

Bonding strengths of grouts used for Leak Control in Concrete Repairs

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Abstract: The bonding strength of two commercially available grouts used for concrete repair was investigated using the CIGMAT CT 3-00 method. The grouts were sandwiched between pairs of rectangular concrete blocks and then tested for bonding strength and type of failure. Results from 6 months of wet-dry cycles were to simulate extreme field conditions.

1. Introduction

The grouts are used for controlling leaks in wastewater systems during maintenance and treating cracked concrete walls. Leaking is a common problem of dams and sewer systems which are structurally sound and grouting is an effective method of rehabilitation (Karol, 2003). Grouts were identified as grout A and grout B.

2. Objectives

The objective of this study was to investigate bonding strength of two grouts and type of failures.

3. Materials and specimens

Material: Two commercially available grouts were tested after 1, 3, and 6 months of curing in water. Grout A was a dark brown liquid with a viscosity of 2500 cps (at 30°C) and a specific gravity of 1.15. It was described as durable and versatile elastic foam or gel which is excellent for heavy or light flow conditions, as well as under water. Grout B was a two part, highly thixotropic system with a viscosity of 150,000-250,000 cps and a specific gravity of 1.29. It was formulated with special additives and modifiers to enhance the water resistance, chemical resistance, and bond strength to a variety of substrates as well as its own internal strength.

Specimen preparation: Specimens were prepared according to CIGMAT CT 3-00 which covered the determination of the bond strength between grouts and concrete. This standard was modified and adopted from ASTM C 321. The grout was sandwiched between two concrete bricks. Grouts were applied over the area on the concrete brick that is marked for the joint. One of the bricks was placed, grouted side up, on a flat level surface. Then two blocks were placed on each side of the joint area of the bottom brick. The thickness of the grout was uniform and did not exceed 1/8 in. The specimens were cured in water up to the date of testing while some specimens curing condition was cycled ten times to simulate extreme conditions. Each cycle included one week of wet and one week of dry cycle.

4. Test results and discussion

Test results have shown that grout A has an average bonding strength of 52 psi with a common failure type of Type 3 (bonding failure) whereas grout B has an average bonding strength of 275 psi (concrete failed) with a common failure type of Type 1 (substrate failure) and Type 4 (bonding and substrate failure). Test results and failure types were shown in Figure 1 and 2 respectively. There was slight increase in bonding strength of grout A from 1 to 3 months however the bonding strength has decreased after 6 months of conditioning. Wet-dry cycles have increased the strength. Same trends were shown for grout B also.

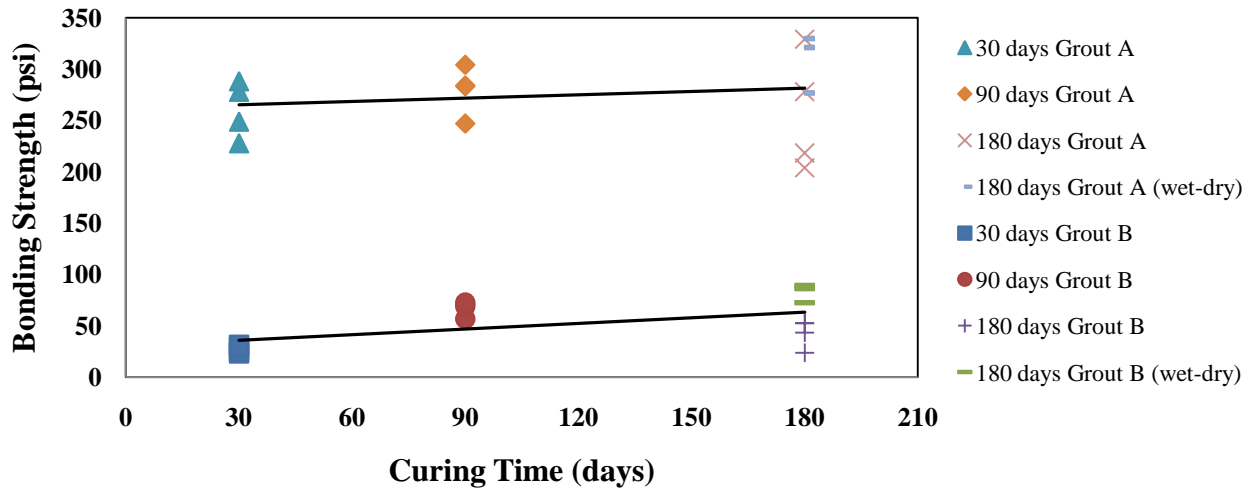
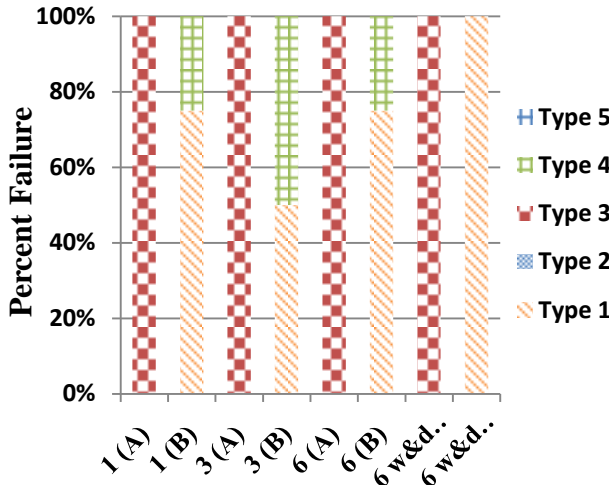


Figure 1: Bonding Strength (psi) vs. Curing Time (days)



| Grout A | | Failure Modes | | | | |
|-----------------------|----------------|---------------|--------|-----------|--------|--------|
| | | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 |
| Curing Time | 1 month | 0 | 0 | 4 (100%) | 0 | 0 |
| | 3 months | 0 | 0 | 3 (100%) | 0 | 0 |
| | 6 months | 0 | 0 | 4 (100%) | 0 | 0 |
| | 6 months (w&d) | 0 | 0 | 3 (100%) | 0 | 0 |
| Total No. (% Failure) | | 0 | 0 | 14 (100%) | 0 | 0 |

| Grout B | | Failure Modes | | | | |
|-----------------------|----------------|---------------|--------|--------|---------|--------|
| | | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 |
| Curing Time | 1 month | 3 (75%) | 0 | 0 | 1 (25%) | 0 |
| | 3 months | 2 (50%) | 0 | 0 | 2 (50%) | 0 |
| | 6 months | 3 (75%) | 0 | 0 | 1 (25%) | 0 |
| | 6 months (w&d) | 3 (100%) | 0 | 0 | 0 | 0 |
| Total No. (% Failure) | | 11 (73%) | 0 | 0 | 4 (27%) | 0 |

Figure 2: Types of failures vs. Curing Time for Grouts A and B

5. Conclusions

Bonding strengths of two commercially available grouts were compared. Grout A showed Type-3 (bonding failure) with an average strength of 52 psi whereas Grout B showed Type 1 (substrate failure) with an average strength of 275 psi (which is concrete bricks strength). Curing time had an effect on strengths of both grouts and also wet-dry cycles increased their strengths with time.

6. Acknowledgements

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7. References

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