

Microbiological-Influenced Corrosion in Concrete Environments

Ini-Ibehe Nabuk Etim^{1,2,*}, Dong Junhua³, Xu Dake⁴, Ruiyong Zhang^{1,*}

¹Key Laboratory of Advanced Marine Materials, Key Laboratory of Marine Environmental Corrosion and Bio-fouling, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, 266071, China

²Marine Chemistry and Corrosion Research Group, Department of Marine Science, Akwa Ibom State University, P.M. B. 1167, Uyo, Nigeria

³Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, China

⁴School of Materials Science and Engineering, Northeastern University, Shenyang 110819, China

ini-ibeheetim@aksu.edu.ng

Abstract Evaluation of the effect of sulphate-reducing bacteria (SRB) on the corrosion of mild simulated concrete solution at pH 9.35 and reinforced concrete (RC) using sulphoaluminate cement was carried out. Mitigation measure was done using organic silicon quaternary ammonium salt (OSA). For mild alkaline simulated concrete pore solution at pH 9.35, four systems were used: Blank (STR), STR + OSA (Blank with OSA), With SRB only (STR + SRB) and With SRB and OSA (STR + SRB + OSA). For the sulphoaluminate cement, three different systems were employed for this study: RC with sterilized NaCl (CS), RC with sterilized NaCl and SRB (CS-1), and RC with sterilized NaCl, SRB and OSA (CS-2). The 28-days SRB growth showed optimized number of sessile cells in the early immersion periods but reduced with extending the time. Consequently, the sessile cells induced the breakdown of the passive film through metabolic reactions of SRB. The corrosion resistance reflected by surface morphologies and electrochemical analysis showed that corrosion rate was higher in media containing SRB compared to media without SRB. The proposed mitigation mechanism shows that the silicate component of the OSA prevent the formation of biofilm while the ammonium component reduces the metabolic activities of SRB.

Keywords Simulated concrete pore solution; Steel reinforced concrete; Microbial corrosion; Biocide.