ON THE ACID RESISTANCE OF ALKALI-ACTIVATED CEMENTS: WHAT ROLE DOES MAGNESIUM PLAY?

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Key Words: Microbial-induced concrete corrosion (MICC), acid degradation, alkali-activated cements, electron microprobe analysis.

Sewer infrastructure worldwide is being affected by microbial-induced concrete corrosion (MICC). This major durability challenge occurs when biogenic sulfuric acid, produced within sewer environments, deteriorates ordinary portland cement (OPC) concrete. While acid-resistant alkali-activated cement (AAC) concrete is a proposed potential solution to this pervasive challenge, all factors contributing to acid resistance are not fully understood. This work addresses current gaps in knowledge by elucidating the role of magnesium on the acid resistance of AACs. A central composite experimental design was utilized to evaluate the effect of (1) silica content, (2) sodium content, and (3) the presence of a magnesium mineral addition on the structure (i.e., mineralogy) and properties (i.e., porosity, acid resistance) of AACs. The mineralogy, porosity, and acid resistance of AACs were explored via X-ray diffraction, ethanol vacuum-intrusion, and electron microprobe analysis, respectively. Results demonstrate that addition of unreacted magnesium minerals yields a decrease in porosity and a decrease in the amount of leached silicon and aluminum during acid exposure, leading to an overall improvement in acid resistance. Furthermore, statistical analysis of experimental data enabled construction of surface response models that aid in prediction of acid resistance. The results presented from this study permit a greater understanding of the acid resistance of AACs and enhance their value as a potential solution to MICC.