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METHODOLOGY FOR PREPARING THE COMPOSITION OF FOAM CONCRETE MIXTURES

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Annotatsiya. Xozirgi kunda zamonaviy konstruksiya va buyumlarni tayorlashda, asosan, yengil qurilish ashyolari keng ishlatilmoqda. Masalan, binoni qurishda og‘ir beton o‘rniga yengil issiqlik izolyatsiyalovchi betonlarni ishlatish binoning umumiy og‘irligini 5 marta kamaytirishi mumkin, natijada bino uchun sarflanadigan umumiy mablag‘ ham tejaladi.

Kalit so‘zlar: tarkib, ko‘pik aralashma, issiqliq himoyalovchi, ko‘pik xosil qiluvchi, urbanizatiya, kompleks qo‘shimcha, sanoat chiqdisi, metalugiya shlagi, ikkilamchi.

Аннотация. В настоящее время при изготовлении современных конструкций и изделий широко используются в основном лёгкие строительные материалы. Например, при строительстве здания использование лёгких теплоизоляционных бетонов вместо тяжёлого бетона позволяет уменьшить общий вес здания в 5 раз, в результате чего также снижаются общие затраты на строительство.

Ключевые слова: состав, пенообразная смесь, теплоизоляционный, пенообразователь, урбанизация, комплексная добавка, промышленные отходы, металлургический шлак, вторичный.

Annotation. Nowadays, lightweight building materials are widely used in the design of modern structures and products. For example, the use of light thermal insulation concrete instead of heavy concrete can reduce the total weight of the building by 5 times, thus saving the overall cost of the building.

Keywords: composition, foam mixture, heat insulator, foam generator, urbanization, complex additive, industrial output, metallurgical slag, secondary.

INTRODUCTION.

Foam concrete prepared from a foam concrete mixture of poor quality, although it has the required density, its strength indicators are still low. The reason for this is considered to be the formation of some negative defects by the gas phase

during the bonding of particles of the solid dispersed phase in the process of forming a stone-like structure. These include the following:

-the beginning of the process of water separation in the lower part of the foam-like mass during the molding and initial forming process;

-the enlargement of pores due to coalescence;

-the process of separation of the mixture into layers.



Figure 1. Mixer, compressor and foam generator equipment for the production of foam concrete.

Analysis of raw materials: To determine the optimal amount of the foaming agent, a sand-cement liquid mixture is prepared. The amount of water must be greater than the volume of physically bound water. The process of the most active interaction of water molecules with solid dispersed particles (physically and chemically bound water) occurs within the first 5–10 minutes after adding water. After 20 minutes, the sand-cement liquid mixture is loaded into the mixer. The required amount of foaming agent is added into the mixer. Then, the preparation process of the foam concrete mixture is carried out in a mixer operating in a turbulent mode. Extending the mixing process beyond 10 minutes leads to the settling of the foam concrete mixture. Therefore, it is generally considered possible to evaluate the quality of the foam concrete mixture after 3 minutes of mixing. A sample is taken from the prepared mixture, and the mass and average density of the mixture are determined. For visual evaluation, the mixture is placed into a glass container or photo fixation may be used. Visual observation is continued from the moment the mixture is placed into the container until the end of the setting time. The foaming agent is added to the remaining mixture in the mixer for the next stage, and the subsequent mixing process is carried out, and another sample is taken in

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the same manner. The sampling process continues until the foam concrete mixture reaches the minimum density (at the specified S:Q:S ratio).

Stability of foam mass

One of the main properties of a stable mass is its resistance to mechanical influence. Such a property is described by Gibbs as follows:

$$E = 2\frac{dy}{d\ln},$$

Bu Here A - is the area of the film,

y- is the surface tension.

For a two-component system, the equation is expressed by Adamson in the following form:

$$e = 4(G_2^1)^2\, d\mu_2/dm^2$$

Here G_2^1 is the surface excess of component 2;

μ_2 - the chemical potential of this component;

M^2 – the amount per unit area of the film.

“E” characterizes the ability of the foam mass to change its surface tension under the influence of stretching or compressive forces. When the surface tension is stretched, the concentration of the surfactant in the film decreases, as a result the surface tension increases and prevents the destruction of the film. Only when both G_2^1 and $d\mu_2/dm_2$are sufficiently large at the same time, as shown in the above equation, can the value of E be high. The surface-active concentration of this substance must be high, but not too high, i.e., the composition of the foaming agent must be optimal.tarkibi optimal bo‘lishi kerak.

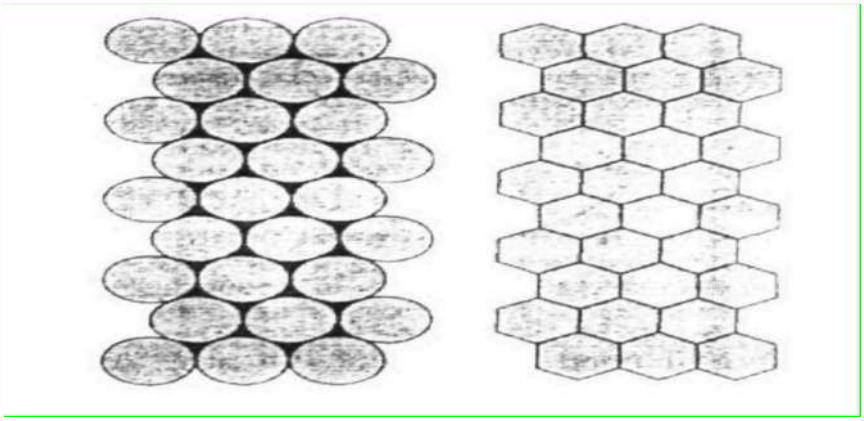


Figure 2. Shapes of pores in foam concrete

High-quality products can be obtained with stable foam. If foam collapse occurs before setting, the average density of the material increases significantly and the structure of the material becomes non-standard, which is an undesirable condition. When additives are introduced, coagulation and heterocoagulation may occur. In technology, foam concrete reflects the role of cement. At this time, the main minerals responsible for the development kinetics of time and strength, which determine the design strength, are said to be tricalcium silicate C_3S (alite) and

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tricalcium aluminate C_3S. These minerals release heat during the hydration process, especially in the early stages of hardening. The content of tricalcium silicate C3S in clinker can vary from 45 to 68%. The higher the content of C_3S, the higher the strength and durability of the product. A high amount of tricalcium aluminate accelerates cement hardening in the initial period up to 2 days.

The presence of surfactants in the foam-cement system changes the hydration properties of cement. According to the effectiveness of surfactants on the properties of concrete, the authors divided all cements into groups: Group 1 – C_3A < 6%, C_3A > 50%; Group 2 – C_3A 7–10%, C_3A > 40%; Group 3 – C_3A > 10%, C_3A < 40%. According to the results of the authors' studies, this grouping is applicable to cements used in the production of foam concrete. The most effective for use in foam concrete technology are Group 1 cements. In the cements of this group, the high content of alite determines the high strength of the cement stone in the inter-pore framework, faster setting, and rapid heat release during hydration.

The cements of the third group have low efficiency. In the presence of foaming agents based on synthetic anionic surfactants in C_3A particles, hemasorption processes occur actively, as a result of which the foam mass collapses and consequently the density of the final products increases. In such cases, manufacturers increase the consumption of foaming agents, which leads to another negative effect: "poisoning" of active centers on the surface of minerals and a delay in setting time [22]. It has been determined that the coagulation stability of the cement + foaming agent system depends on the charges of the functional groups of surfactants and the ratio of cement particles.

RESEARCH METHOD. after 28 days of natural curing or steam curing, the samples are removed from the molds, dried at a temperature of 105–110°C to constant weight, and tested (the average density and compressive strength limit are determined). The average density of foam concrete is determined by the following formula:

$$\rho = \frac{m}{V}$$

Here m – the mass of the sample, kg; V - the volume of the sample, m^3.

The strength of materials is determined by compressing sample cubes in a press until they are crushed. The supporting edges must be selected in such a way that during testing the compressive force is directed perpendicular to the forms filled with the foam concrete mixture, then marked, and the linear dimensions of the working area are measured with an error of no more than 1%.

During the compression test, the test specimen is placed with one selected edge on the lower base plate of the press (Figure 3) or at the center of the testing

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machine. After that, the upper supporting edge of the test specimen on the upper base plate of the press is positioned so that their surfaces fully coincide with each other. Then loading is started. The loading of the specimens is carried out continuously at a rate ensuring complete failure of the specimens (0.6 ± 0.4 MPa/s). In this case, the loading time for one specimen must be at least 30 s. The maximum force achieved during the test is taken as the breaking load.



Figure 3. Diagram of a hydraulic press adapted for testing compressive strength: 1 – base; 2 – piston; 3, 5 – lower and upper supporting plates; 4 – test specimen; 6 – hand wheel for manual lifting of the upper plate; 7 – force measuring device; 8 – oil pump.

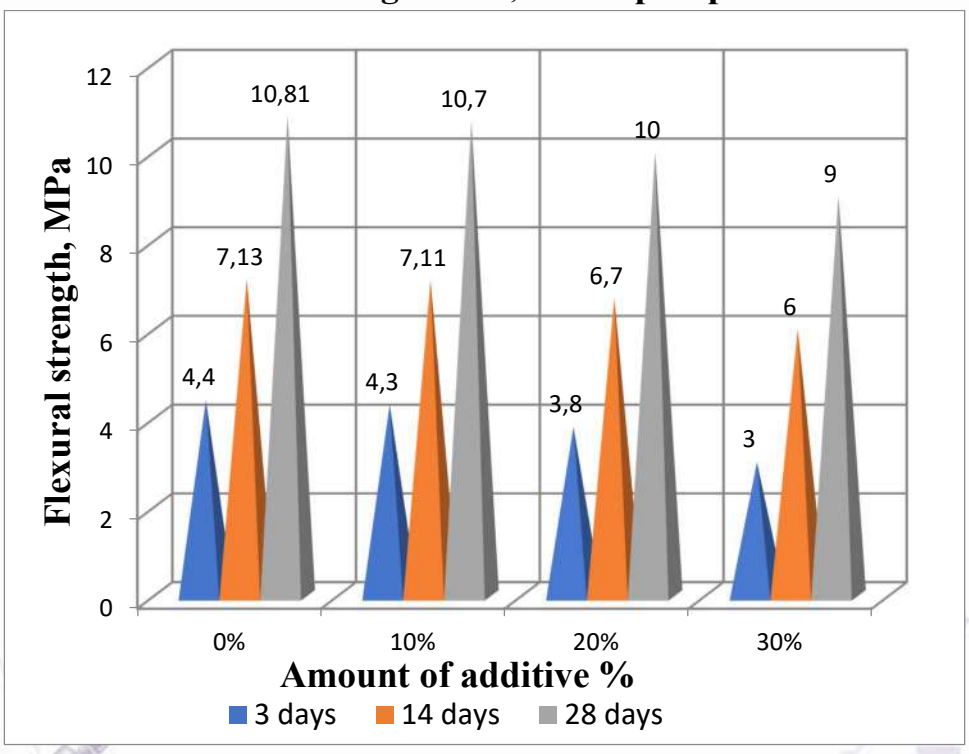


Figure 4. Effect of fly ash on the flexural strength of cement

This graph shows the effect of industrial waste fly ash on the compressive strength of cement.

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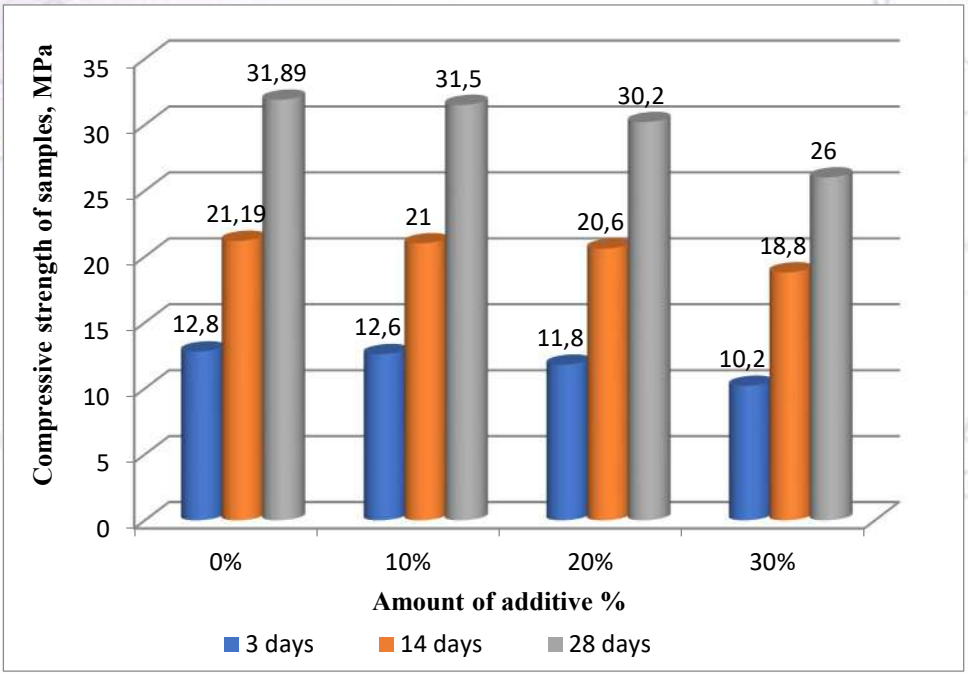


Figure 5. Effect of fly ash and cement on compressive strength

CONCLUSION. Undoubtedly, the optimal composition of the foaming agent is one of the main factors influencing the construction-technological properties of foam concrete. Thus, its compositional deficiency does not ensure the required density of concrete, and a high consumption of foaming agent may lead to a slowing down of the cement system hardening process.

At the same time, under conditions related to an increase in free water in their composition and an increase in the content of the foaming agent per unit of binder, the preservation of the cellular structure of low-density foam concrete is disturbed, which slows down the formation process of the foam concrete mixture system.

In addition to equilibrium or reversible processes, some transient processes may affect the elastic resistance of the film. The surface of the film has relatively high surface tension.

Surfactants, if spread over the surface of the film for a short time, can change the locally initial surface tension of the forming thin film in a short time before the film becomes thinner.

Thus, changes in surface tension are eliminated without reducing the initial thickness of the film, and for some time this region of the film remains mechanically weak. Adamson concluded that good foaming agents should be slowly adsorbed on the surface (on a millisecond scale). It is known that some foaming agents may be incompatible with certain types of binders, as well as with some chemical and mineral modifiers.

When selecting the optimal type of foaming agent, some of them may be incompatible with the accepted type of binder, as a result of which various negative

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phenomena occur, especially foam collapse. For example, a foaming agent made from amine oxide leads to coagulation of Portland cement particles with the formation of large aggregates, which leads to a significant decrease in the strength and other construction-technological properties of foam concrete.

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