Methodology for Rapid Repair of Damaged Pipeline after the Disaster

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Abstract: Natural Disasters like Hurricane and Earthquake mostly damage infrastructure tremendously. Among the initial actions needed for quicker recovery after the disaster is rapid repair of infrastructure especially damaged pipeline. In this study potential of using bladder and grouts for quick repair was investigated.

1) Introduction

Generally the forces generated by natural disasters mostly destroy some of the critical infrastructure on their way or in their vicinity. Among the important recovery actions taken after the disaster is the repair of infrastructure especially damaged pipeline. Pipelines could be water pipeline that is essential for start of post-disaster activities or it could be oil or natural gas pipeline that is really potential of explosions and further destruction. So in all the cases the pipeline rapid recovery is priority measure. This idea is relatively new however, for the methods of fast repair some hints were obtained from the previous studies as follows; Saiidi and Cheng (2004) studied the effectiveness of composites for repairing the R.C Flared columns. They used FRP fabric with fibers in two directions to provide flexural capacity and confinement [1]. In another study Li and Sung (2003) used the Carbon Fiber Reinforced Plastic jacketing to repair the shear failure damaged circular columns [2]. This condition is so similar to the failure of pipe since they have the circular section and also their failure is mostly shear failure due to the uneven movement of the ground. In another research by Li and Ghebreyesus (2004) they used the UV curing FRP composites for fast repairing of RC beams. In their study they used E-glass fiber-reinforced sheets with ultraviolet (UV) curing vinyl ester [3]. Based on literature review and CIGMAT research potential methods for pipe repair are summarized in this study.

2) Objective

Review the potential of using grouts for rapid repair of pipes.

3) Methodology

The process of rapid repair of the pipeline is done in 3 stages. First is about locating the leakage by different methods like ground penetrating radar (GPR), resistivity method or other methods. After locating the leaking, pipeline flow should be shut down from the nearest valve. Second, the pipe either by excavating (trench) or trenchless technology is prepared. Third, the repairing and sealing the damaged part of the pipe starts. In this study focus is on the third stage of operation.

3.1) Cleaning: as the first task the surface of the pipe (external or internal) all around the pipe should be cleaned and be dried for applying the glue.

3.2) Building the FRP Bladder: After the cleaning the, two strips of rubber with the thickness of ranging (7.5-15 mm) will be wrapped and stuck around the pipe on each side of the leake or cracked zone. Now on the top surface of the installed rubber epoxy glue should be applied and a wide strap of UV curing FRP will rest from one strap and continues laterally to the top of the other strap. The final configuration will be like a beam on two supports that the FRP sheet is the beam and the support are those two rubber strap. The final shape will be like (Figs.1 and 2) which is like a bladder that there is empty space trapped between the FRP sheet and pipe exterior surface. After that a small injection hole will drilled on the and a small valve is installed on the hole.

3.3) UV Curing: Now it is time to arrange the UV lamps around the pipe on the FRP sheets and the FRP will be cured for I Hour [3]. The configuration of lamps is shown in Fig.3.

3.4) Grout Injection: At this step it is all about the grout. The selected polyurethane grout is highly expansive and expands 5 to 15 times of its initial volume. As shown in Fig.4 the grout sets within 5 minutes and gains it ultimate strength. Basically, when this grout is injected it starts to penetrate into the leaks and holes and FRP bladder to the pipe. The FRP can provide the mechanical strength and rehabilitation for the pipe. In Fig.4 the temperature &pressure- time behavior of the grout when interacts with contaminations like Oil or water that might exist around the pipe. Within 10 minutes after grout injection the pipe is ready to be put into service.

Figure 1. Repair of joint

Figure 2. bladder

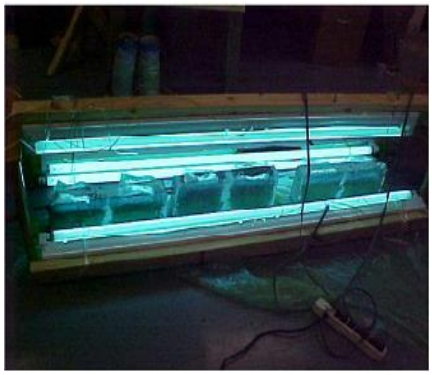

Figure 3. Closer view of grout

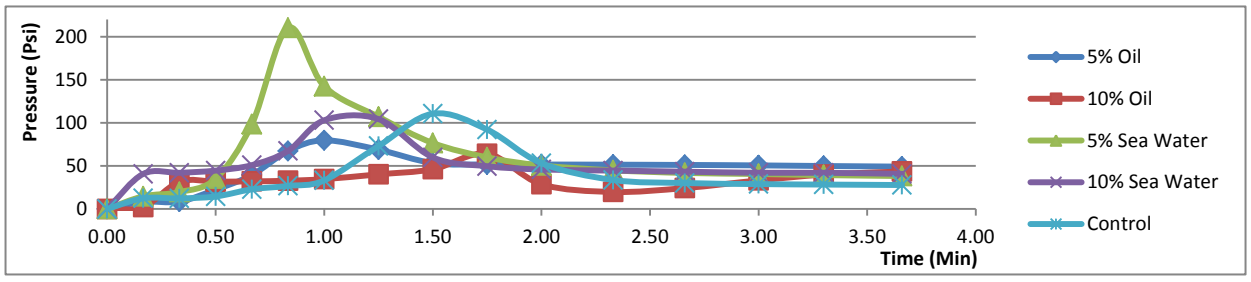

Figure 4 Pressure-time relationship of grout curing

4. Conclusion

Grouts have the potential for use as rapid repair material.

5. Acknowledgement

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6. Reference

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[3] Li, M. and Ghebreyesus, A. 2004." Fast repair of damaged RC beams using UV curing FRP composites" journal of Composite structures, Vol. 72 (2006), PP. 105-110