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PROTECTION FROM CONSTRUCTION BIODETERIORATIONS

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The problem of protecting structures from biological damage is indicated in the article. It was noted that the most aggressive towards concrete is thiobacteria. It is shown that the most common means of protection is biocides. The problem of durable, affordable and ecologically safe biocide protection is urgent.

In the field of construction and maintenance of civil and industrial buildings the problem of biocorrosion is becoming increasingly urgent. Biocorrosion is the destruction of structural materials under the action of microorganisms and their metabolic products [1]. More than 40-50% of the total damages recorded in the world are connected with the activity of microorganisms [2]. The results of a sample survey of various buildings [3] showed that buildings may be affected by bacteria, elementary and other microscopic fungi, algae, lichens and even higher plants. Microscopic fungi considerably worsen service characteristics of materials, causing not only partially damage to the building, but also their complete destruction. The protection against corrosion of building materials based on minerals - concrete, brick and plaster is not given enough attention, despite the fact that the biodegradation of design and decorative materials of civil and industrial buildings and structures in modern conditions is becoming more common. Thus the protection of building structures from biological damage is of practical interest.

The scientific literature on the corrosion of building materials [1-4] shows that microorganisms trigger processes of biodeterioration through their waste products (acids, alkalis, enzymes and other aggressive substances), which interact with the substances belonging to the building materials, destroying the binder solution, brick, rock (stone building), concrete, metal and other building elements. The list of exuded acids is rather extensive: from heavy mineral (sulfuric and nitric) to polyatomic organic (humic acid, pyruvic acid). Structurally simpler organic acids are isolated: acetic, lactic, propionic, tartaric, oxalic, fumaric, malic, citric, and etc. Active acid formation is indicated by the pH on the surface of the building material when investigated.

It was found [1] that the most aggressive towards concrete are nitrifying and thionic bacteria which during the life emit such strong acids as nitric and sulfuric. Under their exposure the protective film of calcium carbonate formed on the surface during the hardening of concrete is destroyed. It is the film that prevents the leaching of calcium hydroxide.

According to the results of the studies performed by G.Y. Drozd [5], the resistance of the concrete is increased with the decrease in permeability (pore size). The penetration of bacteria, whose size is mainly composed of 0.5 - 20 microns, in pore diameter of less than 30 microns is difficult. The thiobacteria size is about 1 micron. Further away from the surface of the concrete the number of aerobic bacteria is decreased more than the number of anaerobic ones.

To eliminate or ensure the destruction of biological pests in infested buildings and structures there are different disinfection technologies. To depress livelihood of thiobacteria it is possible through the usage of biocide additives. The tests carried out in the paper [5] has shown that certain additives - biocides slow down to some extent the destruction of the concrete. However, it was concluded that the tested biocide concrete is not enough resistant to highly aggressive gaseous medium reservoir.

In CRCRI laboratory tests of concrete treated with Penetron were performed [6]. The components of Penetron infiltrate into the concrete and cause in the pores and capillaries the growth of crystals, creating so-called "crystallization obstruction", reducing the permeability of concrete. The concrete treated with Penetron in the initial period had increased the resistance to sulfuric acid solutions. After 6 months of testing concrete samples had minor damages in the reservoir. After 12 months of testing the destruction of protective layers gets started. And bare concrete was extensively breaking down. It is concluded that the Penetron coating applied to the surface of the concrete, only temporarily slows down the process of destruction of concrete in a gaseous environment highly aggressive sewer. The author of the work [6] suggested that in the sewers with slightly and moderately aggressive gas media the material can be useful.

The most commonly used ways to combat the corrosion bio mineral building materials are the chlorine-containing surface treatment compositions designs, a high concentration of ozone in gaseous form, as an aqueous solution or an aerosol or anode gel electrode obtainable by the decomposition of water by a constant electric current [7].

The invention [8] suggests a composition containing liquid chlorine, water and limiting monohydric alcohol with carbon number of 2 or 3, such as ethyl, propyl or isopropyl alcohol. The introduction of alcohol in the composition reduces aggressive effects of chlorine on the surface, which allows the usage of the composition for various types of non-metallic surfaces, such as wood, stone, concrete and plastered surfaces and building brick surface.

Among the many varieties of biocides the most commonly used additives are such as a tsetazol, pentachlorophenol sodium and trilan for plaster compositions. To protect a normal cement floor it is mainly used biocides such as copper powder or magnesium oxychloride, which are reasonably efficient. Normal formalin and a salt of fatty amines or hlorgidrataminoparafina are used to protect concrete products from bacterial dangerous action [7].

Very popular inorganic biocides, such as boric acid, sodium nitrite, salt, acid and salt silicofluorides hydrofluoric acid are used as an additive in concrete mix. Such protective special modifiers as borax and boric acid, copper salts and arsenious acid are used less frequently, as they quickly lose their properties. Different organotin compounds have more efficiency and durability as they retain their unique bioprotective properties long enough [5].

To protect concrete, that is under strong influence of industrial and domestic wastewater it is used cationic surfactants "Katamin" and "Katapin" that are durable and efficient. "Katapin" is used most frequently in the construction of bakeries, breweries, as well as medical facilities [7] .

According to the regulatory documents of the Republic of Belarus TCP 45-5.09-33-2006 [9] and STB 1416-2003 [10] the surface protection structures is provided by paint; gluing insulation; lubricative and plasters based on cement and polymer binders, water glass and bitumen; lining of ceramics, glass, stone and concrete impregnation fluids of: organosilicon compounds; natural and synthetic resins; salts of fatty amines; inorganic compounds.

Meanwhile, a wide range of materials for corrosion protection of mineral substrates is apparent and very limited, due to the high cost of some of the methods and materials of high risk in the use and exploitation of man and the environment of others, narrow biocidal spectrum and a rapid loss of bactericidal efficiency during the operation of building structures. Therefore, the actual problem is the development in the construction of durable, affordable and environmentally friendly means of protection against biological damage of constructions.

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