әзірлемелер жүргізу үшін қажет.жаңартылатын энергия көздері өнеркәсібі. Орнату қуаттылығындағы, құнындағы және төмендеуіндегі соңғы өзгерістер.Бұл мақалада ЖЭК негізіндегі электр энергиясын өндірудің негізгі әдістерінің орнату қуаттылығындағы, электр энергиясының құны мен шығындарының төмендеуіндегі соңғы өзгерістер қарастырылады. Сондай-ақ, бұрынғы жаңартылатын көздер негізінде электр энергиясын өндірудің өсуі және болашаққа болжамдар қарастырылуда. Талдау көрсеткендей, егер жаңартылатын энергетиканың ағымдағы дамуы жалғаса берсе, болашақта әлемдік электр энергиясын өндірудің көп бөлігі қамтамасыз етілуі мүмкін.Болашақта әлемдік электр энергиясын өндірудің басым бөлігі жаңартылатын энергетика технологиялары есебінен қамтамасыз етілетін болады. Талдау сонымен қатар жанармай шығындары мен ластаушы заттардың шығарындыларының едәуір бөлігін ЖЭК негізіндегі электр энергиясын өндіру технологияларын ЖЭК негізіндегі электр энергиясын өндіру технологияларын кеңірек пайдалану арқылы азайтуға болатынын көрсетеді.

ӘОЖ 691.42:691.217 *DOI 10.52578/2305-9397-2024-2-2-307-316*
ҒТАХР 67.15.47

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МҰНАЙ ШӨГІНДІЛЕРІН КЕРАМИКА ҚҰРАМЫНА ҚОСЫП ЗЕРТТЕУ ЖӘНЕ ОНЫ ЭНЕРГИЯ ТИІМДІ ЖӘНЕ ТҮРЛЕНДІРУШІ КОМПОНЕНТ РЕТІНДЕ ПАЙДАЛАНУ
STUDIES OF OIL SLUDGE AND THEIR USE AS AN ENERGY-EFFICIENT AND MODIFYING COMPONENT IN THE COMPOSITION OF CERAMIC MASSES

Аннотация

Мұнай шламын ғылыми-тәжірибелік зерттеу қорытындылары көрсетілген. Мұнай шламын органоминералды конгломерат қоспасына айналдырудың жаңа технологиясы жасалған. Мұнайшламы бар органоминералды конгломерат қоспасын сары саздақ негізіндегі керамикалық массаға қосу оны жоғары сезгіштіктен төменгі сезгіштікке әкеледі.

Органоминералды конгломерат қоспасы құрамындағы мұнай шламы жану кезінде пештің ішіндегі температура көтеріліп, керамикалық өнімнің пісуін тездетеді. Сондықтан үлгілерді күйдіру уақыты 9 – дан 7,5 сағатқа қысқарады. Бұл процесс үлгіні күйдіру кезіндегі энергия шығынын азайтуды қамтамасыздандырады. Осыдан басқа мұнда жаңа өнім 15-20% - ға жеңілдеп, кірпішті қалау кезінде жұмысшылардың еңбек өнімділігін арттырады. Ғимараттар мен үймәреттер іргетастарына түсетін жүктеме құрылыс обьектілеріндегі материал сыйымдылыққа байланысты 10-12% - ға азаяды. Сары саздақ негізіндегі қабырға керамикасы технологиясында энерготиімді және модифицирлеуші қоспа ретінде мұнай шламын пайдаланудың принципті мүмкіндігі дәлелденді.

Мұнай шламы бар органоминералды конгломерат қоспасының Чаган кен орнының сары топырақты саздақтарының реологиялық қасиеттеріне әсері туралы зерттеулер жүргізілді. Зерттелетін саздақ қоспасыз екінші құрылымдық-механикалық типке жататыны анықталды, онда жылдам серпімді деформациялар дамиды, бұл өнімнің пластикалық қалыптауының технологиялық сатысында деформациялық жүктемелерге ұшыраған кезде нашар қалыптау және сынғыш сыну қабілетін сипаттайды.

ANNOTATION

The results of scientific and experimental studies of oil sludge are presented. New technological solutions have been developed for converting oil sludge into an organomineral conglomerate state. It was found that the addition of an organomineral conglomerate mixture with oil sludge transfers a ceramic mass based on loess-like loam from the category of highly sensitive to the category of low-sensitive. The process of burning oil sludge as part of an organomineral conglomerate mixture allows to increase the temperature inside the furnace and accelerates the sintering process of the ceramic shard. Gorenje This is evidenced by a reduction in the firing time of the samples from 9 to 7.5 hours. This process ensures a reduction in energy consumption at the firing stage of the product. In addition, the finished product is lightened by 15-20%, which makes it easier and more productive for workers when laying bricks. At the same time, the load on the base and foundation of the building and structure is reduced, contributing to a reduction in the material consumption of construction facilities in general by almost 10-12%. The principal possibility of using oil sludge as an energy-efficient and modifying component in the production technology of wall ceramics based on loess-like loams has been proved.

The influence of an organomineral conglomerate mixture with oil sludge on the rheological properties of loess-like loam of the Chgan deposit has been studied. It is established that the studied loam without additives belongs to the second structural and mechanical type, in which the development of rapid elastic deformations prevails, which characterizes poor formability and the ability to brittle fracture when exposed to deformation loads at the technological stage of plastic molding of the product.

***Key words**: Organomineral conglomerate mixtures, ceramic mass, oil sludge, loess-like loam, recycling, ceramic brick.*

Introduction. With the growth of the global economy and the world's population, the need for energy resources consumption increases dramatically. According to experts, from the beginning of the 1980s to the present, total global energy consumption has increased almost twice.

Rising energy prices have prompted Governments in many countries, especially energy importers, to promote policies to improve the energy efficiency of the economy.

In developed countries, the policy of energy efficiency contributed to the growth of the competitiveness of the economy and production, the development of science, innovation, and the introduction of new technologies.

According to forecasts, in 2035, providing the planet with energy will require investments of about $ 2 trillion per year, and the cost of energy efficiency will increase to $ 550 billion. Overall, the energy intensity of global GDP will decrease by 31% by 2030.

Therefore, it is no accident that energy efficiency has become the main trend of the world economy, covering all aspects of technological development, modernization and diversification of the economy, and, most importantly, the growth of competitiveness and efficiency of the economy [1].

Based on economic calculations, scientists and specialists in many countries have come to the conclusion that it is much more profitable to invest in energy efficiency and earn income by saving energy resources than to invest in new energy. Therefore, energy efficiency is an"invisible fuel" at a competitive price. [1]

A necessary condition for the development of an industrial enterprise at the present stage is the combination of the two with a sufficient amount of energy and fuel.

The limited reserves of natural fuel and energy resources of non-renewable energy sources, such as peat, coal, oil, and natural gas, made it necessary to develop energy saving programs.

Energy saving is the main and most effective way of sustainable development of a modern enterprise focused on the production of competitive products in terms of quality and cost.

This task is solved by creating conditions for ensuring a set of measures for the implementation of legal, managerial, scientific, industrial, technical and economic measures aimed at the efficient and rational use of fuel and energy resources and renewable energy sources.

Energy conservation in the industrial sector means getting the same economic result, but with the lowest energy consumption, or getting better results with the same or lower energy consumption per unit of output.

This means reducing energy consumption, as well as saving money. [2]

Therefore, scientists in many countries continue to conduct active research work of an innovative nature in order to reduce energy costs for the production of products.

As a rule, these developments are successfully implemented in production, since enterprises have the opportunity not only to modernize the technology, but also to compete in the world market for the price and quality of finished products. [3-4]

Recently, one of the most promising and priority scientific directions in the production of building materials is the use of industrial waste, including waste containing organic components. [3-4]

In general, the use of industrial waste in the production of building materials that are subjected to mandatory heat treatment as required by the technological process is a positive scientific trend in terms of energy efficiency of technology and resource conservation. [5]

From the point of view of increasing energy efficiency in the production of building materials, oil sludge is of the greatest interest.

Oil sludge is formed in the process of oil and gas production, transportation of oil and petroleum products, storage in reservoirs and in the process of their processing. The amount of oil sludge is constantly increasing. In the oil industry, national and foreign companies are not interested in using them for a number of objective and subjective reasons. One of the main reasons for this is the independent development of the technology of deep processing of oil sludge.

However, to solve this complex problem, oil companies need to create new structural divisions and build additional processing plants.

This path requires additional time and financial costs, including retraining of technical specialists and managers focused on innovative technologies for oil sludge processing.

Therefore, most oil companies currently classify oil sludge as waste and try to get rid of it by transferring it to other companies that specialize in disposing of oil sludge in special landfills.

Among the most common methods of disposal of oil sludge by these companies is incineration using various installations, since oil sludge is classified as highly flammable and combustible materials. [6]

The combustibility and flammability of oil sludge is ensured by the presence of valuable hydrocarbon compounds, such as oil, paraffin, resin and asphaltenes.

Therefore, oil ores should not be considered as waste, but as raw materials from which valuable energy is extracted and additionally converted for other sectors of the economy. [7]

Due to the lack of promising scientific developments of an innovative nature that are ready to be applied in relation to the use of oil sludge as an energy distribution and transforming raw material in other industries, the storage of oil sludge in storage tanks and their incineration still causes serious environmental problems [8-9].

The works of foreign scientists are also devoted to the problem of oil sludge utilization [10-12]. Scientists of Vilnius Technical University (Lithuania) conducted scientific and experimental studies on the use of oil sludge in the technology of ceramic materials. The obtained scientific results showed the prospects of using oil sludge in ceramic production in terms of converting ceramic masses and improving the physical and mechanical properties of the finished product.

In [13], the authors conducted studies on the use of automobile oils (petroleum product residues) used in the composition with quartz sand for the production of light fillers as a transformative additive to clay raw materials. A mixture of 1% oil used in the composition with quartz sand made it possible to increase gas formation and swelling of clay raw materials, increase the mechanical strength of clay raw materials and reduce the swelling temperature.

The use of oil sludge as a raw material for other industries is one of the most rational ways to use it, since a certain environmental and economic efficiency is achieved. [14]

Scientists have conducted research on the utilization of oil sludge, which allows us to obtain many useful products: commercial oil, fuel for boiler installations, and some construction materials.

Also known are technologies and special equipment for processing oil sludge by extracting residual oil and recycling solid waste (Cfc) into materials for road construction. [15-18]

One of the most important sectors of the economy of any state is the production of building materials. In the technological process of production of building materials, there are enterprises whose mandatory conditions are high-temperature combustion and high energy costs (coal, gas, diesel fuel, etc.).

These industries include the production of ceramic bricks, expanded clay, sinter, lime, and cement. [3-4]

Currently, there are the following problems in the production of ceramic bricks in the Republic of Kazakhstan:

- lack and limitation of stocks of high-quality clay raw materials for brick production;
- due to the lack of high-quality clay raw materials in the regions, ceramic brick manufacturers are forced to use low-quality raw materials in the form of loess-like alumina;
- loess loam is characterized by lower plasticity indicators due to the presence of harmful mineral impurities in the form of quartz, feldspar and carbonate;
- at the molding stage, loess-like clays are poorly formed, have a high coefficient of sensitivity to drying, which contributes to the formation of cracks in the formed products;
- the finished product has low indicators of strength, water resistance and frost resistance;
- the chemical and mineralogical composition of loess clays does not allow obtaining high-quality ceramic bricks even at high firing temperatures (1050-1100 0C);
- the technology of ceramic bricks using loess clay slabs is characterized by high energy costs, since it requires a high firing temperature in an industrial furnace (1050-1100 0C) and a long time (up to 72 hours) to achieve the completeness of firing ceramic bricks.
- The existing plants in the Republic of Kazakhstan are designed and built without taking into account the special properties of loess-like clays.
- there is no additional technological equipment for finer grinding of the main raw materials.
-there will be no additional technological equipment to include corrective mixtures that replace the chemical and mineralogical composition in the loess loam, in favor of obtaining high-quality ceramic bricks with lower energy costs.

Therefore, the aim of our research is to study oil sludge and the possibility of its use in the composition of the ceramic mass as a component that releases and converts energy to produce high-quality ceramic bricks.

To achieve this goal, you need to solve the following tasks:

- Study of the properties and chemical and mineralogical composition of loess-like loam of the Chagan field;
- study of chemical and rheological properties of oil sludge for the quantitative determination of other compounds that can improve the molding, drying and firing properties of hydrocarbon and loess clays;
- determination of the calorific value of oil sludge, which contributes to the release of additional energy due to combustion in the composition of a ceramic mass based on loess-like loam;
- development of technological solutions for the transfer of oil sludge to a conglomerate state for convenient inclusion in the composition of a ceramic mass based on loess-like alumina;
- carrying out scientific and experimental works on studying the properties of ceramic masses and heat-treated samples based on loess-like clays in a composition with oil sludge transferred to a conglomerate state.

Methods and materials. Research methods. The hydrocarbon composition of oil sludge was studied using an Agilent 7890a/5975C spectrometer (USA)using gas chromatography.

The fractional composition of the studied oil sludge is determined using the ARN-LAB-02 ml distillation device 100 of the test sample and constant monitoring of the thermometer readings and condensate volume.

The mass fraction of sulfur in the studied oil sludge was determined using a Spectroscan-Max GF2E instrument (Russia), measuring the intensity of sulfur fluorescence radiation excited by X-ray irradiation of the test sample.

The calorific value of the test sample was determined in a C2000 calorimeter manufactured by IKA-Werke (Germany) when the previously measured mass was completely burned in a calorimeter bomb in a compressed oxygen environment and the amount of heat and excipients released during combustion was measured.

The content of chlorinated salts was determined by titration of an aqueous extract with divalent mercury nitrate in the presence of a diphenylcarbazide indicator.

The density of the studied oil sludge was determined by immersing the hydrometer in the test product and obtaining readings on the hydrometer scale at the determination temperature and converting the results to Density at a temperature of 200C.

JEOL has determined the quantitative ratio of crystalline and amorphous phases for the determination of JEM-2100 crystal phases, particle size and crystal size.

Qualitative and quantitative phase analysis, determination of cell parameters and crystal orientation, analysis of the structure of polycrystals, microdynamic stresses and textures, quantitative elemental analysis of inorganic substances and materials, and isotope analysis using a PANalytical Xpert PRO diffractometer were performed.

For experimental work in a laboratory jaw crusher 100x250 MSL to form fractions of 5-10 mm loess clay is crushed, then crushed on a laboratory ball mill 1P MSL until it passes through a sieve with a gap of 1 mm.

The object of the study was the storage facility of oil-producing companies" Zhaiyk Munai " LLP (Uralsk, Republic of Kazakhstan), chromatographic analysis was performed in accordance with the methodology given in [19]. The results of these studies are shown in diagram 1.

Diagram 1-group composition of hydrocarbons according to the results of Chromatography-mass spectrometry analysis

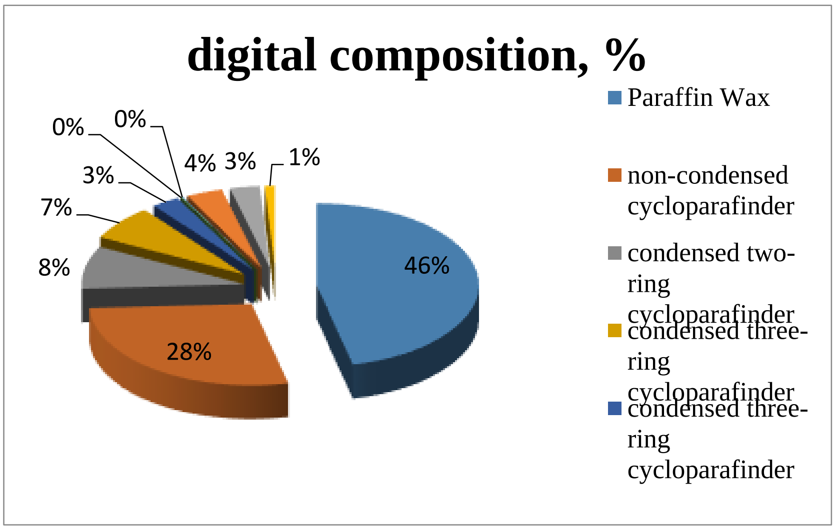

Diagram 1 – Chromatography-mass spectrometry analysis

Rheological properties of the studied oil sludge, i.e. density, fractional composition, mass fraction of sulfur, heat of combustion, presence of mechanical impurities and chlorinated salts, were carried out in accordance with known methods [9-14].

The results of the study of the rheological properties of oil sludge are presented in Table 1.

Table 1 – Arheological properties of oil sludge

Name of the indication	Values
20^0S Density at 20 0 S tygyzdygy, kg / m3	836.4
fractional composition,% 200^0S 300^0S 350^0S	 11 39 54
Kukirtin mass fractionof eel,%	0.024
g heatof anu Heat of anu, KJ/g	44.987 composition
of mechanical components kospalardyn of impurities, %	0.027
Chlorly content of chlorinated salts, mg / dm^3	28.46

The results of these studies showed that the oil sludge produced by" Zhaiyk Munai " LLP makes up 97% of the hydrocarbon group and has a calorific value. The calorific value of the studied oil sludge is 44.987 kJ / g, which is not inferior to the calorific value of natural coal.

The loess-like loam of the Chagan field (West Kazakhstan region), shown in Diagram 2, is used as the clay component.

Loess-like loam of the Chagan deposit is characterized by significant porosity and reaches up to 50%. This is confirmed by the results of electron microscopic analysis.

The addition of oil sludge to the ceramic mass requires a scientific approach, since natural clay raw materials belong to the inorganic silicate system. And oil sludge as a hydrocarbon raw material belongs to the organic group of systems.

According to scientists S.F. Korenkova and T.V. Shein [20], oil sludge refers to petroleum dispersed systems of colloidal chemical origin. They are low-concentrated suspensions in which solid mineral substances with high-molecular organic compounds adsorbed on their surfaces. This is a dispersed phase, and the "water-petroleum oils" emulsion is a dispersion medium. In this state, the addition of oil sludge in small doses to the composition of the ceramic mass leads to the following problems:

- the clay mass instantly clumps immediately after contact with oil sludge, since the porous macrostructure of loess-like loam allows them to be absorbed immediately upon contact;
- the clumping process occurs only at the points of contact, which eliminates the possibility of uniform distribution of oil sludge in the ceramic mass;
- the impossibility of adding oil sludge to the ceramic composition without developing new technological solutions for the production of ceramic bricks;
- to solve the technological problem of adding oil sludge to the composition of ceramic masses based on loess-like loams ensuring uniform distribution of their highly dispersed particles;
- to create technological conditions that promote energy efficiency of production and improve the quality of products.

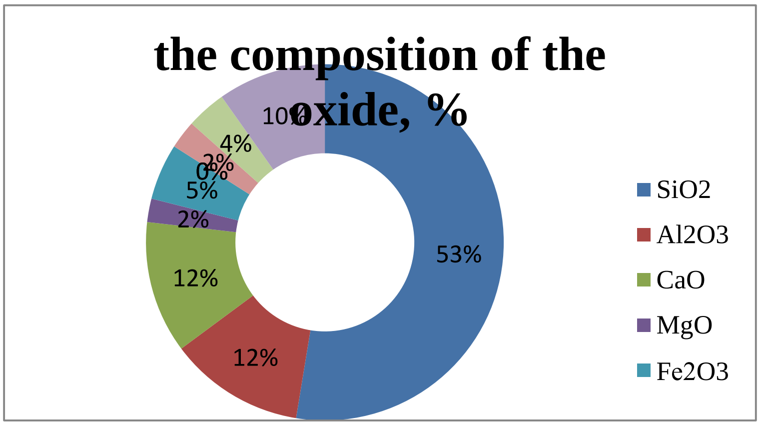

Diagram 2 – Chemical composition of loess loam

To achieve this goal, the task is to transform oil sludge from a suspension state into a loose state, thereby bringing it as close as possible to the flowability state of loess-like loam. At the same time, to achieve and maintain the maximum concentration of oil sludge in the composition for subsequent use in the composition of ceramic masses.

To achieve this goal, loess-like loam was dried in a drying cabinet at a temperature of 100-120 ° C to a residual humidity of 5-7%.

Then the dried loess-like loam was ground in a ball mill until it completely passed through a sieve with a hole diameter of 1 mm.

Since oil sludge, when stored naturally in a container, is a suspension. Being in a container in the form of a suspension, the oil sludge is conditionally divided into three layers. The upper layer of the slurry of oil sludge consists of light fractions, and heavier fractions are found in the middle and lower layers.

In order to achieve a uniform distribution of oil sludge of all three fractions in the composition of the ceramic mass, the averaging process was carried out by intensive mixing in a propeller-type agitator (mixer).

After averaging, the density of oil sludge was 820-850 kg / m3.

After that, by volumetric dosing in a ratio of 1:5, a mixture was prepared in the oil sludge system : loess-like loam and thoroughly mixed in a laboratory runner mixer. The resulting composition is a loose organomineral conglomerate with an average density of 1000-1100 kg/m3.

Research results. According to scientific and experimental studies, a raw composition was made from the components by measuring and dosing. The actual component composition of the object under study is presented in Table 2.

Table 2 – Dependence of the thermal conductivity coefficient of foam concrete on the average density and humidity of the material.

№ composite	components, wt. %	
	Loess -like clay	Munai shlamymen conglomerate mixture with oil sludge
1	88.0	12.0
2	85.0	15.0
3	72.0	18.0

A ceramic mass with a normalized humidity of 18-20% was prepared from the studied compositions. Then, cylinder samples were prepared by plastic molding with a diameter and height of 50 mm. Molded samples are dried in a drying cabinet at a temperature of 75-850C with a remaining humidity of up to 7-8%. The dried samples were fired in an electric furnace SNOL 80/12 according to a specially developed regime. The results of experimental studies are presented in Table 3.

Table 3 – Physical and mechanical properties of the studied samples.

№	Ceramics Compositio n of ceramics weight, %	Kuidirgenge deyingi physical and mechanical properties before firingmechanical properties before firingmechanicalyk kasietteri			Kuidiruden keyingi physical and mechanical properties after firing-mechanical properties after firing, T=980°S±10°S			Annealing y.when firingktygy, hour
		Keptiruge sensitivity to drying coef.	Average density, kg /^{m3}	strength, MPa	strength, MPa	average density, kg/^{m3}	Su water absorption, %	
1	Clay 100 %	85	1355	2,4	8,7	1850	24	9
2	clay 88% blend 12%	110	1240	2,9	9,3	1745	25,5	8,5
3	clay 85% mix 15%	125	1180	3,4	10,2	1670	26.4	8.0
4	clay 72% mix 18%	145	1150	3.8	11.5	1510	26.8	7.5

Conclusion. The results of experimental studies showed that due to the reduction of loess loam, the average density decreases from 1350 to 1150 kg / m3 with an increase in the content of conglomerate with oil sludge. At the same time, the water absorption index of heat-treated samples increases, indicating an increase in the porosity of the samples.

With interest in the composition of an organomineral conglomerate mixture containing oil sludge, the time of appearance of the first cracks increases from 85 to 145 seconds, which indicates a decrease in sensitivity to drying of the ceramic composition.

Thus, the addition of an organomineral conglomerate mixture with oil sludge transfers the ceramic mass based on loess-like loam from a highly sensitive category to a low-sensitive one.

As a result, it allows you to maintain the quality of the finished product and reduces the drying time, thereby reducing energy consumption during the drying stage.

This is evidenced by the reduction in the firing time of samples from 9 hours to 7.5 hours. This process reduces energy consumption at the firing stage of the product.

Thus, the principal possibility of using oil sludge as an energy-efficient and transformative component in the production technology of wall ceramics based on loess-like loam is proved.

ӘДЕБИЕТТЕР ТІЗІМІ

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РЕЗЮМЕ

Представлены результаты научных и экспериментальных исследований нефтешламов. Разработаны новые технологические решения для перевода нефтешламов в состояние органоминерального конгломерата. Установлено, что добавление смеси органоминерального конгломерата с нефтешламом переводит керамическую массу на основе лессовидного суглинка из категории высокочувствительных в категорию низкочувствительных. Процесс сжигания нефтешлама в составе органоминеральной смеси конгломератов позволяет повысить температуру внутри печи и ускоряет процесс спекания керамического черепка. В Gorenje об этом свидетельствует сокращение времени обжига образцов с 9 до 7,5 часов. Этот процесс обеспечивает снижение энергопотребления на стадии обжига изделия. Кроме того, готовое изделие становится легче на 15-20%, что облегчает и повышает производительность труда рабочих при укладке кирпича. При этом снижается нагрузка на фундамент здания и сооружения, что способствует снижению материалоемкости строительных объектов в целом почти на 10-12%. Доказана принципиальная возможность использования нефтешлама в качестве энергоэффективного и модифицирующего компонента в технологии производства стеновой керамики на основе лессовидных суглинков. Изучено влияние смеси органоминерального конгломерата с нефтешламом на реологические свойства лессовидного суглинка Чганского месторождения. Установлено, что исследуемый суглинок без добавок относится ко второму структурно-механическому типу, в котором преобладает развитие быстрых упругих деформаций, что характеризует плохую формуемость и способность к хрупкому разрушению при воздействии деформационных нагрузок на технологическом этапе пластического формования изделия.