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Resistance of Leaked Concrete under the Conditions of Multiple Humidification and Drying

Teshaboeva Nodira Djuraevna
Fergana Polytechnic Institute Senior Lecturer of the Department
"Geodesy, cartography and cadastre"

Kosimova Khafiza Kholmatovna
Fergana Polytechnic Institute Senior Lecturer of the Department

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ABSTRACT

The article presents a change in the temperature-humid operation of the expanded clay concrete structures of water facilities leads to signs of temporary deformations and the accumulation of micro and macro defects that reduce the durability of the material.

A change in the temperature-humid operation of the expanded clay concrete structures of water facilities leads to signs of temporary deformations and the accumulation of micro and macro defects that reduce the durability of the material. The ability to withstand emerging structural stresses largely depends on the composition and conditions for the formation of the concrete structure. [1,2]

The task was set to increase the durability of expanded clay concrete under conditions of changing humidity by modifying the surface of expanded clay gravel in order to control the structure formation of solid concrete by moisture deformations of hardened concrete.

Expanded clay concrete provides a complex system of the "composite in composite" type. A representative structural heterogeneity at the macro level is the contact zone of the porous filler of a stable interface between such two composites, which depends on the ongoing micromechanical processes. [3,4]

Absorbing part of the mixing water mainly by capillaries, the radius of which is less than the radius of the capillaries of the surrounding solution, expanded clay granules undergo moisture deformations 4-5 times greater than when they are moistened during this period in water. swell.If the granule is moistened through defects from the inside, then its volume decreases. Such "shrinkage" is associated, in our opinion, with the redistribution of the internal deformative-stressed state of compressive stresses, and in the transition zone of wetted and dry areas, circumferential tensile stresses. [4,5]

Regardless of the stress, the moisture deformation of expanded clay granules continues to develop after the end of cement setting, causing irreversible structural damage. Previously, dehydration of the mortar part of the concrete due to the absorption of water by the porous filler leads to physical shrinkage, and the reaction of cement hydration leads to chemical shrinkage, causing overall shrinkage of the mortar. In our opinion, with the general shrinkage of the mortar part, there is no compression of the filler, but an increase in the interface between the mortar and the filler.

This leads to the emergence of circumferential tensile stresses in the mortar part between the aggregates. Circumferential tensile stresses are the cause of premature cracking of the mortar part (the appearance of radial cracks). These cracks are new interfaces along which shrinkage continues to develop, preventing them from "self-healing".The immobilization of water by a porous aggregate creates real prerequisites for its uneven distribution over the mortar part. Experiments on models of concrete structural cells have shown that due to the uneven distribution of moisture in the cement paste in the zone of contact with porous aggregates and in the central sections, the period of their structure formation does not coincide by 30- 40 min. The difference in the periods of structure formation of cement paste sections between expanded clay granules also leads to structural stresses and defects. [5,7]

Studies have shown that the physical activity of the porous aggregate and physics - chemical and mechanical processes occurring in the hardening and hardening mortar part predetermine the low resistance of expanded clay concrete under conditions of alternate wetting and drying (K st after 10 cycles is 0.45)

When treated with hydrophobic silicon organic compounds such as GKZH-94, expanded clay gravel sharply reduces moisture deformations in hardening concrete. This also leads between the hydrophobized filler granules, to a decrease in the water absorption of the treated granules, does not cause premature shrinkage of the mortar part, thereby improving the contact zone between the mortar part and the hydrophobized filler. Therefore, the durability of concrete on hydrophobized expanded clay gravel under conditions of repeated moistening and drying is two times higher than the durability of ordinary expanded clay concrete and 1.7 times higher than the durability of concrete with the addition of GKZH-94 introduced with mixing water. [9,8]

Studies show that the physicochemical processes that occur during the formation of the structure of expanded clay concrete cause irreversible changes in it, reducing its resistance to repeated wetting and drying. in variable humidity conditions. One of the most important indicators that determine the possibility of using porous concrete in environments with varying degrees of aggressiveness is its corrosion resistance. To date, long-term tests have made it possible to evaluate the corrosion resistance of this material. At the same time, it is quite clear that an important condition for the use of large-pore concrete, for example, in reclamation facilities, is the need to develop measures to protect it from corrosion. The study of large-pore concrete based on expanded clay is devoted to these issues. The results of which are carried out in the present study. [7,6]

There are various ways to increase the resistance of large-pore concrete to aggressive media. One of them is connected with the selection of cements for dense concretes operating in aggressive conditions, as well as with measures aimed at increasing the density of the cement stone due to the physical or chemical interaction of clinker-forming minerals with additives or chemical impregnations introduced into the concrete. With the development of the production of organosilicon water-repellent liquids (GKZH-10, GKZH-11, GKZH-94, etc.), the prospects for their use for volumetric hydrophobization of large-pore filtration concretes are expanding. [1,2]

In this case, a hydrophobic additive can be introduced into the concrete mixture or immersed in a solution of a water repellent finished products. An effective means of protecting cement stone from corrosion and improving its structure can be the treatment of concrete products with solutions of salts of aluminum, sodium, magnesium and zinc hydrofluorosilicic acid, the so-called fluatization.

These salts are obtained as by-products, for example, in the production of superphosphate. They are not scarce and very cheap. The second way to increase the durability of products and structures made of large-pore filtration concrete, which does not provide reliable waterproofing, is the elimination of direct contact between concrete and water. In practice, this means the creation of new materials with the help of large-pore concrete, which have a macroporous structure and high resistance in aggressive environments. [6,9]

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The field of application of impregnating insulations has so far been limited mainly to protection of external surfaces or external layers of concrete structures from aggressive waters. Some researchers have tried to use bitumen and bituminous varnishes for the impregnation of large-pore concrete. 20 mm as their viscosity is high. Which leads to a sharp decrease in the filter's water throughput.

Asphalt-bitumen varnish, as established by N.S. Pokrovsky, does not provide reliable waterproofing of concrete during one-time processing of products. Repeated immersion of products in baths is unprofitable. An effective material for the impregnation of large-pore concrete is technical paraffin, which has a low viscosity at 80-1500C and a high penetrating ability. water saturation indicator was adopted. The higher this indicator for concrete treated in any way, the more likely it is to accelerate the occurrence of corrosion processes in it. The exception is fluoated concrete. [5,7]

Since the purpose of fluatation is not to protect the cement stone from the penetration of water into it, but the formation of chemically insoluble compounds with calcium oxide hydrate of hydrated cement, which eliminates the cause of one of the most important types of corrosion – leaching $Ca(OH)_2$. The final assessment of the influence of an aggressive environment on the resistance of large-porous expanded clay concrete with various processing methods was given according to the results of testing samples for compression before failure.

The rate of the process of water pumping and impregnation of the cement stone depends mainly on its differential structural porosity. With a water-cement ratio equal to 0.61 for all series of samples, the time of water saturation of the cement stone is 3-6 hours. After the cement stone is saturated with water, the process of expanded clay saturation begins. At the same time, water can enter expanded clay only from cement stone. The process of saturation of expanded clay in large-pore concrete is limited the speed of water filtration through a film of cement stone and therefore, in contrast to the usual water absorption of claydite-claydite in water, is more extended in time.For samples processed in various ways, the process of water saturation can go a little differently. So, after paraffin, depending on the quality of the application of the impregnating insulation, cement stone and expanded clay may not be filled with water at all or saturated in a limited volume. In a similar way, hydrophobic liquids GKZH-94 can act on concrete. Fluating the samples leads to a change in the characteristics of the structural porosity of the cement stone, which should also affect the process of water saturation. Water saturation was determined by periodically weighing the samples stored in an aggressive solution for 7 months. The samples were weighed 30 min after their removal from the solution. Based on the drying curves of the samples, the general view of which is shown in the graph (Fig. 1). It has been established that intensive outflow of water from samples of large-pore concrete occurs during the first 30 minutes. [6,7]

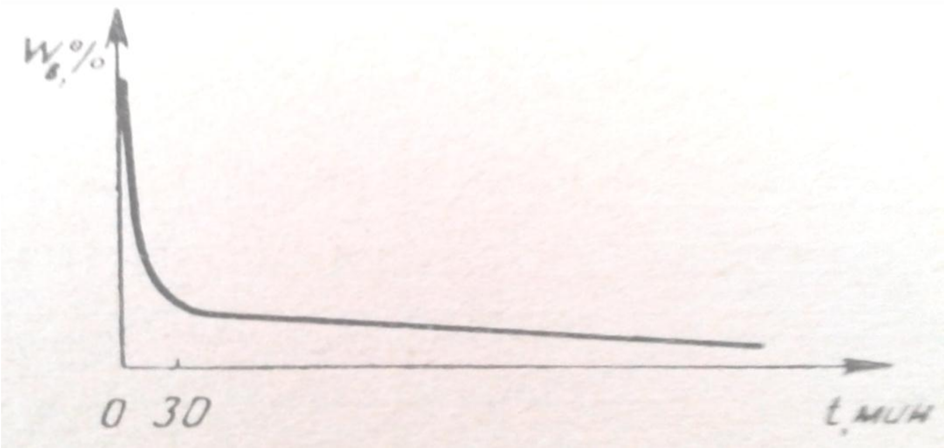

Fig.1. Kinetics of drying samples of large-porous filtration expanded clay concrete.

After their extraction from water, which corresponds to the removal of liquid from non-capillary large pores.Conclusions: It has been experimentally shown that it is possible in principle to increase the corrosion resistance and other performance qualities of large-pore filtration expanded clay concrete under the conditions of exposure to aggressive waters by appropriate treatment of products. The most effective way of protecting against corrosion from among those considered in the work should be considered waxing. [9]

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