International Engineering Journal For Research & Development
Vol.6
Issue 2

TO THE QUESTION OF MECHANOACTIVATION OF METALLURGICAL SLAGS

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INTRODUCTION

Modern construction experience shows that for the construction of modern high-rise buildings and mega structures, it is necessary to use multifunctional high-quality, high-strength concrete, compressive strength, which can reach up to 250 MPa. Such concretes have high tensile strength, bending strength, crack resistance, high impact strength and long-term durability [1-8].

The latest scientific research in the field of building materials science, as well as the results of practical experience in construction, have shown that at present significant success in improving the required properties of concrete and its dominance in comparison with other structural composite materials can be achieved provided that multicomponent (6-12 component) high-quality new generation concrete. When choosing constituents for such concretes, a systematic approach is required that takes into account the chemical and mineralogical activity of additives, the granulometric composition of the mineral powder, and also insistently requires the solution of a number of problems related to the choice of a binder, the preparation of the initial components, their mechanical activation, precise dosage, the method of introducing the components into mixture, mixing technologies, molding, heat treatment, etc. [1-8].

Evolution in the transformation of traditional cement concretes into high-performance multicomponent concretes of a new generation became available with the emergence and use of highly active mineral additives [1-8].

The maximum effect of the mineral additive in order to create the necessary conditions for the flow of the processes of structure formation of filled cement systems is ensured with the optimal dispersion of the mineral powder. An important technological method for obtaining optimal dispersion is grinding, that is, mechanical activation. This article presents the results of a study on the mechanical activation of metallurgical slags of the LMZ JSC “Uzbekiston Temir Yulari” in the shock-abrasive mode of operation of a ball mill.

Research methods and characteristics of raw materials. The process of grinding metallurgical slags was carried out in a laboratory ball mill LBM-100 in a shock-abrasive mode. In the study of the mechanical activation of metallurgical slags, the dried raw material was dried to constant weight at a temperature of ± 105 ° C and loaded into drums in an amount of 15 liters.

The fineness of grinding was assessed by the specific surface area on a PSKh-11A surface meter. The phenomenon of aggregation was determined on a sieve No. 008. The granulometric composition of the crushed material was determined on a laboratory sifting device SS-300 using sieves of the following dimensions, mm: 0.5; 0.425; 0.355; 0.3; 0.25; 0.212; 0.18; 0.15; 0.125; 0.106; 0.09; 0.075; 0.063; 0.035.

The chemical composition of the metallurgical slag is as follows: CrO-0,27%; MgO – 5,99 %; Al_2O_3 – 19,27 %; SiO_2 – 48,21 %; TiO_2 – 0,651 %; MnO – 17,62 %; FeO_2 – 7,63 %; ZnO – 0,133 %.

RESULTS AND DISCUSSION

During the grinding process, the destruction of the material occurs in three stages. In the first stage, the material is divided into separate elements. Separation mainly occurs along structural defects (pores, cracks).

The dispersion of the material increases in proportion to the duration of grinding [1].

At the second stage, crushing becomes more difficult due to a decrease in the number of structural defects, and the resistance to fracture increases. At this stage, the work of breaking bonds depends on the microstructure and phase composition of the material. The growth of dispersion slows down, but the increase in the specific surface area remains [1].

At the third stage, in the process of further grinding, the phenomena of adhesion and aggregation of particles are observed [1].

The results of studies of the grindability of metallurgical slags are shown in Fig. 1.2

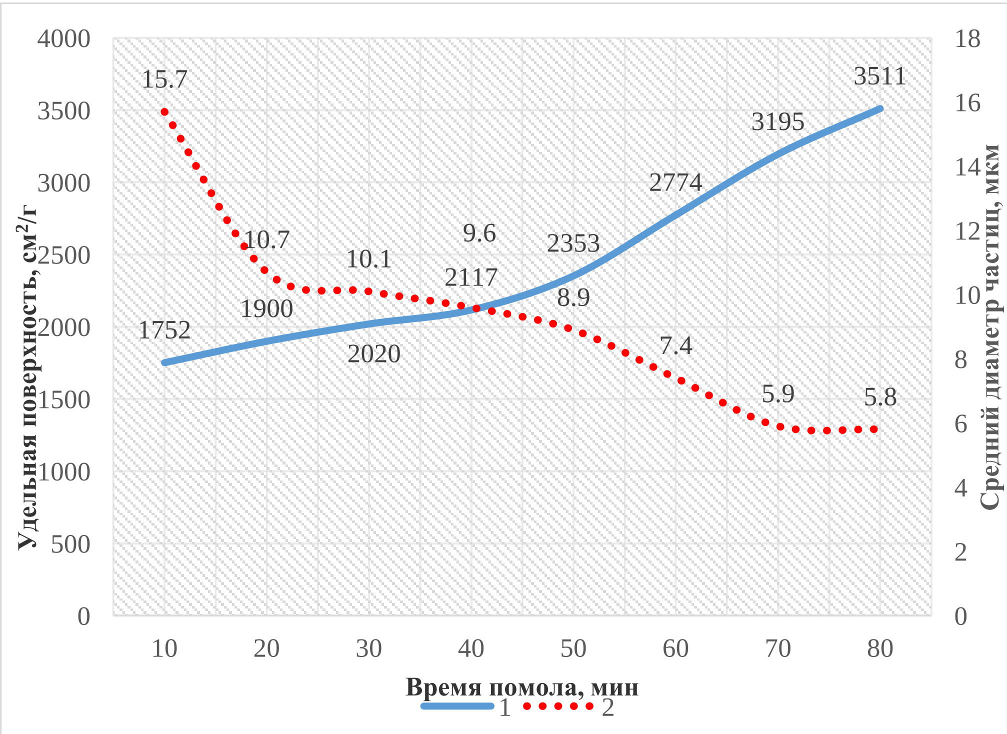

Fig. 1. The effect of grinding time on the specific surface area (1) and average particle diameter (2) of metallurgical slag

The obtained results of changes in the specific surface area show that, after 80 minutes of grinding of metallurgical slag, the specific surface area reaches up to 3511 sm^2/g.

At the same time, the average particle diameter decreases from 15.7 microns to 5.8 microns.

Fig. 3. Influence of grinding time on particle aggregation

In addition, after 70 minutes of grinding, the phenomenon of aggregation and adhesion of particles is observed, as evidenced by the data shown in Fig. 3. For 40 minutes of grinding the metallurgical slag, the residues on the sieve No. 008 are reduced from 68.5% to 24.2%. Further, this value is saved, and the line passes into the horizontal plane and the value of the sieve residue remains for some time. After 70 minutes of grinding, the amount of the residue begins to grow and the phenomenon of particle aggregation occurs.

Thus, the analysis of the grinding results shows that the optimal time to achieve the required specific surface area is 70 minutes, the continuation of grinding is impractical due to the adhesion of particles, which can subsequently affect the physical and mechanical properties of the cement stone.

In addition to the fineness of grinding (specific surface area), its granulometric composition has a significant effect on the technical characteristics of the mineral filler. The data on the granulometric composition of the crushed metallurgical slag are shown in Fig. 3.

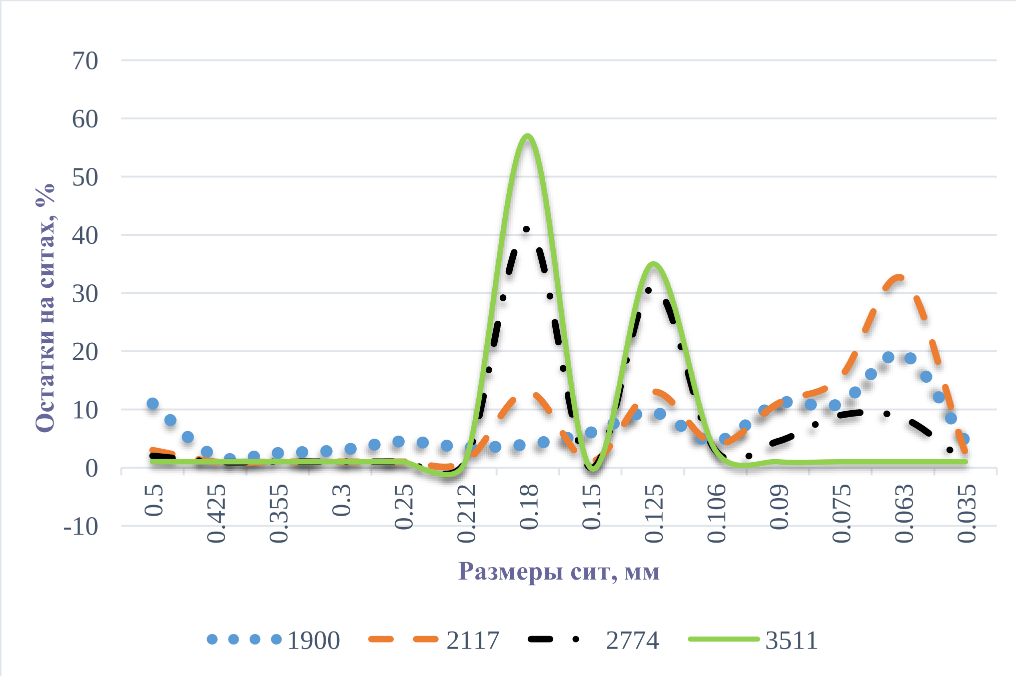

Fig. 3. Granulometric composition of mechanically activated metallurgical slag.

It is seen that the powder with S = 1900 cm2 / g is characterized by a high content of particles of the fraction from 0.5 mm to 0.25 mm. Further grinding contributes to a decrease in coarse particles with an increase in the proportion of fine fractions, which is confirmed by the data of the granulometric composition with S = 2117 cm2 / g. For mineral fillers with S = 2774 cm2 / g and S = 3511 cm2 / g, the residues on sieves 0.18 and 0.125 increase.

Below are the results (Fig. 4-6) of approximation of the curve of the dependence of the mechanoactivation of the mineral filler on the grinding time.

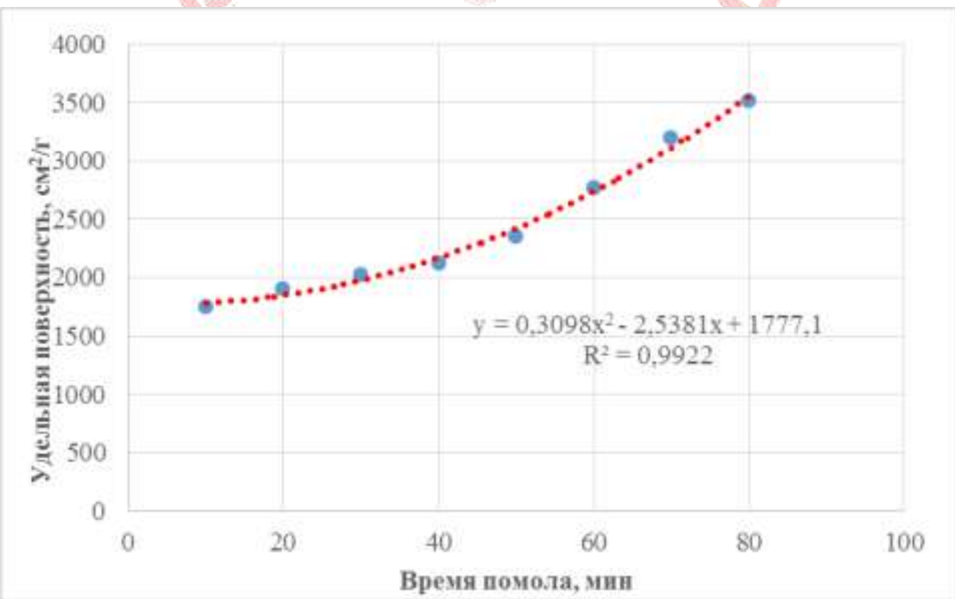

Fig. 4. Dependence of the change in the specific surface area on the time of mechanical activation of metallurgical slag

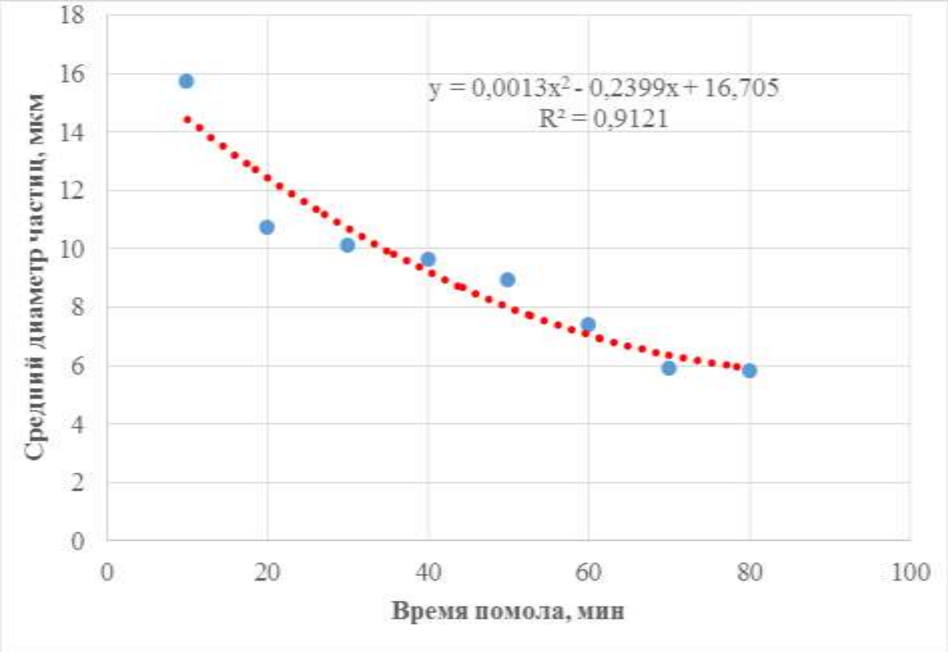

Fig. 5. Dependence of the change in the average particle diameter on the time of mechanical activation of metallurgical slag

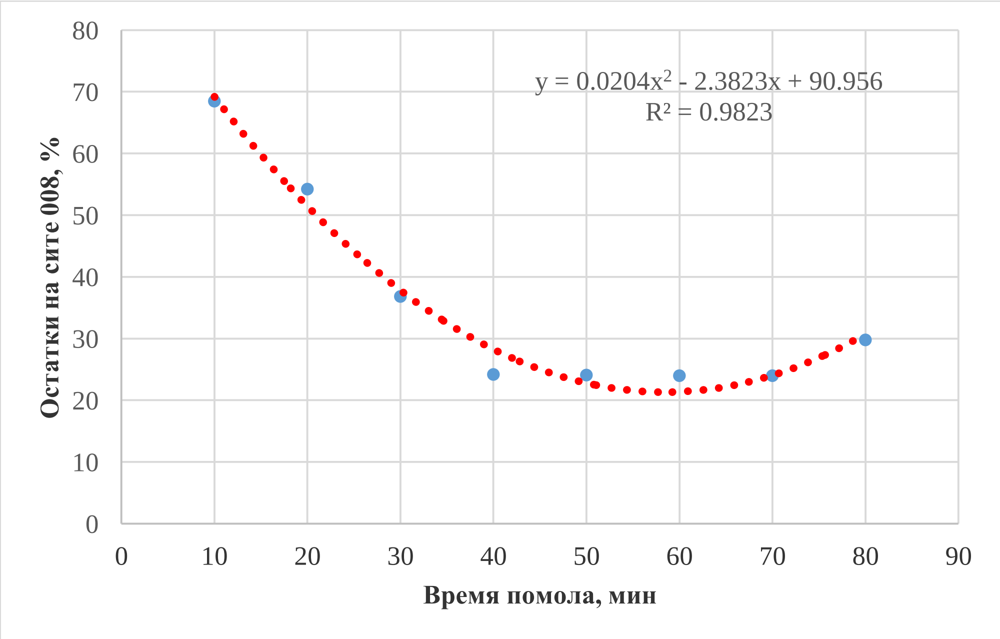

Fig. 6. Dependence of the change in the residue on sieve 008 on the time of mechanical activation of metallurgical slag

The coefficient of determination R2 of the obtained models is in the region of 0.91-0.99, which ensures high reliability of the obtained polynomial models.

Findings. For 80 minutes of grinding of metallurgical slag, the specific surface of the powder increases to S = 3511 cm2 / g, in turn, the average particle diameter decreases to 5.8 µm.

The research carried out to reveal the aggregation of particles showed that after 70 minutes of grinding, the residues on sieve No. 008 begin to grow and particles stick together.

It was also found that from the point of view of the optimal particle size distribution, the most rational is the composition of the powder with S = 2117 cm2 / g. Among other things, models were obtained that adequately describe the entire process of mechanical activation of metallurgical slag.

Further experiments are devoted to the study of the effect of the dispersion of metallurgical slag on the properties of the cement binder.

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