

Element Losses from Cement Paste in Acidic Environment

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Abstract

This study investigated the corrosion of cement paste in hydrochloric acid. Tests were performed to estimate the leaching of elements such as calcium during the chemical attack by hydrochloric acid (1% and 3%) on pure cement paste. Elements leached from cement paste during immersion were measured using atomic absorption spectroscopy. Weight loss of the specimen occurred and elements in the solution by leaching from the specimen increased with immersion time. Visual observation showed the pattern cracks resulting from the volume change of the specimen.

Introduction

Acidic environment caused by industrial wastes or chemical residues in the ground could influence the durability of the Portland cement concrete. When the cement binder in the concrete is exposed to an acid, the corrosion process starts. During the acid attack the elements leached from the cement paste has not been quantified. It is important to take into account the chemical and physical mechanisms that occur on the cement paste during exposing to an aggressive environmental condition. The chemical analysis of the cement paste resulting from the attack of the paste with hydrochloric acid help us to know the chemical mechanisms of corrosion process in acid attack.

Objective

The objectives of this study are (1) to investigate the corrosion of cement paste in hydrochloric acid by monitoring the weight change of the specimen and (2) to investigate the elements leached from the cement paste during the acid attack.

Testing Program

A total of 30 cylindrical specimens of $f'_{c} = 3.5$ inches with W/C ratio of 0.4 cured in moist environment for 28 days before testing. Ordinary Portland cement was used for all the specimens. Specimens were fully immersed in de-ionized water, 1% and 3% hydrochloric acid solutions in plastic jars. The solutions were replaced everyday with fresh ones and the constant pH was maintained. This procedure provided an accelerated simulation of the acid attack on cement pastes. Each specimen was removed from the jars, cleaned thoroughly, inspected and weighed. Each solution was corrected and the atomic absorption test was performed to measure the leached elements.

Results and Discussion

All specimens in the acid solution showed "pattern crack" type resulting from the volume change in the specimen. During the leaching period notable weight loss occurred in samples in 3% and 1% acid solution. Highest weight loss was measured in 3% solution (Fig 1.). Using atomic absorption spectroscopy (AAS), ionic concentrations of calcium, silica, and aluminum were determined (Fig 2. & 3.).

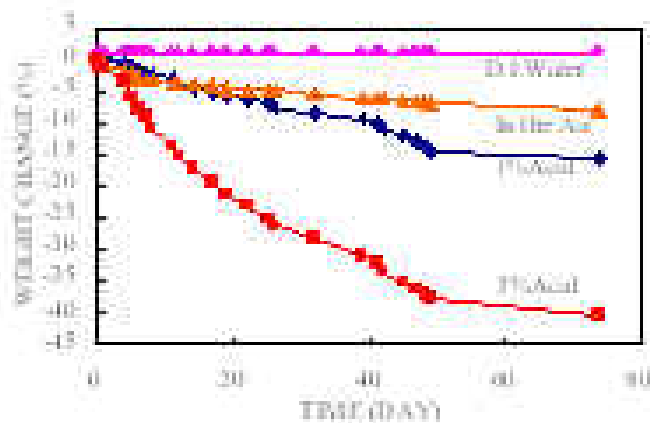


FIG. 1. WEIGHT LOSS OF CEMENT PASTE

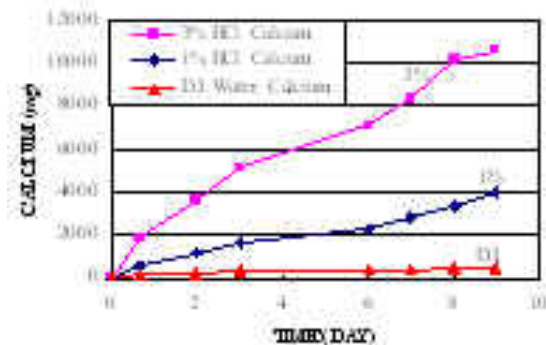


FIG. 2. LEACHING OF Ca, OH, AND Cl

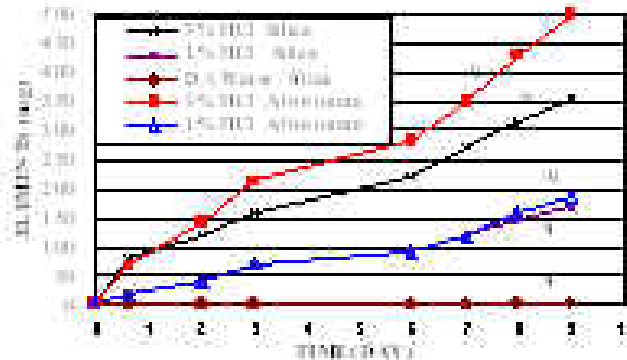


FIG. 3. LEACHING OF SILICA AND ALUMINUM

Conclusion

The following conclusions can be advanced based on the test results of this study:

1. Due to acid attack, pattern cracking occurred on the surface of the cement paste within 12 hours of immersion.
2. Significant weight loss was observed during the test period.
3. The amount of element leached from the specimen due to acid attack was quantified.

Acknowledgment

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References

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If you have any questions, please contact [Dr. C.Vipulanandan](#)
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