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The cause of occurrence of microorganisms in civil engineering and the dangers associated with their growth

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Abstract

The paper is focused on degradation caused by microorganisms, a process called biodegradation, and on risks for human health caused by them. Bacteria and algae are the primary microorganisms on external building surfaces. These pioneer microorganisms have an enriched space of organic carbon, which is necessary for the growth of any subsequent microorganism which is often mold. Biodegradation is a synergic process of chemical reactions (chemical biodegradation) and physical effects of microbial bodies on building materials (biophysical degradation). The paper is a summary of the current state of art and knowledge in the field of biodegradation.

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Keywords: Biodegradation; bacteria; mold; algae; wholesomeness; toxins; Sick Building Syndrome

1. Introduction

Man has been a part of nature and the ecosystem since the beginning of its development. His creations like buildings as well as many other of his products and inventions are surrounded by plants, animals and the wider environment. All these systems influence each other. Also with buildings and organisms these occur in their immediate vicinity or directly on their surface. This problem, in addition to the steadily increasing flood of new information and media reports, involves not only new buildings, but also historical buildings or their remaining parts.

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Microbial metabolites are released into the external environment and these products react with building materials. The new products of those reaction have different water solubility, but mostly there are more water-soluble compounds then before. Physical biodegradation is divided into physical stress (caused by expansion and shrinking of microorganisms´ bodies and cells), abrasion effect, the frost cycle which is connected to retention and drying water through the microorganism. The microorganisms release biotoxins for their own protection but the toxins contribute to a health risk for immune-deficient people e.g. with asthma, allergy, kids etc. A final important point is that microorganisms contribute to Sick Building Syndrome (SBS).

Building materials are damaged by physical and chemical processes in general as has been mentioned. These processes may be the result of weathering, environmental pollution, rising water containing salt dissolved therein, but also through inappropriate building interventions, wrong selection of materials or any of their components, or by bad technological processing. Given that building materials are often heterogeneous systems, it is important to monitor not only damage to the material as a whole, but also damage to its components. Generally the degradation of materials divides into the following groups:

- Physical degradation

Part of the physical degradation going on are such conditions in which the material is subjected to various forces and pressures (inside and outside), which are detrimental to its physical structure. Formation of these forces is often related to variations in temperature, exposure to water and aqueous salt solutions, the formation of new minerals, mechanical vibrations and surface abrasion.

- Chemical degradation

This category includes instances during which the chemical composition of the material is altered, or maybe some of its components, by reaction with the environment (water with pollutants from the atmosphere or from the capillary water, the metabolic products of living organisms, inappropriate conservation work, etc.). The result of the ongoing chemical corrosion is usually a color change or volume change primarily, but also either an increase or decrease in the solubility of the contested folder.

- Biological degradation (biodegradation, biocorrosion)

This term includes degradation processes induced or conditioned by action of living organisms. Their action, however, is essentially manifested as physical degradation (e.g. ingrowth of roots or fungal fibers into a substrate) or chemical corrosion (dissolution of the substrate e.g. "lichen" acids, etc.). This means formation pressures acting on the material or chemical transformation of some of the components [1].

The field of biocorrosion of technical materials originated as a discipline in the fourth decade of the twentieth century, and during the war in Southeast Asia. It was then that there was probably first observed the failure of military technology in environmentally humid tropics, demonstrably caused by microorganisms [2]. Bio-corrosion means any change in the properties of technical materials caused by life activities of organisms, wherein bio-corrosion can act such as microbes, insects, rodents, birds, but also humans [3].

There is a connection of active agents - biodetergents and passive agents – of material in the process of corrosion, which may (but need not) be a substrate for microorganism. With the system of bio-detergents, the material is open and the inanimate material is not able to defend this attack on its own. The interaction of biodeteriogens and material are typical of various forms of bio-deterioration [4].

A simple form of interaction begins already with straightforward settlement of technical products by communities of microorganisms. The practical effects of this interaction are changes to materials: functional (mechanical, electrical, optical, chemical) and morphological (color stains, pulverization, fibrillation). At the start and during the biocorrosion process, there are relevant not only the environmental conditions (macroclimate) but also these conditions are immediately in a contact involving biodeteriogen versus material.

While macroclimate affects the existence of a biodeteriogen in a given environment, microclimate (especially optimal temperature and humidity) may affect which biodeteriogen will attack the materials [5,6].

Nowadays building materials (e.g. sandstone, marble, limestone, igneous and metamorphic rocks but also carbonated concrete) are very good substrates for a variety of microorganisms, which can grow very well in the case