Geophysical Research Abstracts, Vol. 9, 00303, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00303

The contribution of biofilms in concrete weathering: bioreceptivity of mortars and cement paste in natural fresh water

S. Roux, F. Feugeas, A. Cornet

Institut National des Sciences Appliquées, LGECO – GLISS, Strasbourg, France

sebastien.roux@insa-strasbourg.fr / Phone: + 33 (0)3 88 14 47 26

francoise.feugeas@insa-strasbourg.fr / Phone: + 33 (0)3 88 14 47 26

alain.cornet@insa-strasbourg.fr / Phone: + 33 (0)3 88 14 39

Concrete, artificial building material principally made of cement, aggregate, water and various admixtures, is sensitive to weathering which leads to an alteration of the material properties over time. Bioalteration is part of the weathering process: concrete is altered by microorganisms that form a layer called a biofilm on its surface. Although the development of the biofilm can be considered as normal due to the fact that it is a natural process for every element in contact with microorganisms, it can induce an alteration, such as biological stains on concrete facing, or a degradation of the material. A biofilm does not systematically induce bioalteration; but any bioalteration is necessarily due to a biofilm. The literature dealing with the interactions between concrete and biological elements is mainly composed of articles about the biodegradation of concrete in very aggressive environments such as those found in sewers. These studies highlight the fact that concrete degradation and biodegradation are affected by many parameters linked to:

- the material and its parameters such as porosity, roughness, composition, implementation,
- the environment, its physicochemical properties,
- microorganisms present in the environment.

The aim of this study is to highlight the effect of three cement-base compositions (recommended by standards and cement manufacturers for building foundations in chemically aggressive environments) on the bioreceptivity of hardened cement pastes in contact with natural ground water table. The bioreceptivity of three hardened cement pastes have been studied: CEM I 42.5 R CE CPS, CEM III/C 32.5 N CE PM-ES and CEM V/A (S-V) 32.5 N CE PM-ES CP1 (water/cement ratio: 0.4). Tests have been conducted in the natural medium and in four laboratory media made with the natural water: one medium favourable to the global flora (general medium), and three selective media respectively favourable to the growth of sulphato-reducing bacteria (SRB), thiosulphato-reducing bacteria (TRB) and sulphur-oxidizing bacteria (SOB).

In this ground water, the presence of SRB, TRB and SOB have been confirmed by selective culture on Petri dishes. The Low Vacuum SEM observations of CEM I standardised mortars samples immersed for three years in the ground water table showed the presence of discrete deposits randomly located on the surface of the material. After a one-year immersion in the ground water table, all the hardened cement paste samples were colonized by SOB. The laboratory tests made in the natural medium showed that the BTR colonization on the samples surface is the most important one whatever the cement composition of the cement pastes. The laboratory tests carried out in four laboratory liquid media highlighted the importance of the opened porosities and of some specific topography areas, such as cracks, for the bioreceptivity of the material. The study of the samples immersed in the general medium shows that the opened porosities are often more colonized than the remainder surface. The analyses of the sample immersed in the three other laboratory media (for TRB, SRB and SOB) showed that the cracks, spall or badly polished areas also present important microorganisms' colonization.