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GRINDING TECHNOLOGY OF SILICON METAL

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In article is presented application silicon, and advantage him(it) in contrast with the other semiconductor. The aims and purposes of processing of metallurgical silicon electrohydraulic way. Proposed optimal processing parameters of the product. The Certain admixture other element in composition metallurgical silicon processed электрогидравлическим way, and got given are compared to product reduced in mechanical grinder. Processing metallurgical silicon on электрогидравлическим installation does not require the greater expenses for reception powder silicon in necessary proportion

Keywords: electro-technology, metallurgical silicon.

There are many debates in the modern Kazakhstan's science about how to correctly call the material containing 95 to 99% by weight of pure silicon. Some call it the Silicon metal, some metallurgical, some of silicon. For the purposes of this review, we use the following terms:

Industrial silicon is a material with a silicon content of more than 95%, and suitable for use in electronic and chemical industries.

Metallurgical silicon is a material with a silicon content of 50 to 95% and is used in the production of aluminum, iron and steel. Since in most cases, used in metallurgy alloys contain silicon except as iron, in this report we refer to as the silicon metal and ferrosilicon ferroalloys.

Silicon metal is a broad category that combines both technical and metallurgical silicon.

Silicon metal is brittle mineral gray, weak ties which prevents the use of the mechanical properties, but which has been widely used as an alloy for steel and as the basis for the production of silicone products and subsequent forms of silicon.

In an alloy with iron, silicon in the form of ferrosilicon is used for making acid-products, mainly in metallurgy for deoxidation and alloying. There is a production of 50% x (the majority) and 75%-s grades of ferrosilicon.

Industrial silicon is mainly used in the aluminum and chemical industries. Thus, about 54% of the world's commercial silicon directed to manufacture aluminum-silicon alloys, in which the silicon content is only about 6%. These alloys are used in the automobile industry, and the average content of Al-Si alloy car ^ 1995-1999 year is 945 kg [1, 2].

To obtain further redistribution of silicon, namely polycrystalline and monocrystalline silicon, used pure grade silicon, samples of which are shown in the figures. This type of silicon - Technical KpeMHnq chemical quality, is divided into several classes: 441, 3303, 2202. The numbers in the name refer to the number of grades of silicon impurities present in the material. So widespread grade 553 should contain no more than 0.5% iron, 0.5% aluminum, 0.3% calcium.

According to studies of fossil fuels by 2020 can satisfy world energy only partially. The rest of the energy demand can be met by renewable sources.

Among the solutions to environmental problems related to the depletion of fossil fuels, an important place direction, based on the direct conversion of solar energy into electricity using solar cells. This solution of the energy problem is very attractive to environmentally friendly, using virtually inexhaustible source of energy, lack of long-term cycles of heating and rotating machinery.

Many countries are working to develop the production of solar energy converters based on silicon "solar" as the quality of material, favorable for photovoltaic cells (PEC), the physical-chemical properties and high level of modern production technologies. However, the development of this area is constrained by the high cost of the trichlorosilane process unit received power compared to conventional energy sources.

In industry, silicon is obtained by restoring coke SiO_2 melt at a temperature of about 1800 ° C in electric arc furnaces. The purity of such silicon is about 99.9%. Because the need for the practical use of higher purity silicon, the silicon is chlorinated. The formation of compounds of $SiCl_4$ and $SiCl_3H$. These chlorides further purified in various ways from impurities and the final stage of restoring pure hydrogen. It is also possible cleaning silicon due prior magnesium silicide Mg_2Si. Next of magnesium silicide with hydrochloric or acetic acid are volatile monosilane SiH_4. Monosilane further purified by distillation, sorption and other methods, and then decomposed into silicon and hydrogen at a temperature of about 1000 ° C. The content of impurities in the product of these methods is reduced to silicon 10-8-10-6% by weight. Currently, silicon is the basic material for electronics. Monocrystalline silicon is used to mirror gas lasers [3].

Besides silicon is the leading modern semiconductor material, which is widely used in electronics and electrical engineering for the manufacture of integrated circuits, diodes, transistors, thyristors, solar cells, etc. In the first phase of development of microelectronic production as a raw material used germanium (Ge). Currently, 98% of the total number of integrated circuits made of silicon.

Raw material for the microelectronics industry is the electronic polycrystalline silicon, which is then obtained from single-crystal ingots with the necessary physical properties.

The final silicon is a mirror on one side polished single-crystal plate of diameter 15 - 40 cm and a thickness of 0.5 - 0.6 mm with different orientation of the surface.

Industrial silicon is used as an alloying component in steel production (eg, transformer steel) and non-ferrous metal (silicon bronze). Ultra-pure silicon is used as a semiconductor. Over 90% of solar cells made from silicon. At the moment, it is the optimal material for the conversion of sunlight into electricity. Other materials have a low efficiency and high cost. Industrial uses solar power silicon solar cells with an efficiency of 14-16%. In the experimental production of silicon squeeze 26% efficiency, but the cost of laboratory samples is much higher production solar cells [4, 5].

Economically feasible to establish commercial silicon of high purity of at least 99.90%. Production of such silicon is only possible if supequartzitic deposits with a minimum total content on the main contaminants - boron, aluminum, phosphorus, iron, calcium, less than 40 ppm. Quartz deposits of Kazakhstan meet such requirements for cleanliness and elemental composition and quartzite reserves of more than 6.8 million tons.

Therefore, in the laboratory of hydrodynamics and heat transfer of Engineering Thermophysics named after prof. Zh.S.Akylbaev of Karaganda State University named after E.A. Buketov developed and assembled electrohydroimpulse installation, based on the use of pulsed shock wave resulting from the spark discharge in a liquid for crushing and grinding of metallurgical silicon [6-8].

In the experiments the initial diameter of the silicon particles averaged from m fineness increases with specific energy input into the discharge channel, which is explained by the fact that in the processed ore first formed a network of micro-cracks in the path of the shock wave, which creates a continuous state of stress

Unlike mechanical crushers electro setting has no moving parts, much is made of conventional structural steel, so the body is almost no wear at work. The main factors affecting the grinding mechanism, are the intensity of the pulse pressure wave, its duration, the nature of energy input in the discharge channel, the total length of the grinding process, high velocity fluid, formed as a result of volume microcavitating

Experiments were conducted on electrohydropulse installation at different discharge energy, distance between electrodes on the switching device (Figure 1), capacitance capacitor bank (Figure 2), and pulse repetition rate

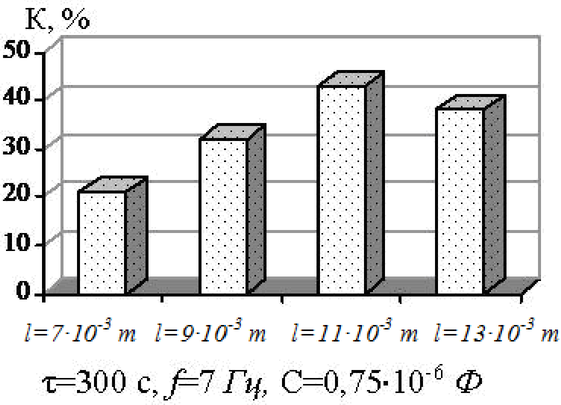

Fig.1. The dependence of the degree of decomposition of silicon the size of the interelectrode distance.

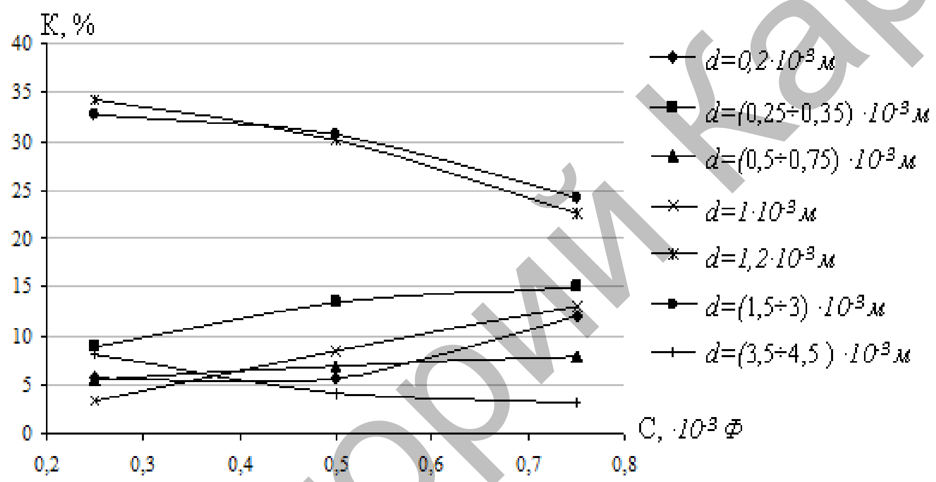

Fig. 2. The dependence of the degree of decomposition of silicon capacity capacitor bank.

From these graphs it can be concluded that increasing the distance between electrodes and capacitance capacitor bank large diameter particles are crushed intense and there is a general pattern of an electric discharge in liquid. The data obtained allows to choose the optimal value of the interelectrode distance requirefor playback experiments.

Below in Figures 3 and 4 it is shown the experimental results of the processing of silicon metal electrohydroimpulse before and after exposure.

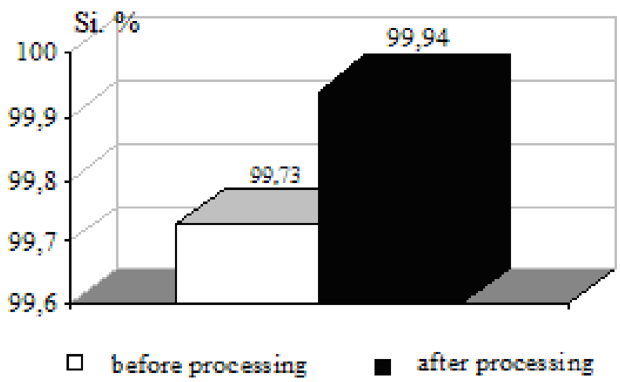

Fig.3. The experimental results of the processing of silicon metal before and after electrohydroimpulse exposure and percentage of pure silicon.

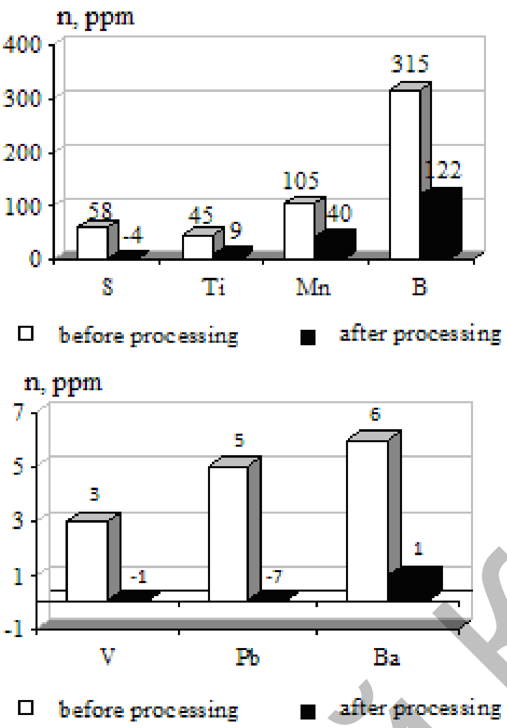

Fig.4. The experimental results of the processing of silicon metal before and after electrohydroimpulse exposure and percentage of items.

As can be seen from the figures, the content of impurities in the medium can be reduced by applying electro-way. However, after a certain period of time, the percentage of Si treatment increased from 99.73% to 99.94%, and the sulfur is reduced from 58 to -4 ppm, titanium from 45 to 9 ppm, manganese from 105 - up to 40 ppm, of boron 322 to 115 ppm, vanadium from 3 to 0 ppm; barium 6 to 1 ppm.

Thus, the impact of implemented with an underwater spark discharge, lead to the destruction of metallurgical silicon with subsequent reduction of alkaline and heavy non-ferrous metals and a simultaneous increase in the elemental composition of silicon.

The results showed that, electrohydroimpulse method of grinding allows you to adjust size distribution of the finished product with high selectivity. The proposed method and power installation options are best suited to industrial environments, provides intensive crushing and grinding of metallurgical silicon. These studies and the implementation of their results to the enterprises will promote technical progress in the industry.

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