Geophysical Research Abstracts, Vol. 9, 03422, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03422

DEVELOPMENT OF A GROWTH MEDIUM ADAPTED TO THE STUDY OF THE BIODETERIORATION OF THE REINFORCED CONCRETE BY *Acidithiobacillus thiooxidans*

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This study is part of a project aiming to better understand the mechanisms of biodeterioration of reinforced concrete pipes of the sewerage system by bacteria of genus *Acidithiobacillus*. Indeed, once the concrete had been leached and consequently had lowered its pH, it can be subjected to the microorganisms colonization, which is likely to amplify the concrete deterioration. In aerobic conditions, sulfo-oxidizing bacteria are able to colonize the concrete surface thanks to the conditions of medium (sulphur sources, oxygen, moisture, pH), that are favorable to their growth. These bacteria are able to metabolize the sulphur compounds (SO_3^{2-}, S^0, S^{2-}, $S_2O_3^{2-}$,...) in sulphuric acid, which is very aggressive and responsible to the degradation of concrete. On the other hand, if some laboratory tests are performed in order to reproduce the biodeterioration, it is essential to differentiate the effect of the growth medium relative to the bacterial effect. Indeed, commonly used growth mediums contain high concentrations of ions such as sulfate ions that are well known to be deleterious to concrete. Thus, the aim of this study is to develop a growth medium that has the lowest as possible effect on the concrete, in order to study the effect of *Acidithiobacillus thiooxidans* on the deterioration of the reinforced concrete.

The selected medium had to fulfill several requirements. It had in particular to allow an optimal growth of *Acidithiobacillus*, while avoiding deleterious interactions of the medium constituents with the concrete. Sulphates, for example, being responsible of concrete degradation by inducing ettringite formation, were replaced by chlo-

rides ions. The tested medium was constituted of all essential elements to the bacterial growth: a source of carbon and energy, a source of nitrogen and biogenic salts, such as phosphorus, magnesium, potassium and calcium. Like the concrete is a possible source of nutritive elements, only elements, which were absent of this last, were provided by the medium. Different tested mediums were inoculated with a suspension of *A. thiooxidans*. Tests were carried out in liquid medium under agitation to 30˚C in aerobic conditions. Bacterial growth was followed as a function of time by measurement of the optical density at a wavelength of 610 nm. The deterioration of concrete by the tested growth mediums was evaluated on simplified systems i.e. pure pastes leached by the medium. Evolution of the concrete mineralogy was analyzed by SEM EDS and the aqueous phase was analyzed by ICP AES to follow the release of trace and major elements by concrete. Finally, results of these two series of experiments enabled us to define a growth medium adapted to the study of the biodeterioration of the reinforced concrete by *Acidithiobacillus thiooxidans.*

Keywords: *Acidithiobacillus*, biodeterioration, reinforced concrete, growth medium