UDC 691.328.44

INNOVATIVE BUILDING MATERIALS: SELF-HEALING CONCRETE

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Problem statement. The emergence of innovative technologies in production and construction is an integral part of scientific progress. The purpose of creating new or modernizing the fear of technology is the human need for a cheaper, more environmentally friendly and reliable material.

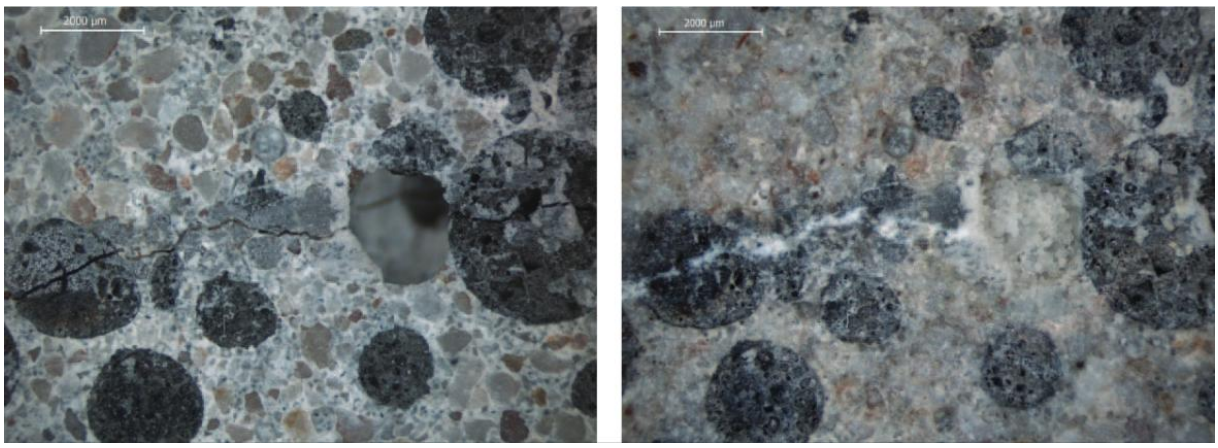
Purpose of the study. The aim of the work is to study today innovative building materials.

Main results. Self-healing concrete could solve the problem of the deterioration of concrete structures long before the end of their service life. Concrete is still one of the main materials in the construction industry, from building foundations to bridge structures and underground car parks. Tiny cracks on the surface of the concrete make the entire structure vulnerable, when water gets in, the concrete collapses and corrodes the steel reinforcement, which significantly reduces the life of the structures (Fig. 1).

Fig. 1. Destruction of concrete and corrosion of reinforcement

The job of bio-concrete is that specially selected bacterial species of the genus Bacillus, along with calcium nutrients known as calcium lactate, as well as nitrogen and phosphorus, are added to the concrete ingredients when it is mixed. These self-healing agents can sleep in concrete for up to 200 years. However, when the concrete structure is damaged and water begins to seep through the cracks that appear in the concrete, bacterial spores will germinate on contact with water and nutrients. Once activated, the bacteria begin to feed on calcium lactate [1].

As bacteria feed on oxygen, it is consumed and the soluble calcium lactate is converted to insoluble limestone. Limestone hardens on the cracked surface, thereby compacting it. Oxygen consumption during bacterial conversion of calcium lactate to limestone has an additional advantage. Oxygen is an important element in the corrosion process of steel, and when the bacterial activity has completely consumed it. This increases the durability of steel reinforced concrete structures (Fig. 2).



a *b*

Fig. 2. Self-healing of concrete: a) before, b) after

Two parts of the self-healing agent (bacterial spores and calcium lactate based nutrients) are injected into the concrete in the form of separate expanded clay granules 2…4 mm wide, which ensures that the agents are not activated during the cement mixing process. It is only when the cracks open the granules and the incoming water brings the calcium lactate into contact with the bacteria that they become active.

The disadvantages of self-leveling concrete are, firstly, clay granules containing a self-healing agent make up 20 % of the concrete volume. This 20 % is usually a denser aggregate such as gravel and this weakens the concrete by 25 % and significantly reduces its strength. The second significant drawback is its cost, which is almost twice the cost of conventional concrete [2; 3].

Conclusions. Based on the foregoing, that for the further development and application of bioconcrete on an industrial scale, it is necessary to eliminate the above disadvantages, as well as for the operation of bioconcrete in aggressive environments, it is necessary to find bacteria that can survive in an extreme alkaline envirnment. Cement and water have a pH value of up to 13 when mixed together, usually a hostile environment for life: most organisms die in an environment with a pH of 10 or higher. It is necessary to find microbes that thrive in an alkaline environment.

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