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Influence of salting mineral materials on the development of fungi

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Abstract

In this paper presents the effects of the combined action of two aggressive environments. Then determine the effect of the content of sulphate ions or chloride on the growth of microorganisms and the possible impact of chemical-biological corrosion properties of moisture, mechanical structure of the ceramic materials.

To assess changes in the samples as a result of corrosion-induced chemical and fungi, the following parameters were selected: a chemical analysis, the goal was to determine the content of sulphate ions or chloride; pH; colony-forming units; mass moisture and absorbability of water, and research on the microstructure under the scanning electron microscope.

The results allowed to formulate a number of statements: ceramic materials are resistant to mould; original ceramic salt contamination of chloride ions or sulphate did not stop the operation of the biological environment; by the co-operation of both aggressive environments, material properties change.

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Keywords: ceramics- brick; mould fungi; $MgSO_4$;NaCl; absorbability of water; mass moisture

1. Introduction

An effect of aggressive external environment on the durability of potsherd is connected with easily soluble sulphate and chloride salts. The related literature review, including such author as Baszkiewicz and Kamiński [1] as well as Stryszewska and Kańka [2] allows one to conclude that the presence of soluble salts containing chloride and sulphate ions leads finally to brick deterioration. Except, of the problem of masonry salinity and moistness an

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effect of microorganisms on mineral building materials is also of great importance.

In mineral materials such as brick, concrete or mortar microorganisms (bacteria, mould fungi, algae) cause slow corrosion, i.e. biological corrosion or biodegradation. The susceptibility of given material to colonisation by microorganisms relies on its specific properties. This has been defined as bioreceptivity (susceptibility to biological colonisation) by Guillite [3]. This paper presents the division into the following three groups: primary bioreceptivity caused by internal material structure; secondary bioreceptivity resulting from features of the material altered by chemical and physical factors; and tertialy bioreceptivity that is a subject to biological colonization of man modified materials (e.g. after using preservatives, conservation).

Cording to Caneva et al. [4] biodeterioration manifests by increased moisture content, stains (discolorations) and mineral salt efflorescences. There are various effects of fungal activity depending on material type, e.g. a lime bonding agent loses its effect, while concrete, mortar or brick crush due to washing out of acid calcium carbonate. This results from the reaction of calcium carbonate with carbon dioxide (formed by fungi in metabolic processes). In addition, fungi produce organic acids, and as reported by May et al. [5] and McCauley [6], its compounds with calcium salts cause the deterioration of building mineral materials. There is a scanty literature on biodegradation of ceramic materials. Only a few papers, e.g. Chee et al. [7] and Gottenbos et al. [8] deal with strictly fungal activity on bricks. The available literature, for example Tiano et al. [9] shows that the pH can inhibit microbial growth on ceramic substrates. Although, ceramic materials should be insensitive to microorganism activity, biological colonisation depends strongly on environmental conditions and even less sensitive to biosensitive surfaces are easily colonised. However, which content of soluble salts causing material destruction effects material susceptibility to subsequent action of microbiological activity (mould hype fungi are specified in the literature. A subsequent action, also defined in the paper of Fiertak and Stanaszek-Tomal [10], occurs when the reactions in which the products (effects) resulting from the action of salts become substrates (causes) for the activity of fungi. The effects of salts and then mould fungi were observed.

Therefore, the aim of this study was to trace effect of two environments, i.e. chemical and microbiological ones and then the determination of effect of the content of sulphate or chloride ions on microbial growth and possible impact of chemical and microbial corrosion on ceramic material moisture properties and microstructure.

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Nomenclature

H_2O	the samples contaminated of water.
$MgSO_4$	the samples contaminated of $MgSO_4$
NaCl	the samples contaminated of NaCl
uncont.	the samples nothing contaminated / reference residing in laboratory conditions
SO_4/uncont.	the samples contaminated with $MgSO_4$, residing in the climatic chamber conditions.
SO_4-P.ch	the samples were first contaminated $MgSO_4$ and then *Penicillium* fungi
SO_4-C.h.	the samples were first contaminated $MgSO_4$ and then *Cladosporium* fungi
Cl/uncont.	the samples contaminated with NaCl, residing in the climatic chamber conditions.
Cl-P.ch.	the samples were first contaminated NaCl and then *Penicillium* fungi
Cl-C.h.	the samples were first contaminated NaCl and then *Cladosporium* fungi

2. Methods and materials

2.1. Choice of a corrosive environment

When selecting chemical corrosion environment the papers showing a significant effect of salt solutions containing sulphate or chloride ions on mineral material properties were taken into account.