Test Protocol for Leak Control at Lateral Pipe Joints

Shiva Sunder and C. Vipulanandan, Ph.D., P.E.
Center for Innovative Grouting Material and Technology (CIGMAT)
Department of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4003
Phone: (713) 743-4278; Email: sivasunder14@hotmial.com, cvipulanandan@uh.edu

Abstract: The aim was to develop a 3-dimensional model to represent the lateral joint leak in the pipelines. This study suggested the important material properties that are to be studied for the grouts and liners that will be used for rehabilitation of the leaking joint. A 3-D model with a leak rate of over 1000 gallons/day has been developed to verify the repair technologies.

1. Introduction

The term infiltration/inflow can be defined as the process of entrance of storm water/groundwater through water pipeline joints, cracks and fissures. The most common defects which might cause infiltration are cracks, fractures, joint displacement, root intrusion, deformation, deformation, collapse, poorly constructed connections and abandoned laterals left unsealed (Ozgurel, 2004). During heavy rainfall events, the I/I can exceed 50000 gpd per acre (Bakeer et al, 2008). Some of the effects of excessive inflow waters are flooding of local sewer lines, streets, and roadways, back flooding of connected properties, increased cost of pumping and sewage treatment, reduced life of pumping and treatment units. Acrylamide and Acrylic grouts have been used in the past in resolving the water pipeline leaks. Narduzzo (2003) studied the implementation of AV-100 and AV-118 chemical grout which had a gelling time of 30 sec to 3 min to shut off the water infiltration into Toronto Subway Tunnel. Brown (2000) studied the process of sealing leaks in 8 in. verified clay pipe using an acrylamide grout. A number of studies have been done in the past to analyze the pipeline failures coated with and without liners. A mathematical relationship between the annular flow in a lined pipeline and the annular gap size between the host pipe and liner was suggested using full-scale tests on pipelines rehabilitated with DR/FF liners by Bakeer et al. (2008).

2. Objective

The main objective of this study was to develop a test protocol to evaluate various technologies that have the potential to control leak at lateral joints.

3. Material Properties

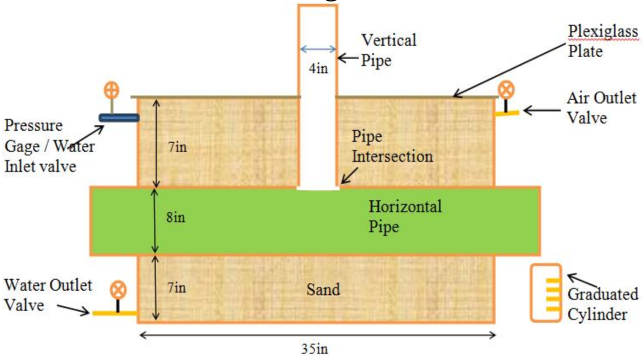
Based on Literature review and experience of the researches, following properties of the repair materials (grouts, liners) must be investigated. Table 1 gives the important material properties to be studied in grouts and liners when they have been used for resolving the I/I flow in lateral water pipeline joints.

Table 1: Material Properties

S. No	Property	Grouts	Liners	Purpose
1	Viscosity	X		For pumpability
2	Setting Time	X		For pumpability
3	Unit Weight	X	X	For placement, volume occupancy
4	Strength	X	X	To withstand I/I water pressures (Compressive
5	Buckling		X	To examine the allowable pressure
6	Permeability	X	X	To minimize the I/I water leak
7	Bonding		X	Interface (material-pipeline) adherence
8	Water Absorption	X	X	Change in weight and volume owing To water absorption
9	Leaching	X	X	To study the effect of TOC in the material.

4. 3-D Model Working

The cross sectional view of the 3-D model is shown in Fig. 1. The sand surrounding the lateral pipe joint can be grouted using a suitable grout material or the pipe can be lined from the interior with a suitable liner material. Fig 2. shows the I&I discharge at pressure of 3, 4 and 5 psi.



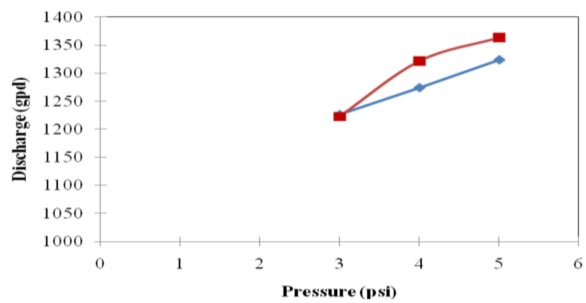


Figure 1: Cross Sectional View of 3-D Model **Figure 2: I&I Leak Flow Discharge vs Pressure**

5. Testing Procedure

Following set of steps is to be followed after grouting/coating/lining to evaluate the functionality of the grout/liner in minimizing the I/I leak at the joint.

1. Hydrostatic pressure of 3 psi is applied and held for 5 minutes; the leak rate is then measured using a graduated cylinder and a stopwatch.
2. Step 1 is repeated at a hydrostatic pressure of 4 psi.
3. Step 1 is repeated at a hydrostatic pressure of 5 psi.
4. Model is then kept under saturated conditions for a period of one week.
5. Water is drained from the model and is allowed to remain as it is for one week.
6. Step 4 is repeated.
7. Step 5 is repeated.
8. Leak rate is measured as described in Steps 1 through 3.

7. Analyses

The test protocol has been used successfully under the Environmental Technology Verification (ETV) of the U.S.EPA program to evaluate various products used in repairing of lateral leaks.

8. Conclusion

The test protocol included several tests on the repair materials and a verification test on the the 3D-leaking lateral model.

7. Acknowledgements

This work was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT).

6. References

1. Bakeer, R. M., Sever, V. F., (2008), “Quantification of Annular Flow in lined Pipelines,” Tunnelling and Underground Space Technology, Vol. 23, pp 727-733.
2. Brown. J., (2000), “Lateral Grouting in South Fayette Township,” Trenchless Technology Magazine, pp. 12.
3. Ozgurel, (2004), “Mechanical Behavior and Groutability of Acrylamide Grout used in Leak Contol at Lateral Pipe Joints”, Master’s Thesis, University of Houston.
4. Narduzzo. L., (2003), “The Toronto Transit Commision’s Subway Tunnel and Station Leak Remediation Grouting Program,” Grouting and Groudn Treatment, GSP No. 120, Vol. 2, pp.1617-1627.