Accelerated Biological and Chemical Corrosion Tests for Construction and Repair Materials

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Abstract

Methods of simulating biological and chemical corrosion in construction and repair materials are being investigated. Preliminary studies showed that microbiologically active environments can be obtained by using selected medium for microorganism growth. The biogenic agents reduced the pH of cement concrete to below 8.5 within a period of 3 months. Test methods for chemical corrosion are also being investigated. Several centitious and polymeric materials are being investigated.

1. Introduction

Corrosion is a deleterious process that takes place via a physicochemical reaction between the material and its environment. Microbiologically influenced corrosion (MIC) may be defined as an electrochemical process where the participation of the microorganisms is able to initiate, facilitate, or accelerate the corrosion reaction without changing its electrochemical nature. Corrosion is a natural process that can attack not only organic but also inorganic materials and occur regardless of human needs. It is a great concern when materials are attacked and loose its quality and service duration. Overwhelming evidence indicates that corrosion is causing billions of dollars damage to economies worldwide every year, wasting large amount of natural resources and causing a great deal of human suffering. Hence, there is a need for developing a better understanding of this phenomenon.

2. Objective

The involvement of microorganisms in corrosion process has led to the question of how the biological agents affect the corrosion process and whether they are able to modify the electrochemical nature of the reaction. Thus, the overall objective of this study is to develop an accelerated corrosion testing method for construction and repair materials (cement concrete, polymer, polymer concrete, polyvinyl chloride, and polyethylene). Specific objectives are (1) to evaluate the corrosion caused by chemical and biogenic agents; (2) to investigate the role of microorganisms involved in the process of MIC; (3) to investigate the changes of mechanical and surface characteristics; and (4) to develop a corrosion measuring indicators.

3. Testing Program

Samples. The most common and popular construction and repair materials such as cement concrete, polymer, polymer concrete, PVC, and polyethylene are being used as test samples.

Testing environment. Studies are being conducted with soil, water and sewer to understand corrosion in various environments. Biologically active environments are being investigated by providing microorganisms with necessary carbon source and other salt medium.

Monitoring and analysis methods. Reactors are being monitored for changes in microbial activities and physico-chemical conditions. Microstructural analysis techniques such as XRD, SEM and Micro-probe are being utilized for elucidating the processes involved with MIC and for establishing relationships between microbial activity and corrosion.

4. Results

Change of pH and ORP. For microorganism active environment the ORP was in the range of -200 to -250 mv within three months. This reduced condition also resulted in lowering of the pH from about 11 to 8.5 in three months.

Change of physical appearance. Samples in the biologically active reactors showed a change in color and biofilm were also observed on the material surfaces.

5. Conclusions

(1) Laboratory tests to simulate corrosion is needed to better estimate the rates of corrosion under biologically and chemically active environments.

(2) Biologically active environment can be obtained by providing microorganisms with proper combination of carbon ource and salt medium. The acidic conditions reduced the pH from 11 to 8.5 in a period of 3 months.

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7. Reference

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