DEVELOPMENT OF CELLULAR CONCRETE (AERATED CONCRETE) FOR THERMAL INSULATION OF WALLS IN THE FORM OF WELL SKIN

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Abstract: The main task of modern construction is to increase the efficiency, quality, reliability and durability of structures and structures, to reduce their material consumption and capital costs as much as possible. The use of high-performance heat-insulating materials in construction makes it possible to create lightweight closed structures that meet the modern requirements of architecture, urban planning, housing comfort, reduce the consumption of materials for the construction of buildings and the overall construction costs. improvement of aerated concrete production technology with drying method is an urgent problem.

Key words: Aerated concrete, construction, volumetric mass, mixture, cement, viscosity, component.

The main laws and processes of structural formation of aerated concrete

When aerated concrete is reinforced with polyamide fibers, subsidence deformations can be reduced. And this means that products made of dispersed aerated concrete with low energy consumption of their production should have improved performance characteristics compared to materials traditionally used in construction. Therefore, the results of studying the structural formation and properties of aerated concretes with non-autoclave hardening dispersed with synthetic fibers should be the basis for directed improvement of their production technology and effectively serve to solve important problems of modern construction.

In order to obtain the given physical and mechanical properties, extensive research was carried out in the field of oriented organization of the structure of aerated concrete mixtures, scientifically based technological principles of obtaining such materials for a wide range of purposes were developed.

Basic physical and mechanical properties of aerated concrete

Aerated concrete is a durable mineral-stone artificial material that does not require serious maintenance. It combined the best qualities of the two oldest materials: stone and wood. This material is fireproof, durable, does not rot, does not age, does not emit toxic substances. By absorbing and returning moisture, cellular Gazobeton maintains a constant humidity of the air in the room. And air bubbles, which occupy about 80% of the material, give it high thermal insulation ability, which helps to reduce heating costs by 25-30% and reject the use of additional heat insulating materials. Thermal resistance of cellular concrete is 3 times higher than clay brick and 8 times higher than heavy concrete. The outer wall of blocks with a thickness of 375 mm provides the required standard thermal resistance Rt\u003d 2.5.

Methods of calculating the main parameters of aerated concrete production technology. Calculation of the strength of concrete according to its volumetric mass

When determining the composition of aerated concrete, it is necessary to ensure

a certain amount of mass and its maximum strength with a minimum consumption of pore-forming and binding substances. In this case, the structure of aerated concrete should be characterized by evenly distributed small pores of regular spherical shape.

The volumetric mass of aerated concrete and its porosity mainly depend on the speed of the pore-forming flow and the level of use of its pore-forming ability. The temperature of the mixture and the amount of water added to harden the mixture have a special effect on them, i.e. the water-hardening ratio S/Q.

An increase in S/Q increases the fluidity of the mixture and thus improves the conditions for the formation of a porous structure if sufficient plastic strength of the mixture is provided by the end of the gas formation process.

Figure 1 shows that the strength of aerated concrete depends on its volume mass. The strength of aerated concrete also depends on its porosity, the size and structure of the pores, and the strength of the shells between the pores. The strength of aerated concrete increases with the increase of S/Q to the optimal value, which provides the best conditions for the formation of the structure of the mixture. The strength of the shells, in turn, depends on the optimal ratio of the main binder and other components, S/Q, as well as the conditions of heat-moisture processing. It follows that the use of mixtures with a minimum S/T value allows obtaining high-strength aerated concrete, provided that a high-quality structure (for example, vibration flow) is formed.

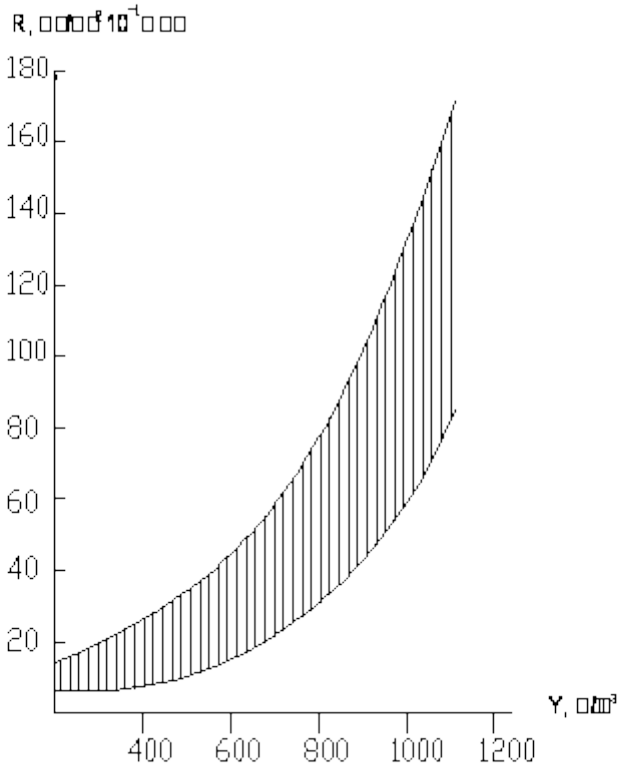

Fig. 1. The dependence of the strength of aerated concrete Rb on its volume mass Y

Technological scheme of aerated concrete production

Concretes with a cellular structure can be obtained by gas formation. Such autoclaved and non-autoclaved cellular concretes are obtained on the basis of portland cement and lime and are called aerated concretes or gas silicates.

Aerated concrete consists of quartz sand, cement, lime and water. Aerated

concrete is produced in industrial conditions using autoclaves that maintain a certain pressure and temperature. When all components are mixed with a gasifying agent-aluminum powder in an autoclave, hydrogen is released. This increases the original volume of the raw mixture several times. And when the concrete mass hardens, gas bubbles form a large number of holes in the material. The production process of aerated concrete requires proper adherence to technology.

300, 400, 500 grade Portland cement that meets the requirements of GOST 970-61 is used for the production of this building material. The production of aerated concrete sets special requirements for Portland cement regarding the alkalinity of the cement paste - the pH level of the paste should not be lower than 12. The alkalinity of cement is determined by the amount of free Cao and K2O with Na2O. According to the work of aerated concrete factories, the amount of alkali (Na2O, K20) in 1 liter of cement solution should not be less than 75 mg. In case of insufficient alkalinity of the solution, lime or alkali should be added to the aerated concrete mass in the form of caustic soda (NaOH).

When lime is used as the main binder, special attention is paid to the large amount of active calcium oxide (CaO) and magnesium (MgO). The total activity of lime should not be less than 75%, the amount of MgO should not exceed 1.5%.

The introduction of lime as a cement additive reduces cement consumption and at the same time increases the alkalinity of the solution, which ensures a strong transition of the gas formation reaction:

$3Ca(OH)_2 + 2Al + 6H_2O_3\,CaO{\cdot}Al_2O_3{\cdot}6H_2O + 3H_2$

In the production of aerated concrete, river rock quartz sand, ash of thermal power plants, marshalite and other materials are used as silicon components. For the preparation of aerated concrete and gas silicate, it should contain at least 80% of SiO2, without the addition of clay and organic substances. The presence of clay slows down the hardening of aerated concrete and reduces its strength. Organic compounds sometimes have a detrimental effect on the shear reaction; in the presence of organic compounds, aerated concrete swells. Ash can be used in the production of aerated concrete with a SiO2 content of more than 55%. Ash should contain small amounts of sulfur compounds, unburnt coal particles and calcium carbonates.

Industrial waste can be used as another component of the raw material mixture. In our republic and abroad, aluminum powder is widely used as a gas producer. Aluminum powder used in the production of aerated concrete should be chemically pure and contain at least 96-98% Al. The size of the aluminum particles should be uniform and should be such that there is no residue when sieved with 4900 OTV/cm2. The uniformity of the particle sizes is necessary for the formation of uniform swelling and the formation of pores of the same size throughout the volume of the cellular concrete product.

Aluminum powder of Pak-2 and Pak-3 brands should be used for the production of aerated concrete. Aluminum powder spontaneously combusts when stored in large quantities. To prevent this, during the production of Pak aluminum powder, its particles are covered with a film of paraffin or stearin, as a result of which they float on the surface of the water and cement mixture. The film removes hydrogen from the Gasobeton mass and prevents the reaction of gas formation. To increase the

reactivity and better mixing of aluminum powder with water, it is pre-calcined for 2-3 hours at a temperature not exceeding 190-200°, or kleekanifolium emulsion is added to the mixture, which reduces the surface tension at the paraffin-water interface. The consumption of aluminum powder per 1 m3 of aerated concrete depends on the weight of the specified volume and is from 300 to 700 g. Iron sulfate, caustic soda and sugar are used as additives for setting the binder and hardening regulators. Sodium nitride cement solutions, bitumen-clay emulsions, etc. are used as an anti-corrosion coating for strengthening aerated concrete.

The main technological feature of obtaining high-quality Gasobeton products with maximum porosity and sufficient strength is to create optimal conditions for two gas generation and gas retention processes at the same time. It is necessary to ensure compatibility between the reaction rate of gas formation and the rate of growth of the structural viscosity of cement paste or mortar. In this case, the outgassing should be completed as completely as possible at the beginning of the installation of the cement-water system. The progress of the gas formation process is determined by many different factors. The maximum effect on the speed of this process depends on the type, amount and properties of the gas-generating substance, the alkalinity and temperature of the medium, etc.

Production of this building material is carried out by wet or dry method. The wet method, in which the siliceous component or its mixture with lime is crushed in the presence of water to form a slurry, is economically feasible. Grinding and mixing of the components with the dry method is carried out in dry form in ball mills. Sand is crushed in ball mills. Heated water is poured into the mill to get wet frost. When lime is used in production, the latter is fed into the mill for compaction together with sand. The sludge from the mill is screened to separate it from large aggregates. Next, the slurry is collected in a collector and fed to a slurry pond or slurry silo by means of a membrane pump or compression with compressed air. To prevent the separation of the sludge, that is, to prevent the sedimentation of sand particles, the sludge in ponds and silos is constantly mixed. At the same time, a mud bubble is produced.

Sludge dosing, heating and pre-mixing are carried out in a dosing bath. Hot steam is used to heat the clay to 40-45°. The dosage of cement is weight. Gas generator-aluminum powder is weighed and placed in a container with kleekanifolium emulsion equipped with a special mixer.

The final mixing of all components of the aerated concrete mass takes place in a portable self-propelled aerated concrete mixer. The materials in the aerated concrete mixer are loaded in a certain sequence. First, sand clay is poured, then uncrushed sand (if necessary) and finally cement. After that, the whole mass is mixed for 2-3 minutes. Introduction of aluminum powder and kleekanifolium emulsion.

Conclusions

The quality of finished products is controlled by the factory laboratory in accordance with the requirements of the state standard or TSH. A certain number of samples are taken from each batch in order to describe the appearance of the material, determine its size, shape, as well as conduct physico-chemical and mechanical tests. is subjected to all regulated tests, after which a conclusion is given on its quality.

The test results are sent to the passport-customer and include a document

accompanying each batch that satisfies its standard requirements.

In addition to the test results, the name and address of the manufacturer, the brand and type of the product, the main external characteristics, the mass or quantity of the products in the batch, the date of manufacture and the retail price are indicated in the passport.

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