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Study of reinforcement corrosion in expanded clay concrete

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Abstract Expanded clay concrete differs from heavy-weight concrete not only by the composition and performance properties, but also by modes of chemical interactions between the components. So, not the primary problem of reinforcement corrosion in heavy-weight concrete under the normal conditions and the correct protective layer, becomes in the major problem in expanded clay concrete. The issue of reinforcement corrosion in expanded clay concrete is considered in this article. The studies on the effect of different compositions on the corrosiveness were conducted. Researchers have proposed various options for expanded clay concrete reinforcement protection from the environmental impact, including those through a variety of chemically active additives. According to the data obtained by experimenting, the diagrams of corroded area size dependence on various factors were presented.

The results of the studies conducted are the recommended design and technological measures for the reinforcement protection against corrosion in various fine aggregate-based (natural sand, ash and dry hydroremoval) light-weight expanded clay concrete. Thus, the minimum concrete protective cover for main and distribution reinforcement of external walls must be at least 25 mm. It is necessary to inject additives – reinforcement corrosion inhibitors (sodium nitrite, sodium tetraborate) to the concrete composition. The consumption of cement, and hence, the cement paste content of concrete mixture must be not lower than 220 kg/m^3, and under the application of the active dry fly ash removal −200 kg/m^3.

Introduction

It is known that under exposure to atmospheric impact the reinforcement in heavy concrete hardly corrodes, provided that its protective layer has the required thickness, and the concrete is sufficiently strong, tight and contains in its composition the amount of cement required for creating and long-term preservation of high alkaline medium [1–3].

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Fig. 1 Reinforcement bars from the laboratory samples.

However, there is active metal reinforcement corrosion in expanded clay concrete that reduces the strength and durability of structures. This reduces the economic feasibility of expanded clay concrete and raises the question of metal reinforcement protection, or its replacement with alternative materials and reinforcement methods.

Therefore, authors have carried out studies of reinforcement corrosion in expanded clay concrete on various fine aggregates.

Experimental

Amount of fines contained in the composition of expanded clay concrete gravel is not enough for obtaining lightweight concrete of dense structure.

Therefore, as a missing part of the fine aggregate natural sand, fly ash of dry removal (ZSU) and powdery ash of hydraulic removal (ZSU) of Kemerovo thermal power stations were used. The 400 M portland cement content was varied from 180 to 350 kg/m^3, and the value of protective concrete layer was equal to 15, 20 and 25 mm.

To protect reinforcement the additive-inhibitors for steal corrosion such as: sodium nitrite (NN) in accordance with GOST 19906-74* E, sodium tetraborate (TBN) in accordance with GOST 8429-77* were used [4,5].

Studies were carried out on $10 \times 10 \times 10$ cm cube samples, in which through the holes in the formwork the 4 mm diameter metal rods were placed. The length of the reinforcement bars was taken 40–50 mm larger than the form sizes. The holes, into

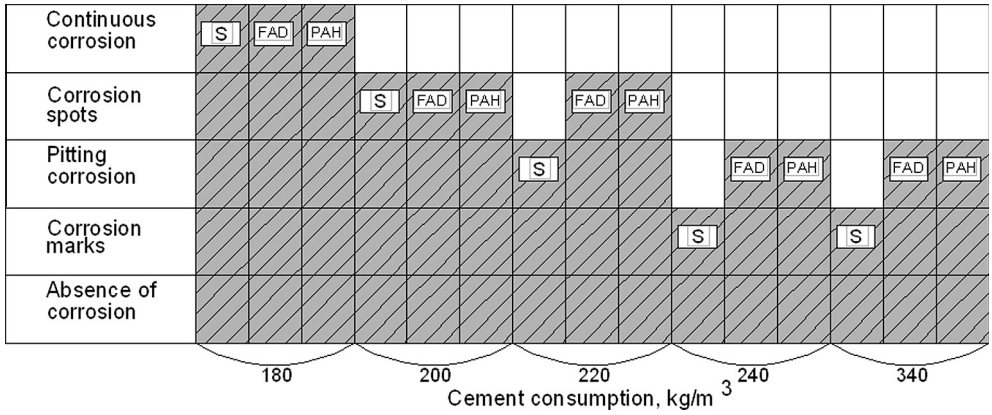

Fig. 2 Corrosion dependence on the type of fine aggregate and cement consumption: S – sand, FAD – fly ash of dry removal, PAH – powdery ash of hydraulic removal.

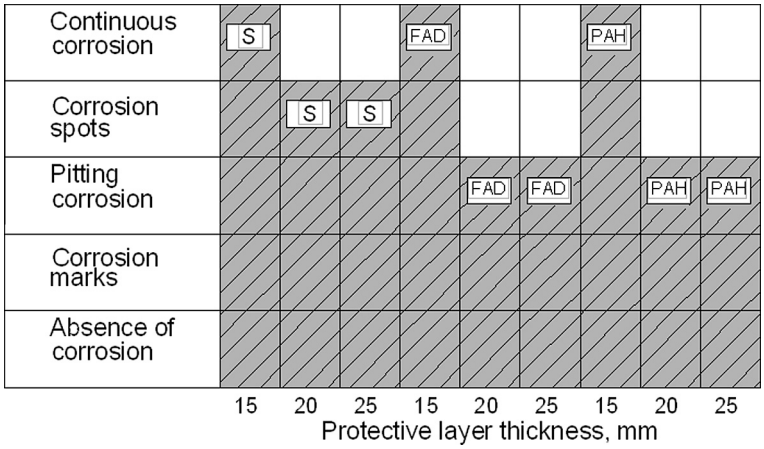

Fig. 3 Dependence of the reinforcement corrosion degree on the magnitude of the protective layer of concrete: S – sand, FAD – fly ash of dry removal, PAH – powdery ash of hydraulic removal.