PERFORMANCE OF LAMINATED POLYMER COMPOSITES IN CHEMICAL ENVIRONMENTS

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Abstract

The effects of various chemicals on glass-mat reinforced polyester ******* representing the cured in place pipe used in sewer pipe were investigated. Tests were performed in accordance with ASTM C 581 standards. Three laminated composites with and without fillers were tested. The pH of the chemical solutions varied from 0.5 to 10. Changes in specimen appearance, cloudiness of solution, weight change, thickness, hardness, pulse velocity, flexural strength and elastic modulus were monitored at the end of specified time periods. A total of 128 flexural tests were performed during this period.
Test results from the initial 12-month period are presented.

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1. INTRODUCTION

Reinforced composite materials are becoming extremely popular as they offer outstanding mechanical properties, unique flexibility in design and ease of fabrication. In addition, these composites are lightweight; impact resistant and possess excellent fatigue strength. Hence, their performance in various aggressive media needs to be monitored.

City of Houston (COH) specification has established procedures to evaluate the chemical resistance of the resin used in cured-in*place pipes (CIPP). The test is to be conducted in accordance with ASTM C 581 standards. According to COH specifications, chemicals used should represent a pH range of 0.5 to 10 and the composite shall not produce more than 20% of the initial flexure properties (ASTM D790) for each test interval and an average loss of not more than 15% for a period of one year. Also, these test specimens shall not have more than 1.5% gain or loss in weight over a period of one year.

2. OBJECTIVES

The overall objective is to investigate the chemical resistance of glass mat laminated polyester composites. The specific objectives are:

1. To determine the chemical resistance of composites in H_2SO_4 (pH 0.5), NaOH solution (pH 10) and deionized water (pH 7)
2. To compare the performance of composites to specifications

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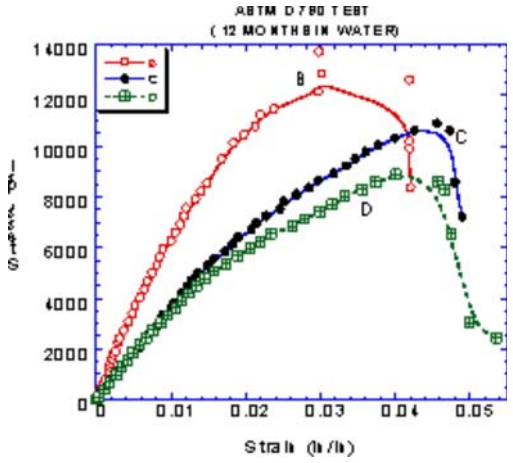
3. TESTING PROGRAM

Several physical and chemical properties were recorded at intervals of 1, 3, 6 and 12 months. At the end of each period, two plate specimens per testing condition were subjected to non-destructive testing and 8 strips were cut from the plates and tested in flexure.

4. CONCLUSIONS

1. The variation in weight gain/loss is very negligible (0.1g to 0.4g). Maximum weight gain of 3.6% was observed in Composite C @ 3 months immersion period in NaOH solution. The same composite suffered a weight loss of 4.6% at the end of 12 months.
2. Hardness ranged from 85-90. (Barcol Hardness). Water had minimum effect on the hardness of the composites.
3. Particulate filled composites showed a decrease in flexural strength by approximately 30%. An initial gain of 13% strength in composite C could be attributed to the relief of internal stresses, later followed by decrease due to interlaminar defects.
4. Composite B exhibited the maximum property retention based on performance evaluation test.



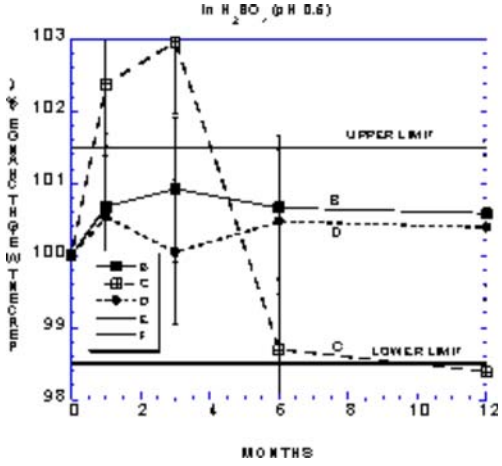


Fig 1: Stress vs Strain for composites Fig 2: Weight Change vs Time

5. ACKNOWLEDGEMENT

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6.REFERENCES

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