Kansas Department of Transportation

TECHNICAL SUMMARY

Corrosion Performance of Prestressing Strands in Contact with Dissimilar Grouts

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Introduction

Close-up of Strand in Simulated Gypsum Grout Pore Solution, Specimen G/PC-1

Inspections of post-tensioned bridges by the Kansas Department of Transportation have revealed voids in strand ducts due to bleeding and shrinkage of older Portland Cement grouts. The Kansas Department of Transportation is faced with a decision whether to fill these voids or to leave them ungrouted. As long as the voids remain dry, the strands typically appear intact with some surface rust. However, field observations indicate that severe corrosion occurs in cases in which water or water containing chlorides comes in contact with the strands. The usual approach to filling voids in post-tensioning ducts involves using prepackaged anti-bleed grouts. Unfortunately, in a number of cases, the repair operations appear to have led to rapid corrosion of the re-grouted strands. A likely cause of the rapid corrosion is a difference in electrical potential in the strands caused by differences in environment provided by the dissimilar grout.

Project Objective

The dual goals of this study are to (1) determine if using a second grout will provide improved corrosion protection for the prestressing strands or result in accelerated corrosion and (2) determine the possible consequences of leaving the voids unfilled. To accomplish these goals, this research is designed to measure the effect of the differences in the environment provided by different grouts and to compare the level of corrosion caused by filling the voids with an anti-bleed grout to that resulting if the strands are not re-grouted but are subjected to water or water containing chloride.

Project Description

Portland Cement grout, gypsum grout, and four commercially available prepackaged grouts were analyzed to determine the chemical composition of the resulting pore solutions and tested to determine if using a second grout will provide improved corrosion protection for prestressing strands or result in accelerated corrosion. The potential consequences of leaving the voids unfilled were also evaluated.

Pore solutions were analyzed for pH and sodium, potassium, fluoride, chloride, nitrite, sulfate, carbonate, nitrate, and phosphate ion content. The analyses were used to develop simulated pore solutions. Selected grouts and simulated pore solutions were paired to evaluate their potential to cause corrosion of, respectively, grout-wrapped and bare stress-relieved seven-wire prestressing strands using the rapid macrocell test. Strands were also evaluated in simulated pore solutions containing chlorides and in deionized water.

Project Results

Based on the results presented in this report, the following conclusions may be drawn:

1. Leaving prestressing strands unprotected from the elements has the potential to result in rapid corrosion of the exposed strands.

2. The gypsum grout has a significantly lower pH than any of the other grouts tested. It also has a higher sulfate content than all but one of the grouts. Gypsum will cause accelerated corrosion of strands when used in conjunction with Portland Cement grout or any of the commercially prepackaged grouts tested.

3. Corrosion of strands in commercially available prepackaged grouts increases as the sulfate ion content of the grout pore solution increases.

4. When paired with Portland Cement grout, the prepackaged anti-bleed grouts evaluated in this study resulted in corrosion losses significantly below those observed for strands exposed to salt or water. The highest corrosion measured for a prepackaged grout in conjunction with Portland Cement grout occurred for the grout with the highest pore solution sulfate content.

Report Information

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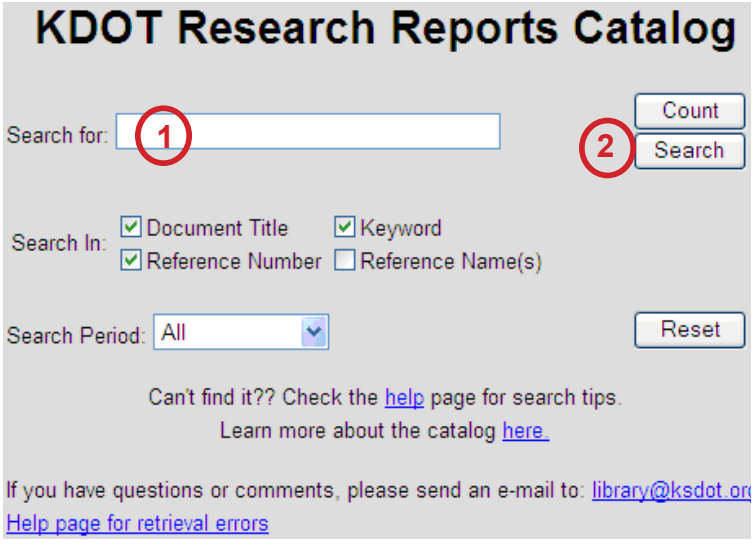

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