STUDY OF THE MECHANICAL AND PHYSICO-CHEMICAL PROCESS OF THE METAL STRUCTURE OF THE SORTING MACHINE

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Abstract

Firebrick plays an important role in many industrial enterprises, including the production of aluminum, cement, glass, iron, oil and steel. Refractory bricks differ in composition depending on their use. The main types are made from raw materials such as aluminum, carbon chrome ore, dolomite, magnesite, silicon and zircon. In the production of refractory bricks, it is necessary to take into account the granulometric composition, as a result of which they become a dense and durable product. Sito-burat SM-237A sorting machine is currently in use. The main feature of the used sorting machine is that it requires the separation of raw materials into the required fractions. The main problem of the raw material sorting machine is the uneven distribution of fractions.

Keywords: Refractory brick, raw material sorting machine, Sito-burat SM-237A, number of rotations, division into fractions.

Introduction

Almost all types of refractory bricks are used in the construction of thermal units operating at temperatures above 1350 °C. Production of iron and steel, as well as the volume of smelting, is a factor that determines the strength of each country's heavy industry. But it is difficult to imagine the huge achievements in the field of metallurgy without technical means. These materials are divided into resistant (1580 °C-1770 °C) and super resistant (above 2000 °C) types according to their temperature resistance. By mixing calcined kaolin or fireclay with unfired clay containing a lot of aluminium oxide, and baking the brick cast from the melted clay in a special oven at a temperature of 1350-1500 °C, semi-sour, fireclay and high-alumina bricks can be obtained.

The Main Part

The properties of refractory aluminosilicate brick depend on the amount of aluminium (III)-oxide included in the mass. As the amount of oxide in the composition increases, the indicators of the brick also increase. In this way, materials prepared on the basis of magnesite, dolomite, forsterite, chromite and artificial compounds differ from others in terms of resistance to high temperature effects. The fact that forsterite brick melts only at a temperature above 1750 °C and can withstand the compression of up to 500 kg of force per square centimetre is evidence of its high hardness [1-8].

For the production of high-quality and durable refractory brick, it is necessary to take into account its granulometric composition, baking temperature and baking time. The baking time and temperature of the firebrick produced in local enterprises is almost the same as the product of this type produced abroad. The only difference is that the granulometric content of 1 ton fireclay firebrick raw material passed through the sorting machine is not at the required level. In the production of firebrick, rotary sieves are mainly used. Sito-Burat SM-237A raw material sorting device is being used in local enterprises. Sito-burat fraction 1 - 30% (300kg), fraction 2 - 23% (230kg), fraction 3 - 10% (100kg) and secondary kaolin - 26% (260kg)The first artificial product of refractory brick consists of aluminosilicate brick obtained on the basis of the SiO_2 - Al_2O_3 system and siliceous brick made on the basis of the SiO_2 equilibrium diagram [9-17].

The raw material of refractory bricks passes through several stages before reaching the sorting process, and the quality of the work done in these processes has either a negative or a positive effect on the sorting process. The raw material brought to the warehouse first enters the jaw crusher, and then it is transported to the begun using a vacuum conveyor. At the next stage, the raw material enters the sorting machine, where it is separated into three different fractions using Sito-burat SM-237A device. Sito-burat SM-237Aconstructionthe deficiency inthe main feature of the machine is that the granularity of the raw materials is not uniform, i.e., the small-sized raw materials go to the next part with the large-sized ones, which has a negative effect on the quality of the manufactured products. Because the required amount of fractions is added depending on the brand of the refractory brick being produced [18-26].

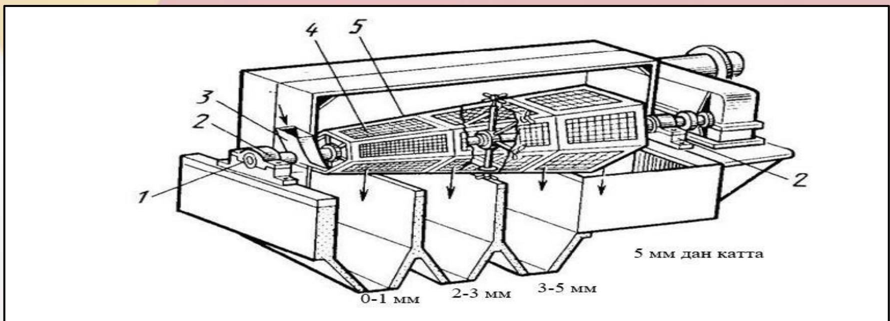

Figure 1. Sito-burat SM-237A: 1- horizontal shaft; 2 – bearings; 3 - raw material input; 4 - mats of different sizes; 5 -frames of sets.

In the working part of the sieve-burat, the raw material moves from the small side of the cone to the large side and is sorted into fractions in this direction. The raw material falling into the first Sito-burat fell into the fine-meshed part, i.e., the raw material up to 1 mm was sieved, and before it was placed in the public, the particles of up to 1 mm were passing to the next part with large ones, but due to the change in the construction of the Sito-burat, the raw material of the size we wanted the material is sorted [27-32]. Then, if a ring (barrier) is placed at a height of 20 mm to prevent it from passing to the next stage together with other larger-sized particles, the small-sized raw materials will not pass to the next stage.

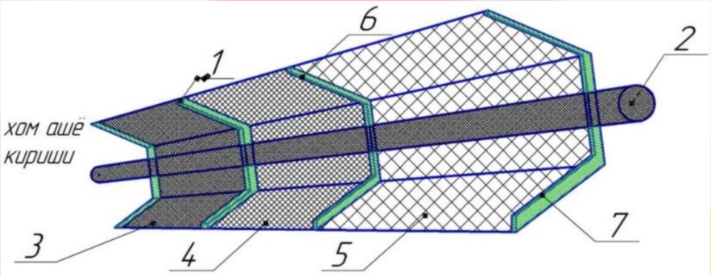

Figure 2. The state after placing the ring. 1, 6, 7-new barrier to be placed (ring); 2nd shaft; 3- 1 mm mesh; 4-3 mm grid; 5-5 mm grid;

Before choosing the height of these rings, several experiments were conducted and the optimal height of the rings was selected. In the second part, raw materials up to 2-3 mm are screened. As in the first part, in this part, together with other larger particles, a 30 mm height fence is placed to prevent them from passing to the next part. . In the last part, raw materials with a size of 3-5 mm are sifted, as in other parts, in this part, too, in order to prevent them from passing to the next part together with other larger particles, if the small raw materials are placed at a height of 40 mm, they will not pass to the next stage. As a result, a dense and durable brick is obtained, which prevents the increase in the cost of the above-mentioned building materials [33-41].

One of the factors affecting the sorting process is the number of Sito-burat cycles, which have threshold values. Deviation of the device from these values reduces the efficiency of the sorting process.

$$n = \frac{8}{\sqrt{(R+r)/2}} \div \frac{14}{\sqrt{(R+r)/2}} \, rpm/\min \qquad (1)$$

If the number of rotations of Sito-burat is higher than the threshold value, the sorting process does not occur, because the raw material settles along the surface of the sieves of Sito-burat under the influence of centrifugal force and rotates together with it. The sieve acts on the raw material moving inside the buret simultaneously by several forces [39-43].

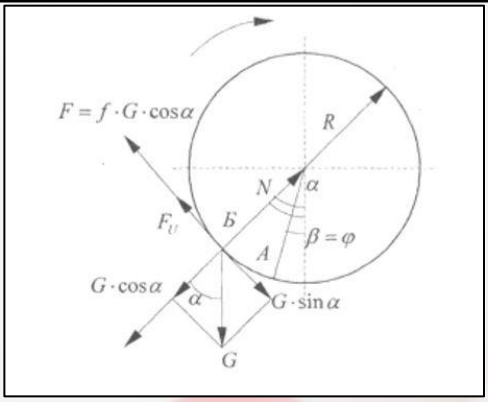

Figure 3. Scheme for determining the number of revolutions of a drum sorting machine.

where *F* is the friction force and it is calculated as follows:

$$F_u = P_u f = fmw^2 R \quad (2)$$

m-mass, kg
w-angular velocity, rad/sec
The average radius of R-drum, m

$$G\sin a = fmw^2 R + fG\cos a \quad (3)$$

$$\sin(a-\varphi) = \frac{v^2}{Rg}\sin\varphi = 4n^2 R\sin\varphi \quad (4)$$

$$n = \frac{1}{2}\sqrt{\frac{\sin(a-\varphi)}{R\sin\varphi}} \quad (5)$$

in practice, angle α is assumed to be 40-45°. The friction angle φ is determined by special calculation books.

$$\varphi = arctg0.7 = 35^0 \quad (6)$$

Taking into account the values of α and φ, the number of rotations of the drum sorting machine is determined as follows.

$$n = \frac{1}{2}\sqrt{\frac{\sin 5^0}{R\sin 35^0}} \div \frac{1}{2}\sqrt{\frac{\sin 10^0}{R\sin 35^0}} \approx \frac{0.167}{\sqrt{R}} \div \frac{0.25}{\sqrt{R}} \quad (7)$$

drum rotation speed: 0.7-1 m/sec.
As we know, the performance of drum sorters depends on the rate of falling of raw materials and the number of revolutions of the sorter. In addition, thanks to the innovation in the design of the device, the efficiency of the sorting machine are increased.
The speed of movement of crushed raw materials that need to be separated into fractions inside the drum sorter depends on the reasons listed above.

$$v_0 = 2\pi Rntg2\beta = 6.28Rntg2\beta \quad (8)$$

where: the average radius of the R-drum sorting machine, m
n- number of rotations,
b- deviation angle,

The dependence of the work efficiency of the sorting machine on its number of rotations is shown in the graph in Figure 4. If the number of rotations is 5 times per minute, a productivity of 40 kg/m^3 is achieved. As the number of revolutions of the sieve burat increases, its productivity also increases. As can be seen from the graph, the sorting machine achieves the highest efficiency when the optimal number of revolutions is 15 rounds per minute. If we increase the number of revolutions of Sito-burat again, the work efficiency of the sorting machine decreases linearly, because the faster the drum rotates, the more crushed raw materials move along the surface of the sieves of the sorting machine, as a result, the sorting process does not take place.

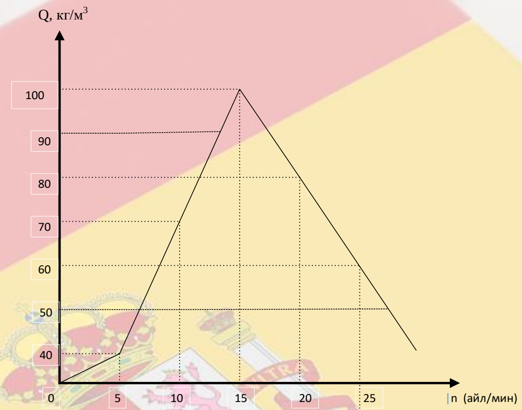

Figure 4. The graph of the dependence of productivity on the number of revolutions

Sito-burat SM-237A is designed with new additional rings to prevent small-sized fractions from passing to the next stage.

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