Epoxy Coatings for Clay Brick Facilities

Jie Liu and C. Vipulanandan
Center for Innovative Grouting Materials and Technology (CIGMAT)
Department of Civil and Environmental Department
University of Houston, Houston , TX , 77204-4003
Tel: (713) 743-4291 E-mail Address: jliu5@mail.uh.edu

Abstract

The performance of two epoxy-based coatings on dry and wet clay bricks was evaluated using a combination of bonding and chemical resistant tests. The test results showed that the bonding strength of epoxy coatings depended on the dry and wet conditions of the clay brick surfaces. The coating films effectively reduced the liquid uptake of the coated clay bricks. There were no direct relationships between bonding strength and chemical resistant properties for the tested coatings.

Introduction

Many municipalities are discovering the structures in the wastewater collection and treatment facilities are subjected to microbial induced deterioration and the cementitious components are degrading rapidly[1]. In most cases, the pH on the sewer is less than 1 (in the worst case, the pH is 0.5) [2]. Although clay brick is a non-reactive material, bricks are held together by cement mortar and coatings are used to protect the facilities; hence, the performance of coatings on clay brick must be investigated.

Materials

Two different epoxy Coatings were selected and tested. The physical properties of the tested coatings are summarized in Table 1.

Table 1 Properties of the Epoxy Coatings

Coating Material	Density kg/m^3	Pulse Velocity (m/s)	Hardness		Thickness mm	Application Condition
			Barcol	Shore		
Epoxy 1	1680	2829	35-42	70	3.2	dry and wet surfaces
Epoxy 2	1530	2730	36-40	73	1.5	dry and wet surfaces

Testing Program

Bonding Strength

The bonding strength between clay bricks and coating materials was measured over a period of 3 years. The specimens were cured under water up to the time of testing. CIGMAT CT-2 (modified ASTM D 4541) was used to determine the bonding strength.

Holiday Test Chemical Resistance (CIGMAT CT 1-modified ASTM G 20)

In this test, 51 mm (2-inch) x 76 mm (3-inch) x 152 mm (6-inch) clay brick specimens were used. Dry and wet specimens were coated on all sides and tested. The test reagents selected for this study were (1) deionized (DI) water (pH = 5 to 6), and (2) 3% sulfuric acid solution (pH = 0.45; representing the worst reported condition in the wastewater system).

Results and Discussion

Bonding Strength

Based on the bonding tests (Figs. 1 (a) and (b)), Epoxy 1 initially had a very high bonding strength on the dry clay brick surface and the failure was Type 1 where the clay bricks failed. After a certain time of immersion, the bonding strength of Epoxy 1 on the surface of dry clay bricks decreased and the failure type also changed from Type 1 to Type 3 (bonding failure). On the other hand, Epoxy 1 on the surface of wet clay bricks had low bonding strength on the wet clay brick surface initially and the failure type was Type 3. Epoxy 1 gradually developed the bonding strength and the failure types changed from Type 3 to Type 1 and Type 2. The results indicated that the substrate conditions affected the performance of the Epoxy 1 coating. Epoxy 2 had a good bonding strength to both dry and wet clay brick surfaces during the testing period.

Chemical Resistance

From Fig. 2 (a), the weight increase was 4.6% for Epoxy 1 coated specimens after six years of immersion and was 3.5% for Epoxy 2 coated specimens after three years of immersion. Epoxy 1 and Epoxy 2 coated wet clay brick also had less weight increases than Epoxy 1 and Epoxy 2 coated dry clay brick in D. I. water. The weight increase was 2.5% for Epoxy 1 coated wet specimens after six years of immersion and was 1.6% for Epoxy 2 coated wet specimens after three years of immersion. The weight increases of the coated clay bricks in 3% sulfuric acid are shown in Fig. 2 (b). The weight increases for Epoxy 1 coated dry and wet clay bricks were 4.6% and 5.3% respectively after six years of immersion. Epoxy 2 coated dry and wet clay bricks had different performances in 3% sulfuric acid. Epoxy 2 coated dry clay brick had 0.36% weight increase in three years of immersion while Epoxy coated wet clay brick had 6.8% weight increase in the same period. The results indicated that the surface conditions may affect the chemical resistance of Epoxy 2 film when immersed in acidic solutions.

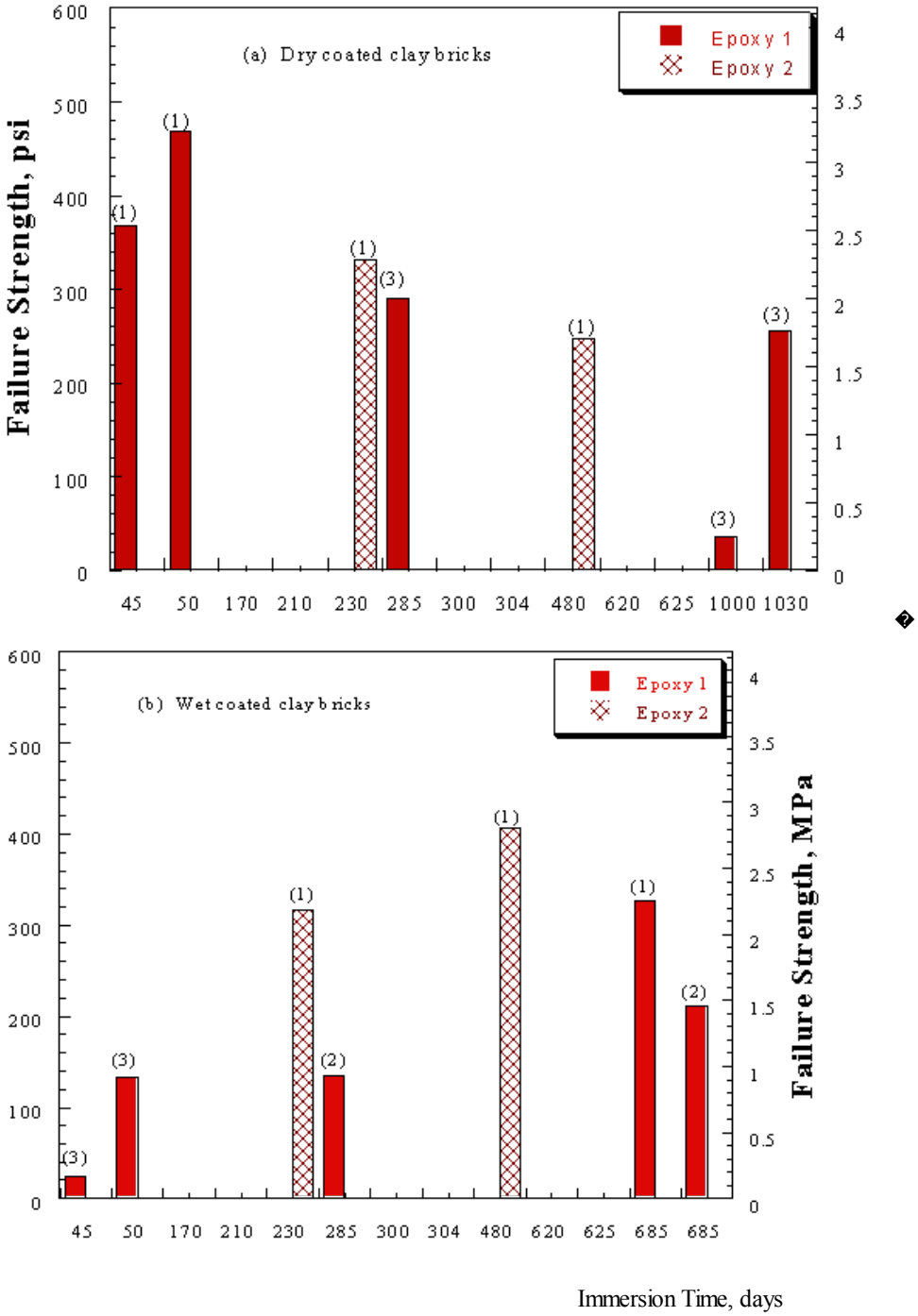

Figure 1 Bonding Test Results from CIGMAT CT-2

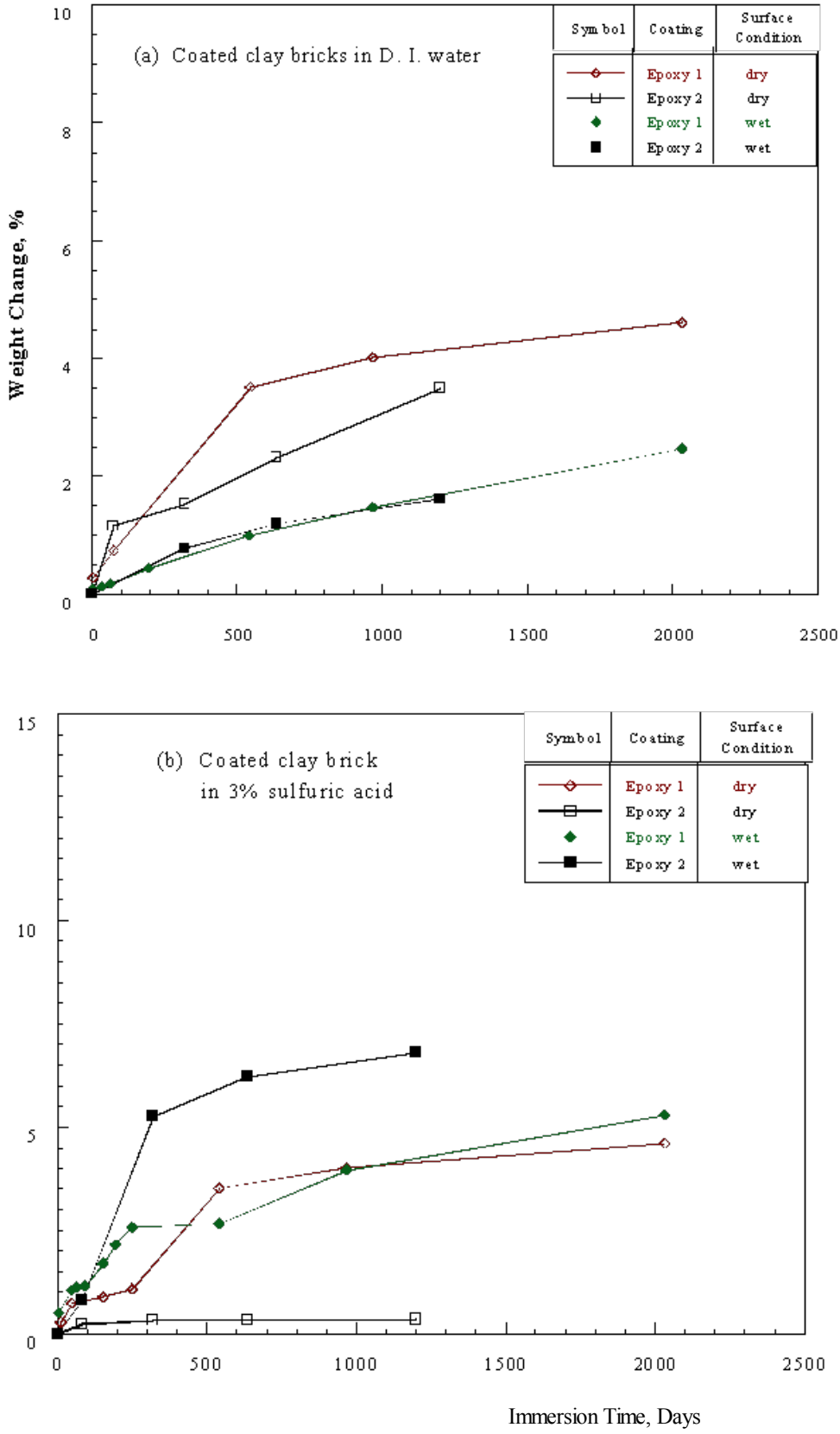

Figure 2 Weight Changes of Coated Clay Bricks in D.I. Water and 3% Sulfuric Acid

Conclusions

In general, epoxy coatings have good bonding strength with clay bricks and the type of failure changed with time. The coated clay bricks only had less than 10% weight gain in six years of immersion in D. I. water and 3% sulfuric acid while the uncoated clay bricks showed more than 20% weight increase in 50 days under the same immersion conditions. There were no direct correlations between the bonding strength of the coatings to clay bricks and the weight gain of the coated clay bricks.

Acknowledgement

This project was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT) under grants from the City of Houston, National Science Foundation (CMS-9526094, CMS-9634685), and various industries.

References

1. John B. Soebbing, Ronald R. Journal of Protective Coatings and Linings (May, 1996), pp.54-64.
2. Robert L. Islander, Joseph S., Journal of Environmental Engineering, 117 (6), 1991, 751-770.

If you have any questions, please contact **Dr. C.Vipulanandan**