Leak Control in Lateral Pipe Joints Using Acrylamide Grout

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Abstract

Infiltration is caused by the deterioration of sewer systems. In this study, sealing sewer pipe leaks at the lateral joints by injecting acrylamide was investigated. A 2D lateral joint model was used to investigate the grout movement through the soil when injected from the leaking joint. The volume of infiltration was measured before and after grouting to determine the effectiveness of grouting. A mathematical model was developed to determine the shape of the grouted region around the lateral joint, the mathematical model was used to estimate the grout volume and compare it to the ASTM F 2304 recommendation

1. Introduction

Pipeline connections that branch off the main sewer to connect building sewers to the public sewer main are called the lateral joints. Infiltration happens when there are connection flaws or cracks in the joint. Regulations limit the volume of infiltration to 200 gal/day/diameter inch (EPA 1970) and to limit it to accepted values, chemical grouting is a method used in repairing the joint (ASTM 2003).

2. Objectives

The objectives of this study were (1) to investigate the grout movement through the unsaturated granular media surrounding the pipe joint using a 2D model, and (2) to verify the performance of acrylamide grouts in controlling leaks at lateral joints.

3. Materials and Testing Method

Commercially available sand with d10 = 0.5 mm, d50 = 0.95 mm and coefficient of uniformity and gradation of 2.17 and 0.9, respectively was used in this study. Commercially available "AV-118 Duriflex" N-methylolacrylamide (NMA) grout (Avanti Grout International, Webster Texas) was used. The 2D Table Top Lateral model was designed to investigate the grout movement around a lateral pipe joint during injection.

4. Results and Discussion

When water and grout were injected through the leaking joint the average ratio of semi-minor to semi-major (h/r) axis was 0.6 and remained constant with varying injection pressure and time (**Error! Reference source not found.**). A model [Eq 1] to calculate the volume of grout required to seal leaking joints was developed and corroborated by comparing it with test data [**Error! Reference source not found.** and **Error! Reference source not found.**]. The relationship is as follows:

$$\frac{V^{G}}{(R_0)^3} = \frac{1}{2}\frac{k^2}{R_0}\frac{\pi\chi \times d^{GS}}{\alpha\left[\frac{1+e}{e}\right]} \qquad (1.)$$

Where V^G is the volume of injected grout, R_0 is the radius of the lateral pipe, k the semi-major axis to the radius of the lateral pipe (r/R_0), χ= semi-major to semi-minor axis ratio (r/h), d^{GS} = 2 in. (with of chamber) for the 2D Lateral model, and finally α is the dilution factor

In this study 500 cm^3 (30 in^3) grout was injected into sand with void ratio of 0.65 at 3 psi (21kPa) injection pressure, wich resulted in a grouted sand bulb with χ=0.56, and k=0.65. Assuming α=1, the volume of injected grout was calculated as 480 cm^3 (29.3 in^3) using the Eq. 1. Such volume was enough to completely seal the joint

5. Conclusion

Only 42% of the volume suggested by the ASTM standard was injected in this study to reduce the infiltration to zero. Less grout was needed to eliminate the infiltration because of the two-dimensional (2D) confined nature of the problem.

The mathematical model was verified with limited data to predict the grout volume based on the grouted sand configuration around the joint.

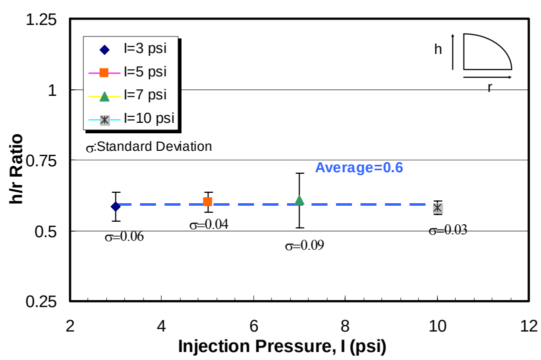

Figure 1 h/r Ratios at Various Injection Pressures

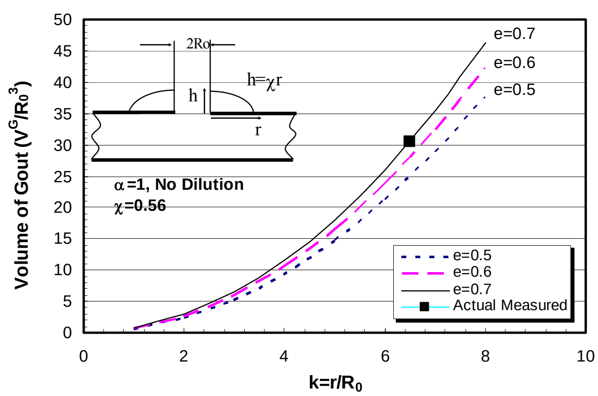

Figure 2 Effect of Void Ratio on the Predicted Grout Volume

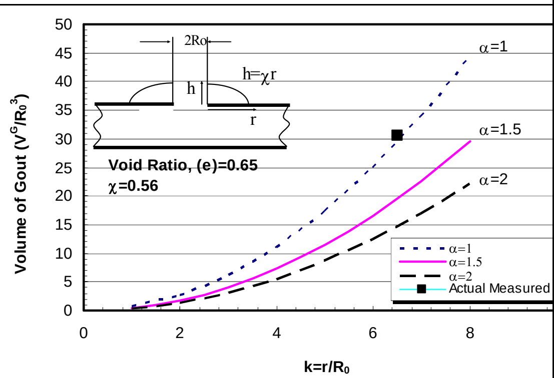

Figure 3 Effect of Dilution Factor on the Predicted Grout Volume

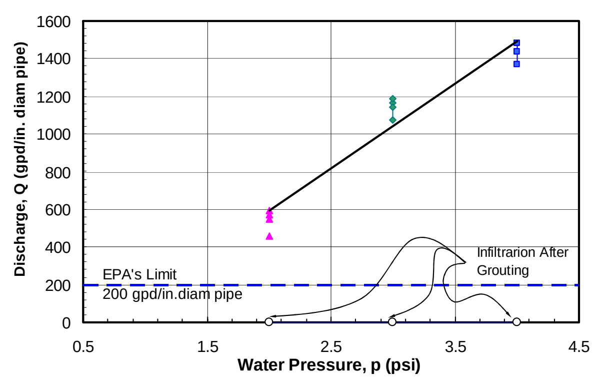

Figure 4 Infiltration Flow Before and After Grouting

6. Acknowledgements

This work was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT)with funds from NSF-International and private companies.

7. References

ASTM, (2003), “ASTM F2304-03 Standard practice for rehabilitation of sewers using chemical grouting”, ASTM standard, west Conshohocken, PA: 1-8.

EPA 1970, “Control of Infiltration and Inflow into Sewer Systems”, Report # 11022EFF12/70. Washington, D.C.