

Characterization of Chemical Resistance of Auger Grouts

Yinan Weng and C. Vipulanandan

Department of Civil and Environmental Engineering

University of Houston, Houston TX 77204-4791

Phone: 713-743-4291 E-mail: yweng2@bayou.uh.edu

Abstract

Chemical resistance of auger grouts . Field samples were collected and cured for 28 days in moist environment and tested in different chemical solutions . Chemical solutions used were Hydrochloric acid (HCl), Sulfuric acid (H₂SO₄) at a pH of 2 and 4; and Sodium chloride (NaCl), Sodium sulfate (Na₂SO₄) at a concentration of 0.5% and 2%. Control tests were performed with potable water. Three parameters were studied; (1) change in weight (2) Leaching of calcium (3) pulse velocity. . An increase in weight was observed in most cases compared to tap water . A maximum of 3.9% weight gain were observed with 2% NaCl , and a decrease in weight was observed in the case of H₂SO₄ at a pH of 2, Na₂SO₄ at a conc. of 0.5% and 2%, with a maximum decrease of 4.2% for H₂SO₄ at a pH of 2 and Na₂SO₄ at a conc. of 0.5%. Deterioration of the specimens was accelerated by the presence of ions, the sulfate ion had much worse influence than chloride ion . There is an increase in calcium leaching with time, maximum leaching was observed in H₂SO₄ environment at a pH of 2, in a period of ten months. The pulse velocity was 4100 m/s and was constant with time .

1. Introduction

Piles deep in the ground can be exposed to various kinds of chemical environments , the reactions between them leads to the premature degradation of the structure . HCl (pH = 4) , H₂SO₄ (pH = 4) , NaCl (0.5%) and Na₂SO₄ (0.5%) were chosen to simulate the natural surroundings, whereas HCl (pH = 2) , H₂SO₄ (pH = 2) NaCl (2%) and Na₂SO₄ (2%) were chosen to accelerate the chemical reaction speed.

2. Testing program

The grouts specimens are rich in cement and fly ash , they were taken from the different depth of the auger cast piles and casted to 3" by 6" cylinders , after 28 days standard moisture room curing , they were immersed into a selected test reagents (prepared by deionized water to full the height in a closed plastic bottle)so that the specimens are exposed to the chemical reagent liquid phase . In this test, 76 mm (3-inch) x 152 mm (6-inch) cylindrical cement grouts specimens were used. Specimens were prepared by different depth of field casted piles . 1) Leaching of calcium (2) weight change (3) pulse velocity . Four test reagents selected for this study are (1) HCl (pH = 2 and 4); (2) H₂SO₄ (pH = 2 and 4) ; (3) NaCl (0.5% and 2%) and (4)Na₂SO₄ (0.5% and 2%) , Control tests were performed with Tap water. Total of 25 specimens were tested under these conditions

3. Results

There is an increase in weight (Figure 1.) in the case of HCl (pH = 2, pH = 4) H₂SO₄ (pH = 4), 0.5% NaCl , 2% NaCl compared to tap water, whereas in the case of H₂SO₄ (pH = 2) and 0.5% Na₂SO₄, 2% Na₂SO₄ there is decrease in the weight with time.

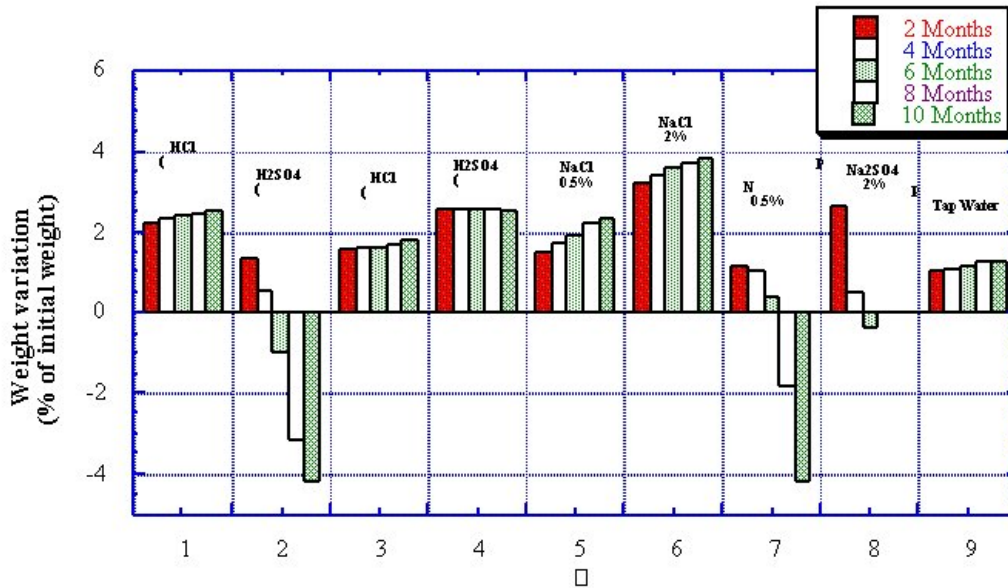


Fig. 1-- The weight change vs time of the Auger grouts specimens

Maximum weight gain of 3.9% was observed in the case of 2% NaCl, whereas there was 4.2% weight loss in the case of H₂SO₄ (pH = 2) and 0.5% Na₂SO₄. In 2% Na₂SO₄ three specimens failed in 8-10 months by breaking into two equal parts. That shows all the ions accelerate deterioration of the grout specimens, and the sulfate ion has much more influence than chloride ion.

In all the cases, there is an increase in calcium leaching with time, maximum of 0.6% (Based on the weight of specimens) or 6.7% (Based on the total calcium mass in the specimens) of the calcium leached out in the first ten months was observed in the case of H₂SO₄ (pH = 2). The leaching of calcium in H₂SO₄ is much more than in HCl medium, especially while the concentration is high, whereas the calcium leached out in NaCl is more than in Na₂SO₄ medium, especially while the concentration of the media is low.

The pulse velocity of the auger cast grouts was approximately 4100 m/s (13451 ft/s), the coefficient of variance was 2%. The pulse velocity did not change in ten months except for those failed specimens which were immersed in Na₂SO₄ media; they were about 3000 m/s after brake down.

4. Conclusion

1. All the ions accelerated the deterioration of the grout specimens, and the sulfate ion had much more influence than chloride ion.
2. Calcium leaching increases with time, maximum of 0.6% of the calcium of the weight (6.7% of total calcium) leached in the first eight months was observed in H₂SO₄ (pH = 2).
3. The pulse velocity of the auger cast grouts was approximately 4100 m/s, it remains unchanged in the first ten months except for those specimens that failed.

5. References

Anik Delagrave, Michael Pigeon, Jacques Marchand and Eliane Revertegat, Influence of chloride ions and pH level on the durability of high performance cement pastes (Part II), Cement and Concrete Research, Vol. 26, No. 5, pp. 749-760 (1996).