**The FRP Retrofit Experts**

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# Tests of Corroded Steel Pipes Externally Wrapped with QuakeWrap®

**Test Date:** July 2013
**Testing Lab:** Polymer Technology Center
Gedung 460, Kawasan Puspiptek
Tangerang-Banten 15314 INDONESIA

**Test Description:**

1. A steel pipe segments with diameter of 5 inch (127 mm) and thickness of 0.118 inch (3 mm) was selected. A 20-mm (0.787-inch) diameter hole was drilled in the pipe to simulate corrosion damage.

2. The pipe surface was sand blasted to meet the Swedish Standards SA 1 (ISO SA 1) for surface preparation. This produced a near white surface.

3. The finished pipe after sandblasting is shown here.

4. The hole was filled and patched with metal repair and epoxy mixed with silica fume. The patching area extended about 50 mm (2 inches) in each direction beyond the hole.

5. Cut a piece of VU20G glass fabric to cover the hole region. This band of fabric is 4 inch (100mm) wide x 16 inch (400 mm) long and allowed for an overlap of about 6 inch (150 mm) at the end of the fabric.

6. Saturate the glass fabric with QuakeBond™ J333SR (Underwater Saturating Resin).

7. Wrap the saturated fabric around the pipe to cover the area where the hole. Note that the fabric overlaps around 6 inches (150 mm).

8. To prevent galvanic corrosion of the steel pipe, we have to prevent direct contact between the carbon fabric and the steel pipe. This was achieved by applying a layer of QuakeWrap® VU20G glass fabric saturated with QuakeBond™ J333SR around the pipe such that no steel was visible.

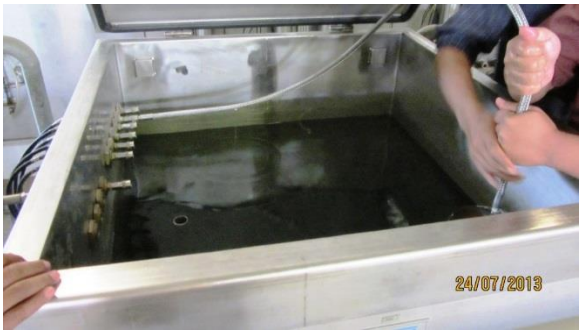
9. The strengthening of the pipe was achieved by applying two layers of QuakeWrap® VU18C unidirectional carbon fabric saturated with QuakeBond™ J333SR resin in the hoop direction. These layers covered the entire length of the pipe and they were each 16 inch (400 m) long to provide the 6 inch (150 mm) overlap at the end.

10. If necessary, apply a top coat of QuakeBond™ J333SR to the carbon fabric to make sure the fabric is fully saturated.

11. Wrap the pipe in plastic (shrink wrap). The wrapped pipe was allowed to cure in ambient temperature for 72 hours before it was sent to the Polymer Center for burst test.

12. The ends of the pipe were capped, sealed and filled water. An initial pressure test was performed to make sure there were no leaks in the system.

13. For added safety, the pipe test assembly was placed inside a tank containing water.





14. The pipe test pressure was set at 95 bar (1378 psi). The maximum pressure reached in the repaired pipe was 93.1 bar (1351 psi). The complete data collected during the test is shown on the next page.

# Sentra Teknologi Polimer

Gedung 460 ,Kawasan Puspiptek
Tangerang-Banten 15314
Indonesia

### Product details

| | |
|---|---|
| Test number | 203 |
| Description | komposit pipa2 |
| Production no. | Pipa Komposit |
| Test type | customer standard |
| Customer | Bumi Mas Jaya Perkasa Karawaci |

### Pressure Test Details

| | |
|---|---|
| Operator | abd, |
| Station | 16 |
| Set Pressure | 97,90 [bar] |
| Hysterisis | 0,95 [bar] |
| Alarm limit | 1,90 [bar] |
| Max. Pressure | 93,15 [bar] |
| Leak rate | 5 |

### Pressure Test Results

| | |
|---|---|
| Total test time | 1:00 hours |
| OK time | 0:00 hours |
| Current test time | 0:07 hours |
| Out of tolerance time | 0:07 hours |
| Power failure time | 0:00 hours |

### Pressure Test Temperature

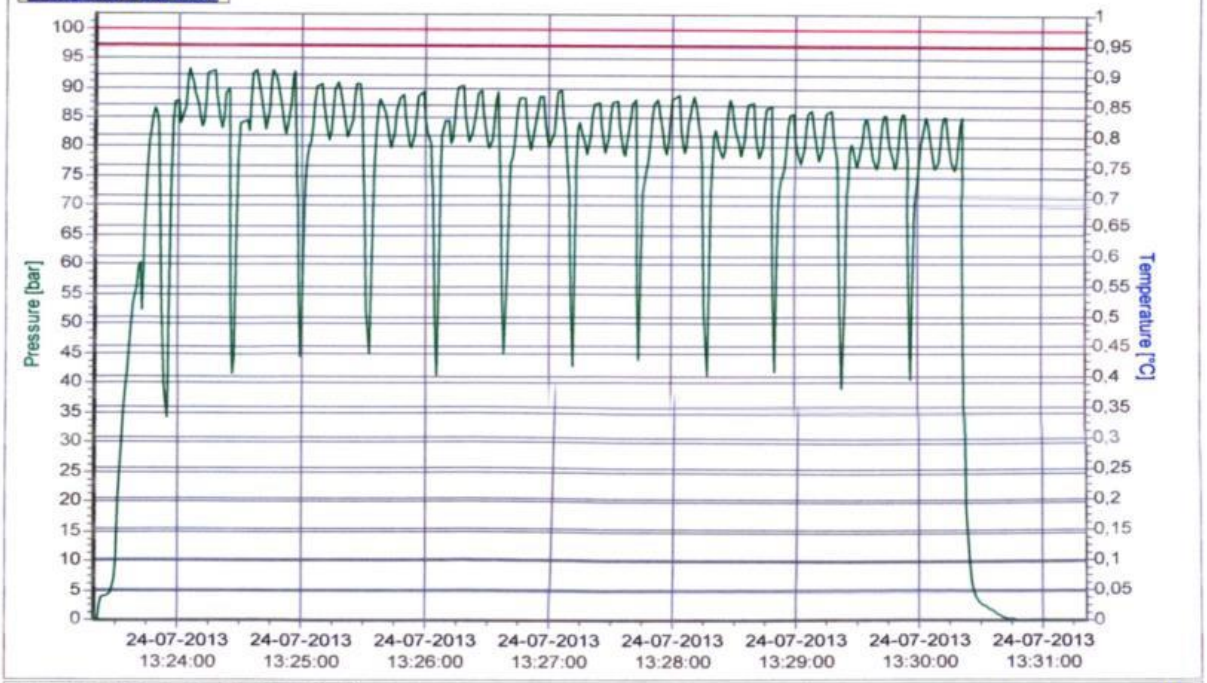
| | |
|---|---|
| Tank no. | 1 |
| Max. temp. | 0,00 [°C] |
| Min. temp. | 0,00 [°C] |

### Test comments

### Dates

| | |
|---|---|
| Start date of test | 24-07-2013 13:23 |
| End date of test | 24-07-2013 13:30 |
| Date of print | 24-07-2013 13:31:58 |

Complete Test View




Pc version = 26 10 2011 8.40
0 version = 18-04-2011

Test approved by :

Date . . / . . / . . .

ORIGINAL

15. These photos show the test specimen at the conclusion of the test with the repair hole location marked. Failure of the specimen was through a small leak at the hole at a pressure of 93.1 bar (1351 psi).




16. Based on the successful tests demonstrated here, QuakeWrap® Carbon FRP system has been approved in 2013 for external repair of pressure pipes in oil and gas industry.

17. Since July 2013, QuakeWrap® Carbon FRP system has been used in a number of projects repairing corrosion-damaged steel pipes that operate under high pressure.

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# Repair of Buried Pipeline


*QuakeWrap®* *PipeMedic®* *PileMedic®* *StifPipe®* *InfinitPipe®*

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# Repair of Pipeline in the Sea

*QuakeWrap®* *PipeMedic®* *PileMedic®* *StifPipe®* *InfinitPipe®*