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Chemical composition influence of cement based mortars on algal biofouling

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The main cause of building-facade biodegradation is the growth of microorganisms. This phenomenon depends on several parameters such as the geographical situation, the environmental conditions and the surface state of the substrate. Several researches have been devoted to the study of the effect of porosity and roughness on the biofouling of stones and mortars. However, none of them have addressed the influence of the mortar chemistry on the microorganism growth kinetic. The main objective of this study is to highlight the influence of the mortar chemistry in relationship with its physical properties on biological weathering. Earlier work showed a good resistance of Calcium Aluminate Cements to biodeterioration by acidogenic bacteria (Thiobacillus) and fungi (Alternaria alternata, Aspergillus Niger and Coniosporium uncinatum). In order to characterize the influence of the mortar chemistry on biofouling, two Portland cements and two alumina cements are used. Among micro-organisms able to grow, green algae are most involved in the aesthetic deterioration of facades. Indeed, they can colonize any type of media and can be a source of nutrients for other micro-organisms such as fungi. The green algae Klebsormidium flaccidum is chosen because of its representativeness. It is indeed the species the most frequently identified and isolated from samples taken on sites. The biofouling kinetic is followed on samples exposed outdoor and on samples tested in a laboratory bench which consists in spraying an algae culture on mortar specimens. The results obtained by in situ trials are compared with the results obtained on the laboratory bench. The microorganism growth kinetic is measured by image analysis. To improve the detection of algae on the surface of the cementitious samples, the raw image is converted in the YIQ color space. Y, I and Q correspond respectively to luminance, in-phase, and quadrature. On the Q channel, the areas covered by algae and the areas of clean mortar are easily distinguished. A threshold in graylevel allows to segment the image and to quantify the surface colonized by algae. The conversion process differentiates algal patches from dark slots caused by the rough relief. The covering rate depending on time is given by the ratio of colonized area to total surface. This experimental method proves that pH and roughness are determining in the biofouling mechanism.