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THE STUDY OF THE INFLUENCE OF RHEOLOGICAL AND STRENGTH CHARACTERISTICS OF FOAMED CONCRETE ON ITS INTEGRAL POROSITY

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The technique of structures and technologies designing for non-autoclave foam concrete hardening with the required parameters of porosity on the basis of experimental studies and mathematical models is suggested.

Key words: foam concrete, integral porosity, non-autoclave hardening, open porosity, conditionally closed porosity, water absorption, filler.

Introduction. The artificial materials are complex structures composed of two or more components, acquire a set of properties different from the properties of the original components, refer to composite building materials (CBM). Existing polystructural theory [6, 7] combines the principles of structure formation and technology CBM, treating them as "structure in the structure". The establishment of structure formation regularities of such complex construction composites will allow to solve the problem of designing optimal structures CBM, which will provide the required physical and technical characteristics and operational reliability of the material. Material properties change in the transition from one component to another, or from one structure to another area, which is a surface of a section. There is a redistribution of stresses and strains between the individual components or structures (structural heterogeneity) CBM under the action of a technological and operational loads on the surface of the section. The materials can be roughly divided into external and internal surfaces of the section; to the outside can be attributed the samples of surfaces and structures, to the internal - boundaries between the individual components or phases, of the structural units (the pores), banks of cracks, defects, etc. [2]. Most of the functional (thermal conductivity, thermal diffusivity) and construction and operational properties of cellular concrete (medium density, strength, water absorption, resistance to various environments) depends on the total porosity, as well as on its characteristics. on their properties The works [1, 4, 5] are dedicated to the study of the influence of porosity of cellular concrete. Analyzing these works, we can do one of the conclusions that the properties of cellular concrete are greatly influenced by the ratio between the open (apparent) and conditionally closed porosity. As noted, with the increase in the number of open pores increases the moisture permeability of cellular concrete, and, therefore, increases thermal conductivity, reduces resistance to impact loads and weather resistance, which ultimately reduces the durability of products and designs. Therefore, when designing structures and the production of porous concrete it's ntctssary to increase conditionally closed pores and reduce open pores in the total volume of porosity. In the experiment, along with the study of the rheological and structural characteristics, the influence of the above variables on the character of the integral porosity of non-autoclave foam concrete hardening has been studied. The value of total porosity, and the amount of open and semi-closed pores has been determined.

The problem. The getting of building materials with the required physical and technical properties, which provide operational reliability with a minimum of materials, energy and labor costs.

The purpose of research. The study of total porosity of the non-autoclave foam concrete hardening management, its characteristics, the ratio between the open and closed porosity by changing prescription-technological parameters of manufacturing.

The methods of research. In the experiment, along with the study of the rheological and structural characteristics, the influence of such variables as moisture permeability, thermal conductivity, resistance to impact loads and resistance, on the character of the integral porosity of non-autoclave foam concrete hardening [4].

The results of the research. We have determined the value of total porosity, and the amount of open and semi-closed pores. In order to do this the pycnometer method was used, allowing to provide high precision measurements, determined the true density of Portland cement, carbonate filler and crushed concrete. The true density of the cement has been determined in a reaction-inert fluid is kerosene. Density of carbonate filler and foam concrete have been determined in distilled water. The density of the foam has been determined in each row of the experiment plan. The samples were collected from samples destroyed when tested for compressive strength. Additional crushed and weed out the fraction size of less than 1.25 mm for testing. To determine the true density of the foam concrete samples has been selected, which were hardened in normal humidity conditions within 28 days. The total porosity of the foam concrete has been determined by the formula:

$$\Pi_{\text{общ}} = \left(1 - \frac{\rho_0}{\rho}\right) \cdot 100\%, \qquad (1)$$

in which ρ_0 – the average density of foam concrete in the dry state, kg/m^3;

ρ – the true density of foam concrete, kg/m^3.

We have judged about the volume of open porosity by the amount of water absorption of concrete. For this the samples have been dried to a constant weight and placed in water. To prevent upwelling the samples were loaded on top. The water level above the samples was 4 sm. The duration of keeping them in the water was two days. After water-saturated samples have been weighed and calculated the amount of water absorption by weight and volume by the formulas:

$$W_m = \frac{m_{\text{нас}} - m_{\text{сух}}}{m_{сух}} 100\%, \qquad (2)$$

$$W_o = \frac{m_{\text{нас}} - m_{\text{сух}}}{V} 100\%, \qquad (3)$$

in which $m_{\text{нас}}$ – the mass of the sample in water-saturated condition, g; $m_{\text{сух}}$ – the dry weight of the sample, g; V - the volume of the sample, sm^3.

For quantitative characterization of open porosity the value of the volumetric moisture saturation has been taken. The volume conditionally closed pores was calculated as the difference between the total and open porosity:

$$П_{у.з.} = П_{общ} – П_{откр} , \quad (4)$$

The results of experimental determinations and calculations are shown in table 1.

Table 1. **The features integral porosity of concrete.**

№ in order	The true density, g/sm^3	The mass of the sample, g		The water absorption, %	The porosity, %		
		in the dry state	in water-saturated condition		open	closed	general
1	2,546	505	765	26	26	51	77
2	2,554	615	1175	56	56	20	76
3	2,598	545	865	32	32	44	76
4	2,603	620	1190	57	57	20	77
5	2,566	553	773	22	22	54	76
6	2,576	500	1000	50	50	26	76
7	2,539	678	898	22	22	52	74
8	2,551	600	1090	49	49	28	77
9	2,538	650	830	18	18	60	78
10	2,576	640	1030	39	39	36	75
11	2,525	658	888	23	23	54	77
12	2,542	648	858	21	21	55	76
13	2,548	580	880	30	30	47	77
14	2,579	610	890	28	28	49	77
15	2,515	568	758	19	19	57	76

Due to the fact that the aim of the experiment was to get foam concrete of equal density in all lines, the total porosity of the samples is practically unchanged and varies between 75-78%. The ratio between conditionally closed and open porosity largely depends on the prescription and technological conditions of foam concrete production. To determine the influence of variable factors, as well as conditions for receiving concrete with the required parameters of the pore space, the results have been processed on computers and on their basis the mathematical models of water absorption (open porosity) and conditionally closed porosity have been constructed. As well as conditionally closed the apparent porosity complement each other to total porosity, only the analysis of the impact of prescription-technological parameters of preparation of foamed concrete to change the closed porosity has been conducted. The influence of these factors on water absorption (open porosity) foam is reversed. The fig. 1 shows a quasi one-factor dependence of influence adopted in the experiment factors on the change of water absorption (open porosity) of the foam concrete.

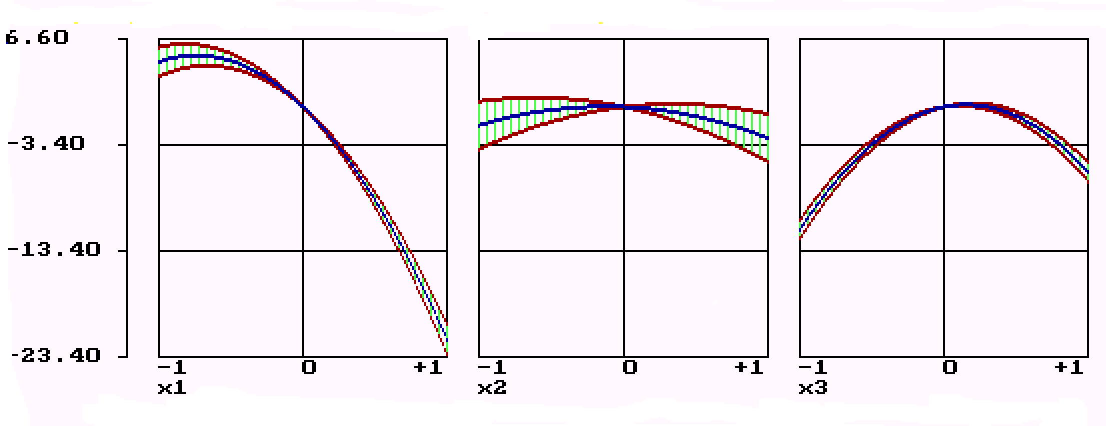

Fig. 1. The water absorption of the foam concrete.

The dependences show that the greatest influence on the change of parametres for the integral porosity has the introduction of the filler in the composition of the mortar mixture. Increasing the amount of filler leads to a significant reduction of the relatively-closed pores in the volume of material (30%). The second factor (X2) on the integral porosity of the foam concrete has not a significant impact. Also an activation time of mortar has marginal effect. It should be noted, however, that the nature of the influence of this factor on the amount of conditionally closed porosity has an extreme within time as 20 seconds.

Conclusions: 1. As a result of the conducted analysis it has been determinated that by changing prescription-technological parameters of manufacturing of non-autoclave foam concrete hardening, you can control both the total porosity and its characteristics, the ratio between the open and closed porosity. 2. The information obtained in the experiment and mathematical models can be used in the design of compounds and technologies for production of foam concrete with the required parameters of porosity.

REFERENCES

1. Gorlov Y.P., Merkin A.P., Ustenko A.A. The technology of thermal insulation materials. - Moscow: The construction publishing house, 1980. - 396 p.
2. Dorofeev V.S., Vyrovoy V.N. Technological damaged building materials and structures: Monograph. – Odessa: The city of masters, 1998. – 168 p.
3. Martynova E.B. Unautoclave foam concrete on the mortar fraction of the activated: Avtorefer. dis. Candidate ... .. tehn. Science. - Odessa: OSACEA, 2005. – 20 p.
4. Merkin A.P. The influence of technological factors on the structure of cementitious substances and properties of aerated concrete mixed substance // The building materials. - 1975. - № 2. - P.33-35. - 1975. - № 12. - P. 19-30. - 1980. - № 3. - P. 12-13.
5. Merkin A.P. The structure of the interporous partitions porous concrete and the technological methods of its improvement // The issues of improving the technology and improve the quality of mortars and concretes: Proceedings of the MECI named by V.B. Kuybyshev. – Moscow, 1975. – Edition № 109. – P. 38-43.

6. Solomatov V.I. The development of polystructural theory of composite building materials // The news of higher educational institutions. Building and architecture. –1985. – № 8.- P. 58-64.
7. Solomatov V.I., Bobreshev A.N., Himmler K.G. The polystructure composite materials in building /Under the edition of V.I.Solomatov – Moscow: The construction publishing house, 1988. – 312 p.

ИССЛЕДОВАНИЕ ВЛИЯНИЯ РЕОЛОГИЧЕСКИХ И ПРОЧНОСТНЫХ ХАРАКТЕРИСТИК ПЕНОБЕТОНА НА ЕГО ИНТЕГРАЛЬНУЮ ПОРИСТОСТЬ

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Ключевые слова: пенобетон, интегральная пористость, неавтоклавное твердение, открытая пористость, условно-замкнутая пористость, водопоглощение, наполнитель.

Резюме

Предложена методика проектирования составов и технологии получения пенобетона неавтоклавного твердения с требуемыми параметрами пористости на основании экспериментальных исследований и математических моделей.

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Summary

Suggested the technique of designing structures and technologies for non-autoclave foam concrete hardening with the required parameters of porosity on the basis of experimental studies and mathematical models.