THE USE OF OIL SLUDGE AS AN ADDITIVE IN BRICK PRODUCTION

Sadykov Sh.Zh.[1], Sarsembin U.K.[2], Alimbekov Zh.S.[3]

[1]Sadykov Shynggys Zhambyluly - Graduate student;
[2]Sarsembin Umbetaly Kuandykovich – Doctor PhD,
INDUSTRIAL ECOLOGY AND BIOTECHNOLOGY DEPARTMENT,
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY AFTER
K.I. SATPAYEV, ALMATY;
[3]Alimbekov Zhailau Samievich – Teacher,
APPLIED ECOLOGY DEPARTMENT,
ZHETYSU STATE UNIVERSITY NAMED AFTER I.ZHANSUGUROV,
TALDYKORGAN, REPUBLIC OF KAZAKHSTAN

Abstract: *here presented the results of experimental studies on the development of composite additive using oil sludge for structural bricks production. As a result of experiments, depending on the composition of the raw mix and different patterns of change in the basic properties of building ceramics firing temperature identified: water absorption, density, tensile compressive strength.*
Keywords: *oil sludge, disposal, water absorption, density, tensile strength under compression.*

UDC 622.276.52

At present, with the development of oil industry, the problem of oil waste formation and accumulation is becoming increasingly important.

Oil sludge refers to the third class of danger, 0.5 tons of oil sludge of sewage treatment plants is formed per 1 ton of processed oil. Modern refineries have an installed capacity of 3 to 20 million tons of oil per year, consequently, the amount of oil sludge accumulating treatment plants for a year is between 1,500-3,000 and 30,000-60,000 tons. Therefore, the task of finding optimal simple ways of processing oil sludge treatment plants is particularly relevant.

In the industry the most common technology of oily wastes utilization is their local combustion with heat recovery. It is of interest to investigate the possibility of using oil sludge treatment plants as a component of clay raw materials subjected to heat treatment, i.e. firing.

The purest clays, consisting mainly of kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$), are called kaolins [1]. Common clays differ from kaolins by chemical and mineralogical composition, because in addition to kaolinite they contain quartz, specular stone, feldspar, calci-spar, magnesite, etc.

In relation to high temperatures, there are fire-clays, high-melting clays and fusible clays. The first [2] is distinguished by a high refractory quality (not lower than 1580°C). This is pure superkaolinite with a low content of mechanical impurities, which reduce the fire resistance to some extent. These clays are characterized by high dispersion and very high plastic property.

A characteristic property of clays is their ability to transform into a stone mass when fired. This process is accompanied by a change in color and density, loss of plastic property and reduction of clay content.

During drying and firing it is necessary to add thinning agents, i.e., non-plastic substances in high-plastic clays requiring large amounts of water (up to 28%), and therefore giving a large linear shrinkage (up to 15%). At this time, the amount of water necessary for gauging the puddle clay is significantly reduced; shrinkage is reduced to 2-6%. Inorganic substances, like quartz sand, chamotte (baked and shredded clay), and product breakage, ground slag and cinders are most often used as thinning agents. These additives not only reduce the shrinkage of products, but also improve the molding properties of the mass, simplify the process and eliminate the waste. In some cases, they improve the physical properties of products, heat resistance and thermal conductivity in particular.

The behavior of oil sludge when heated in air was studied by thermal analysis. The thermogram shows two thermal effects, accompanied by a sample loss of mass. The first effect (endothermic) is observed at a temperature of 20-150°C, and it is probably associated with the evaporation of water and other volatile components. The weight loss is 30.1%. With further heating of oil sludge at a temperature of 150-830°C, a second (exothermic) effect occurs on the thermograms caused by the burning-up of petroleum products.

Self-ignition point of the investigated oil sludge in air was 350°C. The calculated amount of heat released during the burning of oil sludge is 15.1 ± 1 J/kg. The total weight loss was 75.7%; the mass of the solid residue after burning is 24.3% of the initial oil sludge mass.

The results of oil sludge behavior study when heated indicate its high (15.1 ± 1 J/kg) calorific value and confirm the possibility of using oil sludge as a combustible additive in the production of bricks.

As a combustive additive and a thinning agent crude mixture contains a mixture of sawdust and oil sludge in a mass ratio (1-3.5): 1. Content of components in the mixture, % by mass: mixture of sawdust and oil sludge 13-15%; clay - up to 100%.

From the raw mixture the bricks were produced as follows. The mixture of oil sludge and sawdust was combined with dry ground clay and stirred to a homogeneous condition. From the resulting mass, bricks were molded by pressing, which were dried at a temperature of 100-150°C for 1-2 hours and baked at 1000°C for 1 hour.

The advantage of this technology is the possibility of carrying out the process without preliminary preparation of oil sludge. Additional operations to separate mechanical impurities and water from the organic part are not required. The implementation of this technology does not require the construction of additional facilities, which is especially important for existing brick factories.

The presence of petroleum products and mechanical impurities in oil sludge gives them the properties of a combustive additive and a thinning agent simultaneously. The water containing in oil sludge provides the formation of pores.

Technical characteristics of the obtained brick were determined after cooling to 22°C and keeping it in an enclosed room at this temperature. The mechanical strength at compression was determined in accordance with GOST 8462-85.

Brick compression resistance was determined for samples consisting of two bricks. Bricks were laid with bedding on top of each other. The dimensions of the samples were determined with an accuracy of 1 mm. Each linear dimension of the sample was calculated as an average number of the results of two measurement midlines opposing surfaces of the sample.

The diameter of the brick was calculated as an average number of the results of four dimensions: at each end along two mutually perpendicular directions.

Vertical axis was drawn on the side face of the sample. The sample was mounted in the center of the press plates, combining sample and axis of the plate, and pressed against the upper press plate. The load on the sample was raised continuously and evenly at a rate to provide its destruction in 20-60 seconds after the start of the test.

Compression resistance R_{cmr} (MPa) of a sample was calculated by formula:

$R_{\mathrm{cmr}} = P/F$,

where P is full load (kgf), specified on sample test; F is a sample cross-section area (m^2), calculated as an average number of upper and lower surface areas.

When calculating the bricks compression resistance of two whole bricks of 88 mm thick, the test results were multiplied by a factor of 1.2. The compression resistance of the batch samples was calculated to an accuracy of 0.1 MPa as an average number of the test results of all batch samples.

Table 1. Control Sample Test Results

Crude mixture, % by mass.			Brick characteristics		
Clay, %	Oil sludge, %	Pressure mechanical strength, MPa	Freezing resistance, cycles	Open porosity	Heat conductivity factor, W/(m•K)
75	25	38,0	77	35	0,39
80	20	38,2	80	36	0,38
85	15	38,3	91	35,8	0,39
90	10	39,1	91	34,6	0,38
95	5	38,4	91	35,7	0,36

Freezing resistance was determined in accordance with GOST 7025-91. Five samples were saturated with water. Freezing of samples in the freezer and thawing in water was carried out in containers. The horizontal gaps between the samples were not less than 20 mm. The air temperature in the freezer before loading the samples was no higher than -15°C. The freezing time of the samples began from the time of temperature fixing in the chamber -15°C. The air temperature in the chamber from the beginning to the end of freezing was -15 ... -20°C, the duration of one freezing was 4 hours without interruption.

After freezing, the samples in containers were immersed in a vessel with water at a temperature of 25°C, maintained by the thermostat until the end of the thawing of the samples. After one freezing and subsequent thawing the samples were examined and appeared defects were fixed.

Heat conductivity factor was determined on the instrument ITEM-M in accordance with TU 25-1175.127-85. The results of all tests are shown in Table 1.

The test results showed that the samples obtained meet the requirements for the highest grade brick (GOST 530-95) and are characterized by high mechanical strength, freezing resistance and open porosity.

References

1. *Fedoseev S.V., Ibragimov A.M., Gnedina L.Yu. and others.* Silikatnyi kirpich v usloviyah vysokotemperaturnyh vozdeistvii // Stroitelnye materialy, 2009. № 9. P. 48–49.

2. *Wynn A., Marchetti M., Magni E.* Izolyacionnyi ogneupornyi kirpich — maksimum ekonomii energii putem vybora produkta // Ogneupornaya i tehnicheskaya keramika, 2010. № 6. P. 33–38.