Grouting Saves Effluent Pipeline and Maintains Plant Operations

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During a routine facility inspection at a major West Coast paper plant in Canada, a small leak appeared near the shoreline where an underground 42-inch fiberglass reinforced plastic pipe carried effluent to diffusers in the ocean. The leak was in an area where two individual pipes came from defoaming tanks joining in a "Y" to a single line before discharge. (*See illustrations on page 2*). The small leak rapidly increased to about 500 gpm at the surface. At the point of leakage, the top of the pipe is some 22 feet deep. It normally carries about 2 million gallons an hour.

The pipeline can be shut down for only two hours a day without disrupting plant production. The paper company surveyed the inside with a CCTV but could not get a clear picture through the cloudy effluent. However, sonic scanning revealed an offset of nearly five inches at joint #1 in the "Y". This precluded conventional grouting from the inside, although an internal packer was fabricated to exclude as much grout from the pipeline as possible.

With plant shutdown for regular maintenance months away, the fear of catastrophic failure was right around the corner. The paper company decided to try grouting the "Y" area to hold the pipe in place so the entire assembly would not wash away and cause a complete shutdown. Grouting to stop pipe and "Y" movement was the primary objective of the program, with a secondary objective of shutting off as much flow as possible.

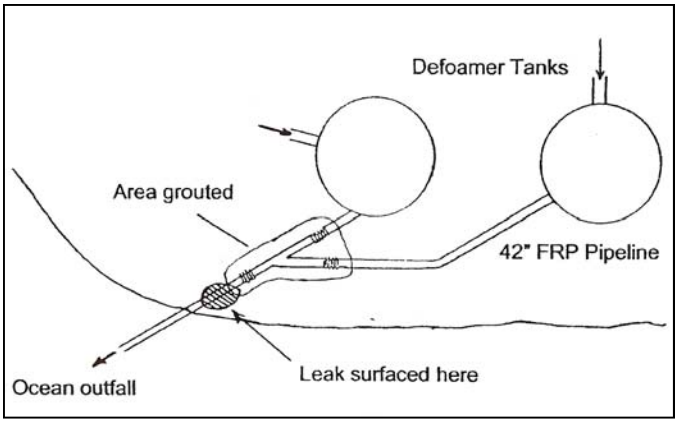
In concert with George Vernon, a paper industry consultant with Mill Creek Management Technologies, Rembco Engineering's Clay Griffin put together a plan that could be carried out quickly. Jay Schrock, a pipeline grouting consultant well known to this publication, advised on grout selection. The pipe was bedded in 3/4 minus limestone sand, and the trench then further filled with sand, cobbles and large boulders (some desk size, a driller's dream). In stabilizing a fiberglass pipe, no hard grout such as cement can be used, as its use will always create a hard spot where the pipe will eventually shear. And one should avoid going through the pipe at all costs, making the selection of drill and bit very important.

It is probable that much of the sand and fines were washed away by the leakage. A two-grout program was suggested. AV-220 Hydracure, a hydrophilic urethane, was chosen as the initial grout to fill voids and large areas. Its ability to foam in a closed space without generating great pressure, and yet not exceed a closed cell configuration during free foaming, was important. The 300 centipoises shooting viscosity would help prevent the grout from moving through any breaks in the joints to any great degree. Then the area would be grouted with AV-100 Chemical Grout, an acrylamide, the lowest viscosity and most controllable grout around. This would allow grouting of the fine sand and soil where the more viscous urethane would not penetrate. Grouting would initially be carried out during the two-hour pipe downtimes that could be made available while the plant continued in operation.

To get the job going, light weight drills, grouting equipment, and key persons were sent from Rembco Engineering, Knoxville, TN; grout was shipped from Avanti International, Webster, TX. An undersized inflatable internal packer (undersized to fit across the offset) was built by Inspection Services of Vancouver to restrict grout from entering the pipe at the break, but it could not be inflated tightly because of the joint offset.

On the job, drilling began through the difficult material over the pipe. At the same time, surface tests were made on-site to predict the action of the grouts in similar soil materials at the in-ground temperature. A maximum flow rate of 3 gpm for the urethane and 5 gpm for the acrylamide was determined. Urethane expansion was estimated to be 6.5:1 at an assumed static head pressure of 9 psi, and the void space in the bedding was estimated to be 45%. The zone to be grouted was to extend two feet below, two feet alongside, and two feet above the pipe.

The injection of AV-220 (urethane) was done in a volume corresponding to 0.52 gallon/cubic feet of bedding to be grouted. Because there was no way to grout directly below the pipe, more grout was injected at the lowest possible point in an attempt to get the grout below the pipe. A total of 350 gallons of urethane was injected at 18 locations, stabilizing an estimated



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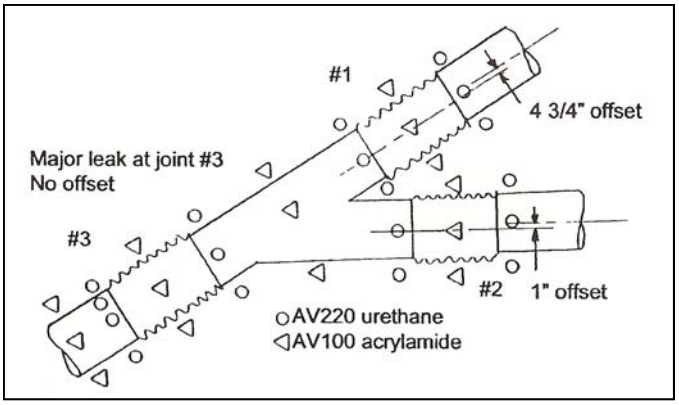
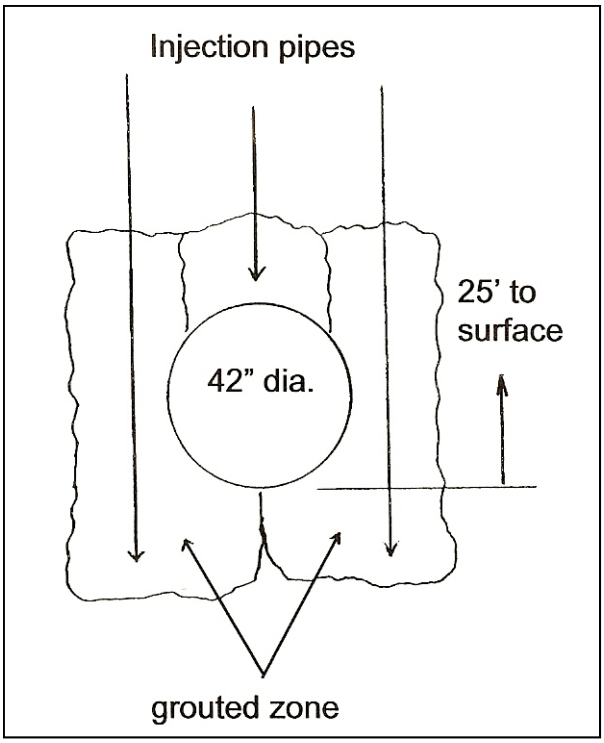


670 cubic feet of bedding. After the first grouting with AV-220, leakage during pipeline use periods began to slow, reaching about 20 gpm as a low point.

A total of 2,375 gallons of AV-100 (acrylamide) was then injected through 15 grout pipes, filling another calculated 700 cubic feet of bedding. During this secondary grouting, all flow back to the surface stopped. To the surprise and delight of all, the leak was completely stopped by grouting from the outside of a large pressure pipeline operating at an internal pressure of about 18 psi. Grouting with AV-100 was continued until there was nowhere else in the immediate area to get any more grout into the ground.



Grout placement was verified by probe drilling at ten locations. Several probe holes at the edge of the area indicated that grout had permeated outside the target area, suggesting the void volume was somewhat less than the estimated 45%. When the packer was removed from the pipe, it had some polyurethane grout adhering to its shroud indicating a small amount of grout reached the inside.

Notified about the project on February 6, 1996, Rembco was at the job site and beginning work on February 12 (U.S. and Canadian border officials notwithstanding). We completed the work and left 10 days later on February 22. At this writing, there are still no visible leaks. Preparations are being made by the paper company to replace or repair the "Y" and joints during the next scheduled turnaround. •

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