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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
АО «Институт топлива, катализа и
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NAS RK is pleased to announce that News of NAS RK. Series of chemistry and technologies 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 chemistry and technologies in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of chemical sciences to our community.

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НАН РК сообщает, что научный журнал «Известия НАН РК. Серия химии и технологий» 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 в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по химическим наукам для нашего сообщества.

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MINERAL AND PETROGRAPHIC ANALYSIS OF CLAY RAW MATERIALS OF THE TURKESTAN REGION USED AS ADDITIVES TO THERMAL INSULATION MATERIALS

Abstract. The article discusses the contributes to the development of a new focus on the use of various mixtures of natural raw materials and waste in the construction materials industry as a strategically important direction for solving the environmental burden and recycling industrial waste with a feasibility study that improves the state of the environment.

This problem is particularly relevant in the production of building materials used in environmentally distressed areas of the republic and in conditions of intense corrosion and erosion wear. The production of efficient building materials and products that meet the modern requirements of environmental friendliness, basic physical and mechanical characteristics, availability and cost is an important and not fully solved task in the field of construction and the construction materials industry.

Analysis have been conducted on the current state of the local availability of perspective materials for high-quality composite construction materials, their chemical and mineralogical and granulometric properties have been studied, the influence of the granulometric composition of the basic properties of a composite material and features of the structure formation during heat treatment were studies; physical and mechanical properties of the obtained compositions were tested.

Optimal compositions and technological schemes for the production of composite materials based on the use of technogenic waste, natural raw materials and their mixtures have been developed to ensure the production of high-quality construction products with specified thermomechanical properties.The optimization of compositions and properties of compositions was carried out using mathematical planning methods, which made it possible to predict changes in the properties of composite materials depending on the number, weight of the components and the size of the filler granules. Experimental batches of at least 3 main types of construction products were obtained.

Keywords: industrial production, natural raw materials,recycling industrial waste, analysis, thermal insulation materials.

Introduction. It is well known that Kazakhstan has accumulated more than 30 billion tons of various technogenicwaste, including about 20 billion tons of mining and metallurgical complexes. Every year, about 4-5 million tons of solid household waste and about 700 million tons of industrial waste are generated in the republic, of which about 250-300 million tons are toxic. Despite the annual growth in the volume of waste generated, only a small part of it is recycled and reused - about 20 %. In all regions of the republic, the bulk of waste is stored in dumps, landfills, and storage facilities that do not meet environmental and sanitary standards.

Waste from mining and processing of mineral raw materials [1,2], as well as subsequent processing in metallurgy [3-5], chemical industry [6-8] and energy [9-12] were the main factors of large-scale environmental pollution [13-17]. Another type of the most dangerous for national health and for the environment is the waste of chemical enterprises [18, 19].

Thus, the variety of secondary raw materials: multi-tonnage industrial waste, sometimes not inferior in chemical and mineralogical composition to raw materials extracted from the earth's entrails, and

sometimes superior in technological parameters, requires a highly qualified approach to them, ensuring their effective use in construction [20-23].Established national strategy for the regulation of regional and global waste management based on coordinated, integrated and effective regulatory work, ensuring the environmental safety of public health, contributes to the consideration of all options for minimizing waste flows [10, 24].

In conditions of shortage of raw materials, the role of saving material resources increases, primarily due to the involvement of secondary material resources in the economic turnover. Calculations show that in the case of complex use of raw materials and technogenic products, the production of many of them can be increased by 25-30 %. Resource saving becomes comprehensive as well as part of the economic worldview as a system of views on the world [25-27].

With significant volumes of technogenic accumulations, the level of their utilization is low. The construction industry can be the main consumer of industrial waste.The production of building materials is the most material-and energy-intensive branch of human activity. In this direction, natural resources are used that are as ready for use as possible, since they require significant labor costs. The extraction of natural resources from interconnected natural states, where their presence ensures the balance and stability of the environment, introduces an imbalance in the system of self-organizing processes of the geosystem [25]. At the same time, there is a significant reduction in the reserves of high-quality natural materials, and the anthropogenic load on the environment increases when technogenicdeposits are formed from newly formed waste [28].

Industrial waste by chemical, granulometric and phase-mineral composition is largely identical to natural mineral raw materials [16, 29]. Based on this, we believe that the use of a different mixture of waste in the construction materials industry is one of the strategic ways to solve the environmental problem to improve the state of the environment in our region.

In the southern region of the country there are deposits of polymetallic ores (the south-western slope of the Karatau ridge, near the city of Kentau, Achisay, Baizhansay, Mirgalimsay deposits, etc.). Of great industrial interest are the deposits of iron ores of the Karatau ridge. Available mineral resources for the production of building materials such as limestone, gypsum, quartz sand, refractory ceramic and bentonite clay, mineral paints, ornamental stones. On the territory of the Turkestan region, there are known deposits of 5 types of mineral raw materials suitable for the production of building materials. The largest number of deposits are brick raw materials (9), carbonate rocks (3), gypsum (6) and cement raw materials (5), which together make up 92 of 142 or 64.8% of the total number of 5 types of raw materials. Meanwhile, the large reserves of clay gypsum discovered in the territory of the Turkestan region remain unutilized due to the low concentration of gypsum in nature.

High growth rates of industrial production can be ensured by the development of a modern, highly efficient technology for involving industrial waste in the complex processing of technogenic waste. The scientific task of great practical importance is the development of composite materials without their processing, which does not require additional costs. This problem is particularly relevant in the production of building materials used in environmentally distressed areas of the republic and in conditions of intense corrosion and erosion wear. The production of efficient building materials and products that meet the modern requirements of environmental friendliness, basic physical and mechanical characteristics, availability and cost is an important and not fully solved task in the field of construction and the construction materials industry. The focus of the state's policy on low-height construction requires the involvement in the construction industry of such modern materials and technologies for their production, which would significantly reduce the use of material and fuel-energy resources while maximizing the use of local raw materials and waste [30-32].

According to the literature review, research aimed at the development of building materials with improved construction, technical and environmental properties for urban planning and restoration works is currently relevant.

Also, it should be recognized that the literature review on this topic states the relevance of scientific and applied research aimed at developing building materials with improved construction, technical and environmental properties recommended for urban planning and restoration work.

This fact contributes to the development of a new focus on the use of various mixtures of natural raw materials and waste in the construction materials industry as a strategically important direction for solving the environmental burden and recycling industrial waste with a feasibility study that improves the state of

the environment. The use of secondary mineral resources for the production of building materials is relevant from different perspectives [17,18]. Therefore, the development of thermal insulation materials based on technogenic and natural raw materials with specified thermal properties is a very urgent task.

The purpose of this work is to study a new composition of thermal insulation material from industrial waste of the Turkestan region with improved construction- technical and environmental properties, intended for civil construction.

For the study, the original components were analyzed, selected from the technogenic and natural formations of the Turkestan region, namely, the overburden of the Achisai polymetallic combine and the clay deposits of the Ibata, Urangai and Sauran. Quality control of the products obtained is carried out by determining the physicochemical properties of the object of study. The selected research methods and the proposed technology are the most rational, without analogues and with a low cost. Rational compositions of composite materials based on local natural raw materials and industrial wastes have been obtained, ensuring the production of solid, durable and economically viable products for civil construction.

Research technique. Methods of collecting primary (initial) information, its sources and application for solving the problems of the work are based on the analysis of domestic/foreign literary and stock materials using a systematic approach, as well as theoretical developments, laboratory and field experiments are the basis of research, and is of an applied nature. The methodological and theoretical basis of the research will also be the works of domestic and foreign scientists devoted to the development of composite materials based on industrial waste.

The work was carried out on the basis of updated methodological guidelines for conducting analytical and testing work, certified measurement methods, updated SGT-s, as well as other regulatory documents necessary for conducting research work. The research work was carried out both in the laboratory and in the production environment. Scientific research is based on the results obtained during laboratory, large-scale laboratory and pilot-industrial tests and other types of analysis.

Detailed order and mechanism for conducting research:

- analysis have been conducted on the current state of the local availability of perspective materials for high-quality composite construction materials,their chemical and mineralogical and granulometric properties have been studied, the influence of the granulometric composition of the basic properties of a composite material and features of the structure formation during heat treatment were studies;physical and mechanical properties of the obtained compositions were tested;

- optimal compositions and technological schemes for the production of composite materials based on the use of technogenic waste, natural raw materials and their mixtures have been developed to ensure the production of high-quality construction products with specified thermomechanical properties;

- the optimization of compositions and properties of compositions was carried out using mathematical planning methods, which made it possible to predict changes in the properties of composite materials depending on the number, weight of the components and the size of the filler granules;

- experimental batches of at least 3 main types of construction products were obtained.

The final products of the project are the following export-oriented, low-cost, economically viable, environmentally friendly, socially acceptable building materials and products:

1) ceramic brick – high strength (≥ 25 MPa), resistant to almost all climatic conditions;

2) facing tiles (concrete and ceramic) - high strength (≥ 25 MPa), resistant to almost all climatic conditions;

In the laboratory, the optimal conditions for the formulation process are established based on the study of the physical - chemical characteristics of raw materials and products, namely strength, stability, chemical and radiological analysis, frost resistance, thermal conductivity, heat resistance, moisture and chemical resistance, mobility, microhardness, setability, porosity, economic low cost is calculated, etc.

Autoclave microwave decomposition systems were used for sample preparation and analysis of the composition of the technology products. To study the physical and chemical properties of solid samples, methods of identification were used: gross suspended solids, bulk density, humidity, strength, Bond index, corrosion activity on metal, organoleptic evaluation, solubility in water, acid capacity, acid absorption, phase composition, determination of the chemical composition of atomic emission spectroscopy with inductively coupled plasma, chemical volume analysis, porosity state – scanning electron microscope.

Results, analysis and discussion. Clay raw materials were studied by the mineralogical-petrographic method with the use of dyes - solutions of methylene blue and potassium chloride.

Sample №1 Ibata

Macroscopically, the kind is light gray with a greenish tinge, smoothly colored, but with signs of iron hydroxides on the planes of layering, thinly layered, in sharp-angled slab pieces of various sizes with a smooth matte fracture. The kind is finely dispersed, small to the touch, non-swelling in water, pelitic fractions when dried give a smooth surface, does not boil under the action of a drop of hydrochloric acid.

Hydromica-montmorillonite clay, ferruginized and with slightly applied gypsum

A good thin section was not obtained due to the viscosity of the clay. Clay raw materials were studied by the mineralogical method using immersion liquids and using dyes.

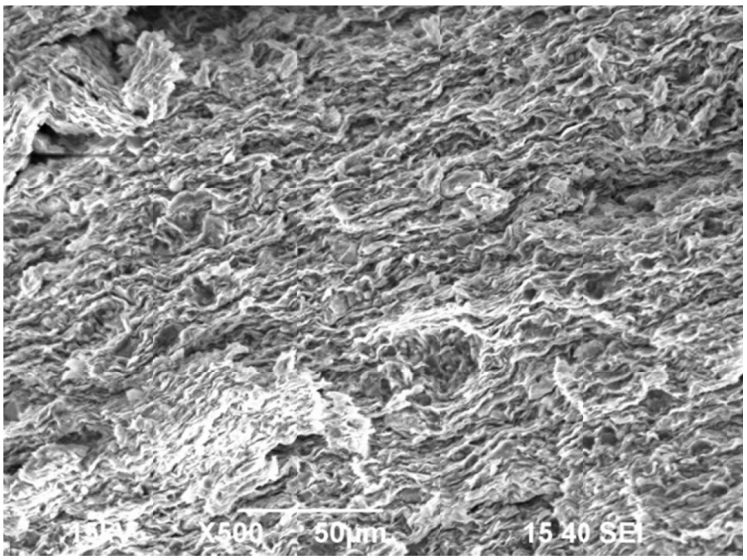
Behavior of the clay component in dyes

As a result of dyeing of the sample suspensions with a solution of methylene blue, the pelite fractions were colored in a purple-blue color, which, when potassium chloride is added, becomes blue-green with a slightly gel-like precipitate. This qualitatively indicates the presence of montmorillonite in the sample.

Table 1 - The mineral composition of the sample

№ S/n	Minerals	Content, %
1	Montmorillonite	42,0
2	Hydromica	36,0
3	Quartz + silicamodifications	8,3
4	Gypsum	0,9
5	Calcite	0,6
6	Rutile	0,6
7	Phosphates	0,3
8	Feldspars	s.v.
9	Chlorite	«
10	Zeolite	«
11	Iron hydroxides	11,3
In total:		100,0

According to the chemical analysis in the sample SO_3equals 0.42%. Minerals containing sulfide sulfur are absent.Sulphate sulfur is present in scattered microscopic gypsum plates (picture 1).



Picture 1 - Microscopic analysis of clay of the Ibata deposit

The investigated raw material is represented by clay, consisting of pelite particles with a size of <0.01 mm (-95%) and aleurite material with a size of> 0.01 mm (~ 5%)

Pelite material (particle size from 0.01 mm and less) is represented by montmorillonite mixed with hydromica and admixed with iron hydroxides and finely groundaluminosilicates.

Clay type: hydromica - montmorillonite.

Sample №2 Urangai

Macroscopically, the kind is light gray with a greenish tint, smoothly colored, with a few traces of iron hydroxides on the layering planes, thin-layered, with gypsum inclusions, in acute-angled platy pieces of various sizes, with a smooth matte fracture, partially swelling. The kind is small to the touch; when dried, the pelite fractions give a smooth surface, does not boil under the influence of a drop of hydrochloric acid.

Hydromica-montmorillonite clay, slightly ferruginized and intensely applied gypsum

A good thin section was not obtained due to the viscosity of the clay. Clay raw materials were studied by the mineralogical method using immersion liquids and using dyes.

The behavior of the clay component in dyes. As a result of dyeing the suspensions of the sample with solutions of methylene blue, the pelite fractions turned into a pure purple color, which, when added with potassium chloride, becomes light blue with the formation of a weakly gel-like precipitate. This qualitatively indicates the presence of montmorillonite in the sample.

Table 2 - The presence of montmorillonite in the sample

№ S/n	Minerals	Content, %
1	Minerals	47,0
2	Montmorillonite	25,0
3	Hydromica	9,1
4	Gypsum	7,5
5	Feldspars	6,3
6	Quartz + silicamodifications	1,0
7	Kaolinite	0,6
8	Chlorite	0,5
9	Rutile	s.v.
10	Calcite	3,0
11	Iron hydroxides	100,0
In total:		47,0

According to chemical analysis in the sample $S0_3$ equals 4,23%. Minerals containing sulfide sulfur are absent. Sulphate sulfur is present in nest-like formations and gypsum micro-layers.

The investigated raw material is represented by clay, consisting of pelite particles with a size of <0.01 mm (= 95%) and aleurite material with a size of> 0.01 mm (= 5%).

Pelite material (particle size from 0.01 mm and less) is represented by montmorillonite mixed with hydromica and kaolinite and with an admixture of finely ground aluminosilicates and iron hydroxides.

Clay type: hydromica-montmorillonite

Sample №3 Sauran

Macroscopically, the kind is fawn, smoothly colored, slightly crumbly, with microscopic pores, weakly stains hands, soaks well in water, boils strongly under the influence of a drop of hydrochloric acid.

Aleurite calcareous loam

Texture: nest-shaped. Structure: pelitic-aleurite

The kind consists of a mixture of clastic and clay material. Clastic material predominates, is present in an amount of about 70%, is unevenly distributed, microlenses are observed, composed of essentially clay material. Fragments of an angular and angular-rounded shape with a size of 0.2 mm and less are represented by quartz, feldspars, and calcite. There are also fragments of amphibole, siliceous rocks, completely chloritized fragments, hydrated biotite sheets, single microscopic fragments of coal, and gelified plant remains. Oxidized ore mineral and tourmaline are present as admixtures.

The clay mass is brown in color, consists of pelitic particles with a refractive index greater than Canadian balsam and low, rarely high birefringence, and is probably represented by kaolinite with a few flakes of hydromica, an admixture of pelitomorphic calcite, finely ground aluminosilicates, and scattered dispersed iron hydroxides.

The behavior of the clay component in dyes. As a result of dyeing the sample suspensions with solutions of methylene blue, the pelite fractions were colored in light purple color, which did not change the color when potassium chloride was added. This qualitatively indicates the presence of kaolinite in the sample.

Table 3 – The mineral composition of the sample

№ S/n	Minerals	Content, %
1	Quartz	25,2
2	Feldspars	20,5
3	Calcite	20,4
4	Kaolinite	15,2
5	Chlorite	6,7
6	Hydromica	3,0
7	Amphiboles	2,0
8	Biotite, hydrated	1,5
9	Rutile	0,6
10	Magnetite	0,5
11	Phosphates	0,4
12	Gypsum	0,2
13	Tourmaline	s.v.
14	Coal	«
15	OxidesandhydroxidesMп	0,1
16	Ironhydroxides	3,7
In total:		100,0

By chemical analysis in the sample S0зequals 0,10%. Minerals containing sulfide sulfur are absent. Sulphate sulfur is present in nest-like formations and gypsum micro-layers.

The investigated raw material is represented by loam, consisting of pelite particles with a size of <0.01 mm (-30%) and sandy-aleurite material with a size of> 0.01 mm (= 70%).

Pelite material (particle size from 0.01 mm and less) is represented by kaolinite with an admixture of hydromica, pelitomorphic calcite, finely ground aluminosilicates and iron hydroxides.

Clay type:hydromica - kaolinite.

Sample №4 Besaryk

Macroscopically, the kind is fawn, smoothly colored, slightly crumbly, stains hands, soaks well in water, boils strongly under the influence of a drop of hydrochloric acid.

Aleurite calcareous loam, slightly applied gypsum

Texture: slightly nest shaped. Structure: pelitic-aleurite

The kind consists of a mixture of clastic and clay material. Clastic material predominates, is present in an amount of about 75%, and is not quite evenly distributed. Fragments of an angular and angularly rounded shape, with a size of 0.1 mm and less, are represented by quartz, feldspars, calcite, limestone, completely ferruginous and chloritized fragments. Fragments of amphibole, pyroxene, epidote, hydrated biotite leaves, and gelified plant remains are also present. Magnetite is present as an admixture.

The brown clay mass consists of pelitic particles with a refractive index greater than Canadian balsam and both high and low birefringence, represented, apparently, by kaolinite with an admixture of hydromica, pelitomorphic calcite, finely ground aluminosilicates and dispersed iron hydroxides. The gypsum is weak, the gypsum develops unevenly, with nests up to 0.2 mm in size. The nests are stacked with gypsum plates measuring one hundredths of a mm.

Clay Behavior in Dyes

As a result of dyeing the sample suspensions with solutions of methylene blue, the pelite fractions were colored in light purple color, which did not change the color when potassium chloride was added. This qualitatively indicates the presence of kaolinite in the sample.

Table 4 - The mineral composition of the sample

№ S/n	Minerals	Content, %
1	Calcite	25,0
2	Quartz	23,5
3	Feldspars	20,1
4	Halloysite + kaolinite	12,6
5	Chlorite	6,7
6	Hydromica	3,0
7	Amphiboles	2,0
8	Biotite	2,0
9	Gypsum	0,7
10	Rutile	0,6
11	Magnetite	0,5
12	Phosphates	0,4
13	Epidote	s.v.
14	Pyroxene	«
15	Ironhydroxides	2,9
In total:		25,0

According to chemical analysis in the sample, S0з equals 0,35%. Minerals containing sulfide sulfur are absent. Sulphate sulfur is present in microscopic gypsum plates**.**

The studied raw material is represented by clay, consisting of pelite particles with a size of <0.01 mm (= 25%) and aleurite material with a size of> 0.01 mm (= 75%).

Pelite material (particle size from 0.01 mm and less) is represented by halloysite-kaolinite mixed with hydromica and with an admixture of pelitomorphic calcite, finely ground aluminosilicates and iron hydroxides.

Clay type:hydromica - halloysite - kaolinite.

Conclusion. To improve the strength properties, it is necessary to introduce into the raw materials neutralizing additives (from lime inclusions), which prevent the destruction of the sample cubes after burning, or immerse them after burning immediately into water to extinguish lime (at least 2 days).

The neutralizing additive for carbonate inclusions of limestone is sodium chloride or calcium chloride.

The action of sodium chloride is catalytic: table salt promotes the chemical interaction of calcium oxide with Si02 and A1203 with the formation of silicates 2 CaO«Si02type and aluminates of the type 3CaO*A1203 at burning temperatures of 900-1000 °C.

Usually, not all lime manage to react, there remains a calcium oxide core surrounded by a cavity formed as a result of a reduction in the amount of carbonate. This cavity is filled with the remaining lime that expands during quenching, without causing stress for the products. The hydration of lime compounds of silicates and aluminates is not accompanied by an increase in volume, which is dangerous for the integrity of the products. Sodium chloride is injected in an amount of 0.5-1.0%, and calcium chloride up to 1.5%. The neutralizing additive from water-soluble salts - the appearance of white plaque - are barium salts - chloride or carbon dioxide barium. Salt is recommended to be added mixed with water.

The clay kind intended for the production of ceramic bricks is evaluated by the general mineralogical and petrographic characteristics, the content of the main chemical components, the indicators of technological properties and the identification of the specific efficiency of natural radionuclides.

The main indicators of technological properties are the granulometric composition, the content of coarse-grained inclusions, including carbonate inclusions, plasticity, the coefficient of sensitivity of clay raw materials to drying, as well as linear shrinkage, sinterability, strength of baked products and frost resistance.

For the final decision on the applicability of clay raw materials for the production of bricks, it is necessary to test the raw materials in full.

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ЖЫЛУ ОҚШАУЛАҒЫШ МАТЕРИАЛДАРҒА ҚОСПА РЕТІНДЕ ПАЙДАЛАНЫЛАТЫН ТҮРКІСТАН ОБЛЫСЫНЫҢ САЗДЫ ШИКІЗАТЫН МИНЕРАЛОГИЯЛЫҚ-ПЕТРОГРАФИЯЛЫҚ ТАЛДАУ

Аннотация. Мақалада қоршаған ортаның жай-күйін жақсартатын техникалық-экономикалық негіздемесі бар экологиялық жүктемені шешудің және өнеркәсіптік қалдықтарды кәдеге жаратудың стратегиялық маңызды бағыты ретінде құрылыс материалдары өнеркәсібінде табиғи шикізат пен қалдықтардың әртүрлі қоспаларын қолданудың жаңа бағытын әзірлеу қарастырылады.

Бұл проблема республиканың экологиялық қолайсыз аудандарында және қарқынды коррозиялық және эрозиялық тозу жағдайларында қолданылатын Құрылыс материалдарын өндіру кезінде ерекше өзекті. Экологиялылықтың, негізгі физикалық-механикалық сипаттамалардың, қолжетімділік пен құнның қазіргі заманғы талаптарына жауап беретін тиімді құрылыс материалдары мен бұйымдарын өндіру құрылыс және құрылыс материалдары өнеркәсібі саласындағы маңызды және соңына дейін шешілмеген міндет болып табылады.

Жоғары сапалы композициялық құрылыс материалдарын алу үшін перспективті материалдардың жергілікті қол жетімділігінің қазіргі жағдайына талдау жүргізілді, олардың химиялық-минералогиялық және гранулометриялық қасиеттері зерттелді, гранулометриялық құрамның композициялық материалдың негізгі қасиеттеріне және термиялық өңдеудегі құрылымдық ерекшеліктеріне әсері зерттелді, алынған композициялардың физикалық-механикалық қасиеттері сыналды.

Белгіленген термомеханикалық қасиеттері бар жоғары сапалы құрылыс өнімдерін алуды қамтамасыз ететін техногендік қалдықтарды, табиғи шикізатты және олардың қоспаларын пайдалану негізінде композициялық материалдарды өндірудің оңтайлы құрамы мен технологиялық схемалары жасалды. Композициялардың құрамы мен қасиеттерін оңтайландыру математикалық жоспарлау әдістерін қолдана отырып жүргізілді, бұл құрамдас бөліктердің санына, массасына және толтырғыш түйіршіктерінің мөлшеріне байланысты композициялық материалдардың қасиеттерінің өзгеруін болжауға мүмкіндік берді. Құрылыс өнімдерінің кемінде 3 негізгі түрінің тәжірибелік партиялары алынды.

Түйін сөздер: өнеркәсіптік өндіріс, табиғи шикізат, өнеркәсіптік қалдықтарды қайта өңдеу, талдау, жылу оқшаулағыш материалдар.

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МИНЕРАЛО-ПЕТРОГРАФИЧЕСКИЙ АНАЛИЗА ГЛИНИСТОГО СЫРЬЯ ТУРКЕСТАНСКОЙ ОБЛАСТИ, ИСПОЛЬЗУЕМОГО В КАЧЕСТВЕ ДОБАВОК К ТЕПЛОИЗОЛЯЦИОННЫМ МАТЕРИАЛАМ

Аннотация. В статье рассмотрены вопросы развития новой направленности по использованию различных смесей природного сырья и отходов в промышленности строительных материалов как стратегически важным направлением по решению экологической нагрузки и утилизации промышленных отходов с технико-экономическим обоснованием, которые улучшают состояние окружающей среды.

Особенно актуальна эта проблема в производстве строительных материалов, используемых в экологически бедственных зонах республики и в условиях интенсивного коррозионно-эрозионного износа. Производство эффективных строительных материалов и изделий, соответствующих современным требованиям экологичности, основным физико-механическим характеристикам, доступности и стоимости есть важная и не решенная в полном объеме задача в области строительства и промышленности строительных материалов.

Проведен анализ современного состояния наличия перспективного местного сырья для получения высококачественных композиционных строительных материалов, изучены их химико-минералогические и гранулометрические свойства, исследованы влияния гранулометрического состава на основные свойства композиционного материала и особенности структурообразования при термообработке; испытаны физико-механические свойства полученных композиций.

Разработаны оптимальные составы и технологические схемы производства композиционных материалов на основе использования техногенных отходов, природного сырья и их смеси, обеспечивающие получение высококачественных строительных изделий с заданными термомеханическими свойствами. Проведены работы по оптимизации составов и свойств композиций с использованием методов математического

планирования, что позволило прогнозировать изменение свойств композиционных материалов в зависимости от количества, веса составляющих и размера гранул наполнителя. Получены опытные партии не менее 3 основных видов строительных изделий.

Ключевые слова: промышленное производство, природное сырье, переработка промышленных отходов, анализ, теплоизоляционные материалы.

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