World Scientific and Engineering Congress "Energy of the future: innovative scenarios and methods of their implementation" WSEC-2017

Astana
June 19-20, 2017

TO THE ISSUE OF ENERGY SAVING AND IMPROVING THE QUALITY OF THE CERAMIC WALL TECHNOLOGY

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Summary

The results of the scientific and experimental work on the establishment of the basic laws of change in physical and mechanical properties of ceramic wall based on loess loam in the composition of oil sludge, depending on the firing temperature were given. It was established that heat treatment of the ceramic mass on the based loess loam in the oil sludge composition, accompanied by the combustion process inside the molded samples. While the energy is provided by an internal support, which promotes rapid uniform fired ceramic crock. This process reduces the energy-intensive and long lasting firing in the general technological mode of the ceramic brick production.

Keywords: Oil sludge, energy efficiency, curing, loess loam, recovery, ceramic brick, environmental effect.

Introduction

The increase in energy prices has pushed many governments, especially importing energy resources to promote the energy efficiency growth policies in economy.

In developed countries, the energy efficiency policy has contributed to the growth of competitiveness of the economy and production, development of science, innovation, introduction of new technologies. Energy efficiency in the industrial sector means getting the same economic result, but with the lowest energy consumption or obtaining higher results with the similar or less energy consumption per unit of production. This means a reduction of energy consumption and at the same time cost savings. [1] Scientists and experts of many countries on the basis of economic calculations came to the conclusion that it is much more efficient to invest in energy efficiency and earn income by saving energy costs, than to build new capacity. Therefore, energy efficiency is "invisible fuel" at a competitive price. Recently, one of the most promising and priority scientific areas in the production of building materials is the use of secondary industrial resources, including those containing in its composition organic [2] components. Among the common methods of oil sludge disposal in such projects is their incineration by using different installations, as the sludge is classified as easily flammable and combustible [3] material. Therefore, we believe that the oil sludge should not be regarded as waste but as a valuable energy releasing and further modified raw materials for other industries [4] of economy. The problem of oil sludge disposal is considered in research papers of foreign scholars [5]. The scientists of Vilnius Technical University (Lithuania) carried out scientific and experimental research on the use of oil sludge in the technology of ceramic materials. These scientific results have indicated prospects for the use of oil sludge in ceramic production from the point of view of ceramic masses modification and improvements in the physical and mechanical properties of the finished product.

Objectives

Currently, production factories of ceramic bricks in the Republic of Kazakhstan face the following problems: due to the lack of quality of clay raw materials in the regions producers of ceramic bricks are forced to use low-quality raw materials in the form of loess loam.
To achieve this goal it is required to resolve the following objectives: to study the chemical and mineralogical composition of loess loam, to choose the detailed content of composition in the system of loess-like loam, oil sludge; to choose the heat treatment temperature region of the studied ceramic samples; to select the most important physical-mechanical properties of the heat-treated samples, reflecting their quality and degree of incineration completeness; to establish the basic patterns for the studied properties due to incineration temperature and duration.

Research methods

Изучение углеводородного состава нефтешлама проводили с помощью газового хромато-масс спектрометра Agilent 7890A/5975C (США). Теплоту сгорания исследуемого образца определяли на калориметре C2000 фирмы IKA-Werke (Германия).

Results and discussions

Studying the composition of hydrocarbon sludge was carried out by gas chromatography-mass spectrometer Agilent 7890A / 5975C (USA). The heat of incineration of the tested sample was determined on calorimeter C2000 of IKA-Werke Company (Germany).

Sludge of "ZhayykMunay" LLP Oil Company (West Kazakhstan region) and loess loam of Chaganskiy deposit (West Kazakhstan region) were chosen as objects of study. Below given are the results of studies of a set of characteristics of loess loam and sludge (Figure 1 and Table 1).

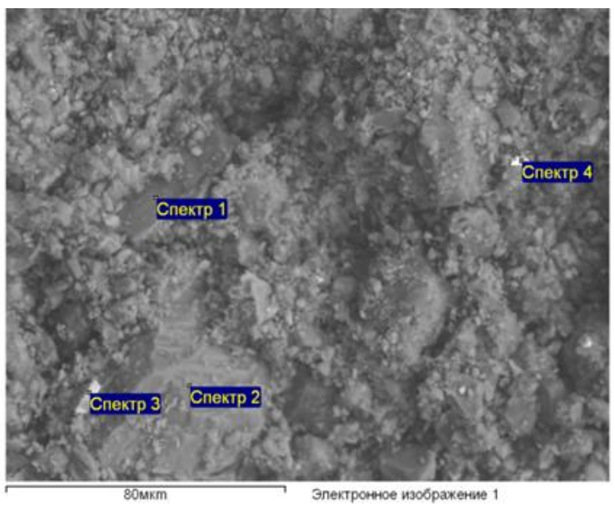


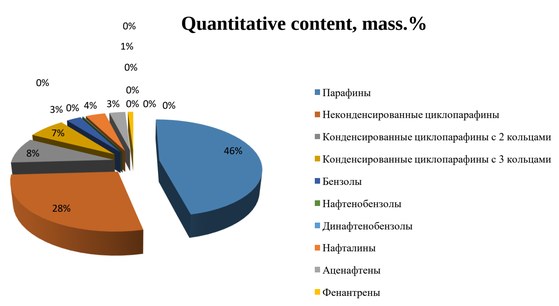
Figure 1 - The microstructure of loess loam from Chaganskiy deposit indicating the point locations of analysis of the chemical elemental composition

Table 1 - Research results of phase composition of loess foam from Chaganskogiy deposit

No.	Visible	Ref. Code	CompoundName	ChemicalFormula	SemiQuant [%]	ML	TL
1	True	01-085-0457	á-Si O2	Si O2	69	14	17
2	True	00-041-1480	Albite, calcian, ordered	(Na , Ca) Al (Si , Al)3 O8	13	12	63
3	True	01-070-6988	MagnesiumAluminumOxide	(Mg0.63 Al0.35) (Al1.70 Mg0.30) O4	7	5	11
4	True	01-074-1786	Kaolinite-1A	Al2 Si2 O5 (O H)4	4	29	151
5	True	01-082-1571	silicondioxide	Si O2	7	10	59

The results of these investigations show that loess foam from Chaganskogiy deposit consists mainly of quartz minerals and contains minerals such as kaolin, albite, calcite. Furthermore, there are mixed-minerals containing magnesium and aluminum oxides.

Diagram 1 - Diagram of the group composition of hydrocarbons based on results of gas chromatography-mass spectrometry analysis of sludge



Results of the study of the rheological properties of sludge are shown in Table 2.

Table 2 - Rheological properties of oil sludge

Indicator item	Values
Density, kg/m^3 in 20^{0}C	836,4
Fraction composition, % об. 350^{0}C	54
Combustion heat, kJ/g	44,987
Content of mechanical impurities, %	0,027

The research results demonstrate that the oil sludge of oil company "ZhayykMunay" LLP contain up to 97% of the hydrocarbon group and have significant combustion heat. Combustion heat of the investigated sludge is 44.987 kJ / g, which is not inferior to the heat of natural coal combustion.

For research there is composite structure selected, limited the following maximum concentrations of the components, mass%: loess loam - 75.0, conglomerate mixture with oil sludge - 25.0. Samples were molded by using plastic manner and dried in a drying oven at 75-85 0 C to a residual humidity of 7-8%. The dried samples were incinerated in an electric furnace 80/12 SNOL in specially developed regime for fixed temperatures of 800, 900, 950, 1000 0C. At the same time the duration of incineration was determined based on the structure of homogeneous incinerated samples. The final incineration time period is the time when the heat-treated samples had a uniform structure while bended.
As the results of experimental research indicate with the increased burning temperature from 800 to 1000 0C there is a steady increase of the strength of heat-treated samples based on both loess loam and compositions of sludge.

Conclusions

The analysis of the scientific and experimental work has allowed to establish the following facts and common regularities:
- Heat treatment of the ceramic mass on the basis of loess loam in the composition of oil sludge is accompanied by the combustion process inside the molded samples. This provides internal energy support, which promotes rapid uniform fired ceramic crock. This process reduces the energy-intensive and prolonged incineration in the general technological mode of production of ceramic bricks;
- the use of oil sludge as part of the ceramic material not only provides the effect of energy, but also contributes to the improvement of basic physical and mechanical properties of the final product, such as compressive strength, the average density and water absorption. As a result of burning oil sludge the process of sintering clay mineral particles is intensified, which explain the increased strength characteristics of heat-treated samples.

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