INTERNATIONAL MULTIDISCIPLINARY JOURNAL FOR RESEARCH & DEVELOPMENT
SJIF 2019: 5.222 2020: 5.552 2021: 5.637 2022:5.479 2023:6.563 2024: 7,805
eISSN :2394-6334 https://www.ijmrd.in/index.php/imjrd Volume 11, issue 11 (2024)

APPLICATION OF FINE-DISPERSED SILICA WASTES IN THE PRODUCTION OF LIGHTWEIGHT EXPANSION CEMENTS

Negmatov S.S., Talipov N.X., Panjiyev O.X.
State Unitary Enterprise "Fan va Tarakkiyot", Tashkent, Uzbekistan

Annotation: This article explores the potential of utilizing fine-dispersed silica wastes, commonly generated as byproducts from various industrial processes, as a sustainable alternative in the production of lightweight expansion cements. The article analyzes the benefits of silica waste utilization, outlines the methodology for its integration into cement production, and discusses its potential applications in various construction sectors.

Keywords: Silica waste, lightweight expansion cement, sustainability, construction materials, pozzolanic activity, thermal insulation, compressive strength, density.

Microsilica condensed is formed in the process of smelting ferrosilicon, as well as its alloys at the "Uzmedkombinat" (Bekabad Metallurgical Plant). Contains a large amount of amorphous silica spherical particles in the form of a very fine product are formed from some part of silicon monoxide after oxidation and condensation. In the technological process, part of the silicon monoxide - SiO_2 forms an extremely fine product in appearance such as ultrafine powder, while its particles are particles of amorphous silica, which have an average specific surface area of about twenty square meters / g. Granules of average size are about 0.1 microns, and this is a hundred times smaller than a grain of medium-sized cement.

Microsilica condensed is an ultrafine material consisting of spherical particles obtained as a result of the production of silicon-containing alloys. It is microscopic spherical particles of amorphous silica with an average specific surface area of about 20 square meters. m/g. This highly active mineral additive consists of oxides of silicon, aluminum, iron, calcium, magnesium, potassium, carbon and sulfur. The main quality indicators of microsilica Uzmedkombinat (Bekobod) are brought in the table.

Table 1

The main physical properties of microsilica

№	Name of indicators	The meaning of the indicators
1	Appearance	Ultra-dispersed material of dark gray light
2	Humidity, % by weight, no more than	3
3	Loss on ignition mass fraction (LOI), % no more than	3
4	Mass fraction of silicon dioxide (SiO_2) % not less than	85
5	Mass fraction of sulfur dioxide (SO_3) % no more than	0,6
6	Mass fraction of magnesium oxide (MgO), not more than	3
7	Bulk density, kg/m³, not less than	250

It is known that Portland cement during hardening has a tendency to deformation changes, to shrinkage, which is undesirable for use in cementing casing columns, as well as for well casing work. The use of cement slurries complicates the task, due to the formation of capillary pores in the cement stone. In this regard, it is advisable to use lightweight cement slurries that can expand during hardening.

Oxide expansion of composite lightweight cement slurries during hardening is the most promising method of expanding the cement stone.

Conducted laboratory studies have shown that the expansion of materials used for cementing casing columns is the most promising method of expanding the cement stone. Expansion - as a way to combat shrinkage deformations has been used for a long time, but the studies do not say that the values of the coefficient of linear expansion decrease when obtaining lightweight cement slurries, which are prepared by increasing the water-cement ratio. Previously conducted studies have shown that the use of finely dispersed additives in the composition of oil well cement reduces shrinkage deformations of the cement stone. It has been established that with an increase in the water-cement ratio, the coefficient of linear expansion of lightweight oil well slurries decreases.

The results of the study showed that increasing the water-cement ratio from 0.5 to 1.0 increases the distance between the cement hardening products due to the large amount of water. With a water-cement ratio of 1.0, the distance between the crystal hydrates increases very much, leading to the fact that the expanding additive may not reach them after expansion. All this leads to undesirable consequences: shrinkage deformations - the formation of channels between the boundaries of the Portland cement stone - casing; inter-column flows and gas, oil and water shows. Thus, increasing the water-cement ratio reduces the useful effect of the expanding additive.

Microsilica is a highly active pozzolanic additive to cement with a fine granulometric composition, which, when interacting with the cement mortar, creates conditions for the transformation of brittle calcium hydroxide (formed when mixing the cement mixture with water and hydrating clinker material) into crystalline calcium silicate. Microparticles fill the space that is released by water. Accordingly, the density of the composition increases, which, in turn, also increases its strength.

To ensure shrinkage-free well lining of lightweight composite cements, we conducted a study of calcium oxide as an expanding additive. To obtain expanding composite cements, lime was used in the work in an amount of 5-7%.

It was found that with the introduction of an additive of more than 7%, the bending strength of the cement stone begins to decrease. Expansion occurring due to calcium oxides, which in the process of formation of calcium hydroxide is maximum at minimum concentration of additive..

The mechanism of expansion of lightweight cement slurry containing microsilica and calcium oxide is associated with an increase in the water-cement ratio of the mortar mixture. Between the hardening products (crystal hydrates), consisting of cement grains and cement gel, the process of formation of hydrated compounds of cement monominerals occurs. In the process of formation of the structure, an increase in the size of the crystalline hydrates of cement monominerals occurs.

Laboratory studies on the volume expansion of the developed compositions showed that during the hardening of lightweight composite cements containing microsilica and calcium oxide, depending on their content, an expansion process occurs associated with an increase in the volume of the formed cement gel. It was also found that lightweight composite cements containing microsilica and calcium oxide had a compressive strength limit at the design age of 37.0 MPa. The best result was obtained using 10% microsilica. It was also shown that finely dispersed microsilica in the composition of the cement slurry improves such characteristics as compressive

and flexural strength, adhesion, wear resistance, frost resistance and chemical resistance, and significantly reduces the permeability and porosity of the cement stone.

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