Tensile strength of smart oil well cement

S. Ranjbarian[1], C. Vipulanandan[1], Ph.D., P.E. and B. Head[2]
[1]Center for Innovative Grouting Material and Technology (CIGMAT)
Department of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4003
E-mail: sranjbarian@uh.edu, cvipulanandan@uh.edu Phone: (713) 743-4278
[2]Program Manager – RPSEA, Sugar Land, Texas 77478

Abstract: The induced tensile stresses are considered as the cause for failure in cement sheath. Hence, ultimate tensile strength and piezoresistivity behavior of the smart oil well cement was investigated. Splitting tensile test and direct tensile test showed tensile strength in the range of 270 psi while in 3 node bending test, tensile strength was increased 26 percent for smart oil well cement. Piezoresistivity behavior was observed around 10% for direct tensile and 3 nodes bending test while it was near 80% for splitting tensile test.

1. Introduction:

It is apparent from calculating the stresses imposed upon the annular cement sheath of well that failure will likely be of a tensile nature. Even though there is a recommended method for compressive strength by API and ISO, there is not a significant method for testing oil well cement under tensile load. This problem led the related industry to adopt various tensile tests. Direct tensile test, splitting test and three node bending test are testes to evaluate both ultimate tensile strength and piezoresistivity behavior of the smart oil well cement (R.l.Dillenbeck et al.,2005, and T. Heinold et al., 2003).

2. Objective:

The main objective was to investigate the piezoresistivity behavior and ultimate tensile strength of the smart oil well cement.

3. Materials and Methods:

Different samples were made for direct tensile test,3 node bending test and splitting tensile test with water to cement ratio of 0.38.Dry materials were mixed together for 4 minutes to the water containing 0.1% carbon fiber. Samples were cured in the ambient temperature. Figures 1 illustrate the schematic test detail for all the three mentioned tests.

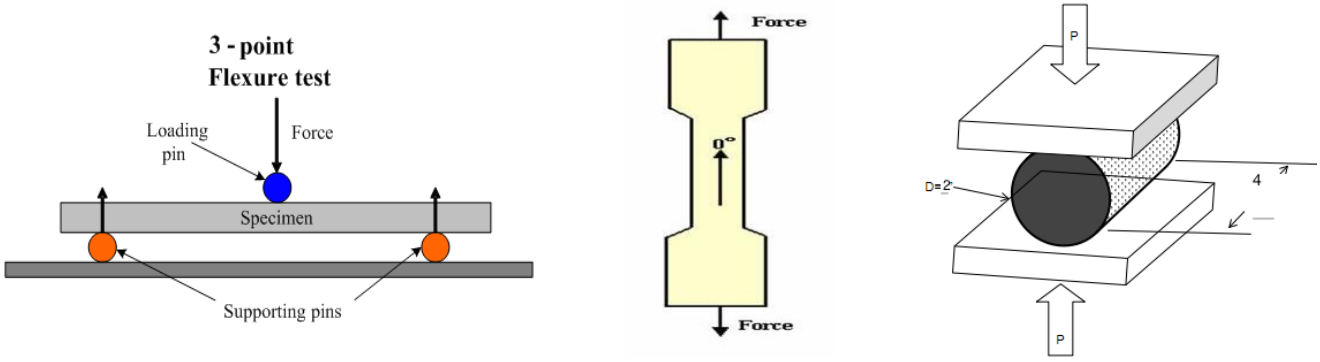

Figure 1. Schematic test detail for three node bending, direct and indirect (splitting)tensile test

4. Results and Analysis:

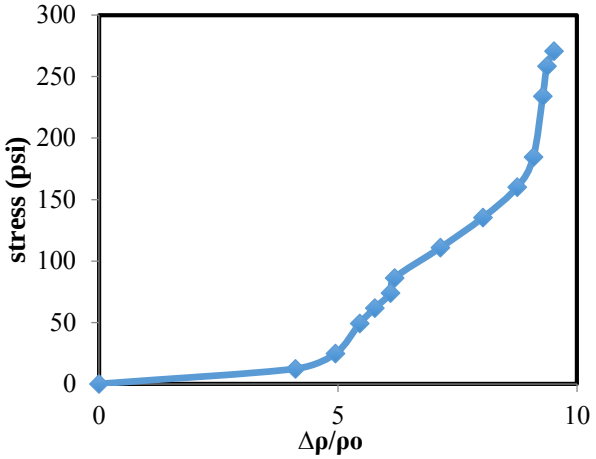

Figure2.direct tensile test after 28 day

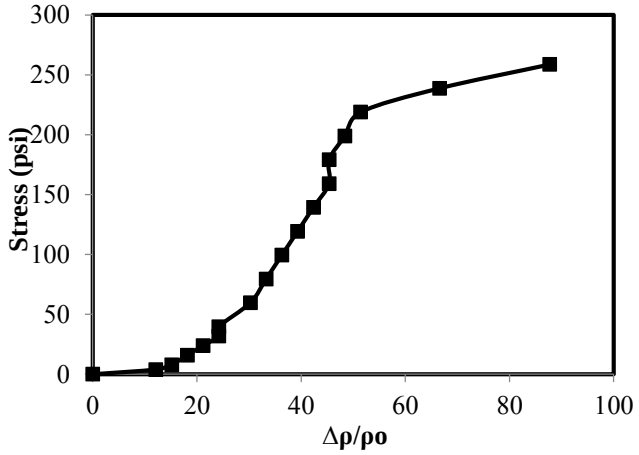

Figure3. Splitting tensile test after 28 day

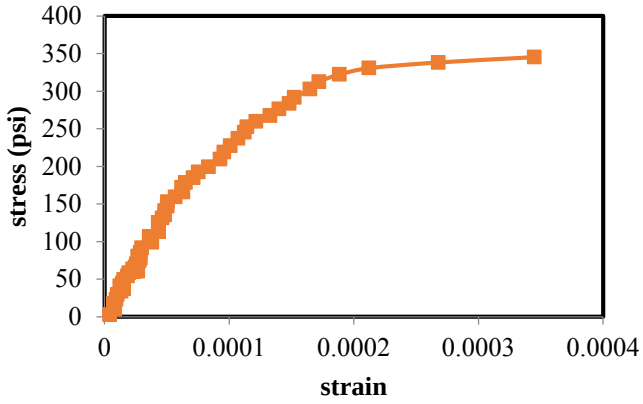

Figure4. Stress-strain relation

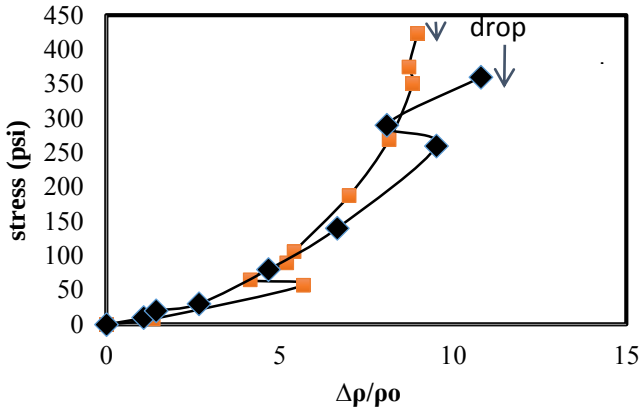

Figure 5. bending test after 28 day

6. Conclusion: Tensile strength of smart oil well cement is around 270 psi after 28 day.There was a 26% difference in strength for 3 node bending test.Piezoresistivity behavior is around 10% for direct test and 3 node bending test while for splitting tensile test it showed 8 times more piezoresistivity behavior.

7. Acknowledgements: This study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT), University of Houston, Houston, Texas with funding from the Ultra Deepwater Program DOE/NETL/RPSEA (Project No. 10121-4501-01).

8. References:

1. Heinold, T., and Dillenbeck Robert, l., (2003), "analysis of tensile strength test methodologist for evaluating oil and gas well cement system", SPE84565.
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