials with the transfer of all components to industrial products is an urgent problem [5].

In the scheme of rational integrated use of mineral raw materials, the following independent areas are distinguished: geological and mineralogical, mining, enrichment, chemical and metallurgical, economic and environmental. The geological and mineralogical direction includes the following sections: a comprehensive study of mining areas and deposits; patterns of placement of deposits, minerals and coal; material composition of ores and coal; separation of technological types of ores, technological mapping of deposits; poor and off-balance ores; geological and mineralogical research of man-made raw materials; study of peeled and containing rocks; technological geochemistry and Mineralogy. The mining direction includes the following sections: development and implementation of optimal mineral extraction systems; secondary processing of deposits; rational use of mineral raw materials with the organization of selective extraction; underground leaching of metals; creation of quality management services for extracted raw materials [6].

Results and discussion. Introduction of optimal schemes for chemical and metallurgical redistribution; extraction of additive elements; use of hydrometallurgy for unfertilized ores; use of technological dust and gases; bulk leaching of metals. An important issue associated with the problem of rational use of mineral raw materials is the involvement of secondary raw materials in the metallurgical production cycle. This will make it possible to economically spend natural ore resources, obtain metals by simple and inexpensive metallurgical methods, and further increase the production of metal products. In the future, secondary raw materials should become the main source of production of some metals. Organization of production and economics.

Table 1 – Probable areas of waste use in industrial facilities

Waste Industries	Products from industrial waste						
	Fuel	Ferrous metals, their compounds and alloys	Non-ferrous metals, their compounds and alloys	Fertilizers and basic chemical products	Construction materials	Raw materials of nuclear energy	Other types of use
Coal industry	Coal dumps, methane from mines gasification of dumps	Fe From Pyrite	Al, Al_2O_3, Al - Si alloys	Soil limestone, sulfuric acid from pyrite	Aggloporite, crushed stone, brick	–	Construction of Mines, Road Construction
Heat Power Engineering	Combustible mass of ash, heat of power plants	Fe-Si ash alloys	Al-Si ash alloys, Ge, Ga, Mo	Sulfuric acid from waste gases, micro-ceramic	Crushed stone, aggloporite, brick	U, Th	Road construction
Ferrous metallurgy	Heat of metallurgical furnaces	Fe from oxidized quartzites	Metals from old dumps, slags, waste, sediments, sewage	Sulfuric acid, trace elements	Crushed stone, aggloporite, brick	U, Th, Li, Be	Laying mines
Non-ferrous metallurgy	Autogenic sulfide application, heat of metallurgical furnaces	Fe from pyrite, pyrotite, titanomagnetite	Metals from old dumps, slags, waste, sediments, sewage	Sulfuric acid, microplastics	Crushed stone, aggloporite, brick	U, Th, Li, Be	Laying mines
Mineral fertilizer-tar production (mining chemistry)	–	Magnetite; titamagnetite; perovskite	Rare earth elements, derived from nepheline	Phosphorus from enrichment waste, soda products from nepheline, fertilizer from waste	Crushed stone, aggloporite, brick	Salt solution U, Li-i dien, Th	Laying mines
Production of non-ore building materials	–	Magnetite and Fe in the enrichment of Sands	Al, Ti, Mg Rare places in the processing of TI sand	Soil limescale; improve soil structure; moisture adsorbents in soil	Crushed stone, aggloporite, brick	–	Laying of Mines and quarries; road construction; irrigation facilities
Nuclear power	Thermal installations	Fe, Mn	Au, Cu, Zn, Pb	Microfertilizers, phosphoric fertile-izers, sulfuric acid	Crushed stone, aggloporite, brick	U from waste, Th to get	Laying mines

This direction includes the following sections: development of a methodology for determining the socio-economic efficiency of mineral raw materials; Organization of low-waste mining and processing of ores; development of an economic mechanism for the effective use of minerals. The economy of mineral resources and its assessment are the most important complex issues, including the analysis of reserves and industrial and geological conditions of mineral deposits, their development, extraction and processing. Geological and economic assessment is carried out at all stages of Field Research [7].

During the search period, this makes it possible to eliminate non-industrial deposits and deposits, and from the rest to choose the most promising ones for preliminary exploration. The problem of rational integrated use of mineral raw materials along with its directions should be considered taking into account environmental conditions. Issues of Environmental Protection, field development, and technological processing of minerals should be considered in a single complex. Scientific and technological progress develops the most important problems in the main areas of mineral enrichment, leading to the improvement of technological processes, improving quality indicators and reducing the cost of the resulting product. Rational use of minerals at the stages of extraction and enrichment is a single indivisible problem, the most complete use of the main and rare earth scattered metals. The solution to this problem is to revise and reduce the minimum Industrial content of useful components in ore, and, consequently, to involve poor ores in mining and processing [8]. To prepare ore for enrichment, it is envisaged to develop and implement effective ways to manage its quality on the basis of nuclear-geophysical methods.

They include, in particular, geological and technological mapping of ore deposits by geophysical logging of Wells, radiometric sorting of ores in order to eliminate ore-destroying ores-free rocks. Ore preparation processes can be most effective if they are combined in the geological, mining and enrichment part based on the study of the Geophysical and geochemical fields of ores and the bedrock and their technological properties. New approaches to solving the problem of ore quality management will allow increasing the integrated use of raw materials and the extraction of metals by 5-10%, and labor productivity by 15%. Depending on the industrial and genetic type of the deposit, the petrographic composition of the ore deposit rocks, the accepted method of its development, the composition of the peeled and deposited rocks transferred to the mountain piles is determined in accordance with the accepted classification. The main rocks extracted during the development of mineral deposits are widely used in the national economy. They are used in the construction industry, metallurgy, light and food industries as chemical, ceramic and agronomic raw materials and as a possible source for obtaining metals, minerals and other useful components [9].

They find especially different applications in the production of various building materials. In general, the use of ore mining and enrichment waste in non-ferrous metallurgy is significantly lower than in ferrous metallurgy. Disposal of waste from mining chemicals. The largest amount of mining chemical waste involved in processing goes to apatite-nepheline concentrators. In them, during the flotation enrichment of ore, apatite concentrate is obtained. Part of the apatite flotation waste is sent to the blade, the rest is used to obtain nepheline concentrate. The technological scheme of waste recycling provides for their two-stage classification in hydrocyclones. The sands of the latter are sent to the pile, and the drain is de - silted by 0.02 mm, thickens to 35% and enters the reverse flotation of nepheline. The additional amount of methane in the technology under consideration is obtained by violating the integrity of the mstiscoaching rocks under the coal bed due to their explosions. Through the channels and cracks that open in them, the methane of the disturbed area, which is mainly in a Free State, migrates to the coal bed. The result is a man-made methane deposit. Only after that they begin to mine it through the well. The positive effect of the proposed technical solution is to increase the degree of methane extraction by redistributing the gas scattered in the bedrock to the coal deposit. This technology can be used in the industrial extraction of methane from coal seams, which is not affected by mining [10].

The efficiency of extracting methane from the coal bed increases with its microbiological reproduction. In this case, the methane of the coal bed is started by supplying the final carbon dioxide at a pressure of 10-12 MPA. Carbon dioxide replaces methane in coal and is practically not subsequently removed to the surface. After the initiation is completed, methane is extracted according to the above technology, which gradually enters the surface during the day through the well. Further, the treated part of the coal layer is protected from the untreated massif, and then microorganisms are supplied to it that decompose free oxygen. Products are also introduced that ensure their vital activity, that is, are a nutrient medium for them. After oxygen decomposes, hydrogen-forming bacteria are transferred to the coal bed. Laying the developed spaces. With the construction of space mined in the mining industry of our country, methods of mine mining of minerals are developing. Dumps and enrichment waste of mining enterprises, as well as waste from other industries (slags, ash, etc.) can be used as a filling material and are used for the purpose of more complete mining, since with the usual technology of their excavation, it is necessary to leave guard celics consisting of tens and hundreds of millions of tons of ores and solid fuels underground to compensate for the mining pressure. The use of the Bookmark of the mined space is very promising, since it allows not only to increase the production of ore and fuel (thanks to protection installations), but also to eliminate a significant part of the solid waste stored on earth [11-13].

Enrichment carried out in order to reduce sulfur in coal is accompanied by the formation of carbonaceous colchedane, which contains 42-46% sulfur and 5-8% carbon. Integrated use of raw materials and production waste. Many types of mineral and organic raw materials are multicomponent. The concentration of a valuable component in raw materials determines the suitability for the use of this raw material in this sector of the economy. During the production of Target products, waste with a negligible composition of the target component is formed. One area of waste processing is the use of waste as raw materials to obtain additional components that are used locally or sent to other industries. The essence of the complex processing of this raw material is the processing of apatitonephelin ore, which is released by flotation into apatite and nepheline, as an example of the complex use of raw materials. Apatite is used to obtain compounds of fluorine, phosphoric acid and mineral fertilizers. In the production of 1 t apatite concentrate, 0.6-0.7 t nepheline concentrate is simultaneously obtained. During hydrometallurgical processing, 1 ton of ore receives about 1 ton of waste. 100 tons of ore mass accounts for 20-30 or more tons of free rock and off-balance sheet ore. During the enrichment of the ore Mass at the concentrator, at least 20-30% of the waste is released from the total volume of the mass produced. Thus, 1 ton of ore gives about 1.5 tons of waste suitable for use [14-15].

Conclusion. Engineering activities make it possible to improve the quality of artificial arrays from inactive waste of production. However, not so much. This limits the area of disposal of production waste. Without additional processing, domain slags and other substances often play the role of inert fillers, which is economically unreasonable, given the limited resources of raw materials for the production of cement. The transfer of production waste and available raw materials to production is not always economical, technologically difficult and unreliable in terms of protecting the Earth's surface from destruction. Directions for Environmental Protection, disposal of production waste are relevant: - optimization of the requirements for the filler mixture according to the criteria of strength and stability of the array, reliable transportation through pipes and minimum costs; - control of the properties of the filler mixture through the ratio of the initial components, slag grinding and other measures; - ensuring control over the properties of the mixture being poured from local production waste; - development of methods for calculating the parameters of pipeline transport of filler mixtures in the gravitational-vibropneumatic mode; - optimization of the composition of the filler mixture from waste of local production by activating the internal energy capabilities of materials. Activation - a technological effect on a substance in order to change its properties in the desired direction. The main purpose of activation during waste disposal is to reduce the consumption of hardening laying components while ensuring the regulatory strength of laying arrays. This is achieved by mechanical, chemical, physical, energy exposure, as well as by placing the materials of the mixture. The concepts of grinding and activation differ in their travel time during material processing. Blast slag, enrichment residues, crushed rocks and other residues have hardness. Replacing complex viscous cement with such materials reduces the transport of impurities. To maintain the elasticity of mixtures, the utilization of clay materials is used. The waste combination is then the optimal way to jointly address variable factors: strength, cost and portability according to the criterion of the maximum waste disposal volume. The joint solution of equations determines the range of optimal values of Nature-Saving development technologies.

Despite the high dispersion, there are fewer dust - like particles in the remains than in loams, accounting for 36.8-39.2% by volume. The tails are dominated by silica - 49.5 - 66.3%. Other oxides (CaO, MgO, Feo), which are contained in residues from 1 to 10%, negatively affect the strength of the filler mixture. In Table 2 shows the processing technologies of mining waste by resource and energy efficiency indicators a comparison of waste recycling technologies by resource and energy efficiency indicators is proposed.

Table 2 – Mining industry

№	Technology	Resource performance	Energy efficiency	Economy	Environmental friendliness
1	Images, filling of quarries and mine depressions	High	High	Low	High
2	Use as building materials	High	High	Low	High
3	Production of building materials	Average	Average	Average	Average
4	Secondary development of useful components of ores	Low	Low	High	Low

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ТАУ-КЕН ҚАЛДЫҚТАРЫН ҚАЙТА ӨҢДЕУ ЖӘНЕ ҚАЙТА ПАЙДАЛАНУ

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Андатпа. Бұл ғылыми мақалада авторлар кәсіпорындар мен өндірістердің өнеркәсіптік қалдықтарының қайталама минералды ресурстар ретінде жарамдылық дәрежесін анықтап оларды геологиялық әдістермен, соның ішінде геохимиялық, минералогиялық, петрографиялық, құрылымдық, литологиялық және басқалармен зерттеулер жүргізген. Сонымен қатар, авторлар

аталған әдістер арқылы қалдықтарды гидрогеологиялық, инженерлік-геологиялық, физика-механикалық зерттеулермен біріктірген. Өнеркәсіптік қалдықтарды байыту, пирометаллургиялық және гидрометаллургиялық қайта бөлу бойынша заманауи технологиялық сынақтар кешенін кеңінен тарта отырып зерделеу жасаған.

Техникалық-экономикалық мәселелер техногендік кен орындарын игеруді жоспарлау кезінде ең маңызды болып табылады. Олар техногендік қалдықтарды үнемді өңдеуді қамтамасыз ететін осындай минималды өнеркәсіптік құраммен сәтті шешілуі мүмкін. Оларды әзірлеудің экономикалық пайдасы екі жағдайда қамтамасыз етілуі мүмкін: алынатын компоненттер құнының күрт өсуі және техногендік шикізатты өңдеудің түбегейлі жаңа жоғары тиімді технологиясын қолдану. Техногендік қалдықтар көбінесе сазды-құмды-ірі түйіршікті құрамның қатты аралас жыныстары болып табылады, оларды өнеркәсіп үшін маңызды материалдарды жасау үшін тікелей қолдану мүмкін емес. Авторлар фракцияланбаған материалдың орасан зор қорларын, оларды технологиялық пысықтау мәселелерін ескере отырып, дәстүрлі материалдарды алмастырғыштарды іздеу және халық шаруашылығында кеңінен қолдануға болатын жаңа түрлерін алу үшін арнайы зерттеулер жүргізген.

Тірек сөздер: техногендік қалдықтар, утилизация, минералды шикізат, өнеркәсіптік қалдық, экология, құрылыс материалдары.

ПЕРЕРАБОТКА И ВТОРИЧНОЕ ИСПОЛЬЗОВАНИЕ ОТХОДОВ ГОРНОДОБЫВАЮЩЕЙ ПРОМЫШЛЕННОСТИ

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Аннотация. В этой научной статье авторы определили степень пригодности промышленных отходов предприятий и производств в качестве вторичных минеральных ресурсов и провели их исследования геологическими методами, включая геохимические, минералогические, петрографические, структурные, литологические и другие. Кроме того, с помощью указанных методов авторы объединили отходы с гидрогеологическими, инженерно-геологическими, физико-механическими исследованиями. Разработан комплекс современных технологических испытаний по обогащению промышленных отходов, пирометаллургическому и гидрометаллургическому перераспределению с широким привлечением. Технико-экономические вопросы являются наиболее важными при планировании разработки техногенных месторождений. Они могут быть успешно решены таким минимальным промышленным составом, который обеспечивает экономичную переработку техногенных отходов. Экономические выгоды от их разработки могут быть обеспечены в двух случаях: резкое увеличение стоимости получаемых компонентов и применение принципиально новой высокоэффективной технологии переработки техногенного сырья. Техногенные отходы чаще всего представляют собой твердые смешанные породы глинисто-песчано-крупнозернистого состава, которые не могут быть непосредственно использованы для изготовления важных для промышленности материалов. Авторы провели специальные исследования для поиска заменителей традиционных материалов и получения новых видов, которые могут быть широко использованы в народном хозяйстве, с учетом огромных запасов нефракционированного материала, вопросов их технологической проработки.

Ключевые слова: техногенные отходы, утилизация, минеральное сырье, промышленные отходы, экология, строительные материалы.