P.O. Box 577
Brookshire, TX 77423
U.S.A

WEST ENGINEERING SERVICES

Tel: (281) 375-5515
Fax: (281) 934-1600
west@westengineer.com

ISO 9001:2008 Certified

TECH TIDBITS, vol. 14

Zinc Bromide *plus*

Zinc Bromide and Bonnet Seal Bonding

In 2006, a rig operator in the Gulf of Mexico was planning to use zinc bromide (ZnBr2) in the subsea BOP stack during completion operations and thus requested a rubber goods compatibility statement from the equipment manufacturer. The manufacturer had performed many such tests on their rubber goods with zinc bromide in the past. They provided the operator with the results of these tests and a statement that, under normal conditions, the seals should be unaffected by the zinc bromide for at least two months; a period of time sufficient for the operator's needs.

However, after just a little over two weeks of use, multiple seal failures were experienced on the BOP stack that resulted in an unplanned stack pull. It was suspected that zinc bromide contributed to the seal failures. Elastomer engineers were consulted but again stated that, given the wellhead fluid conditions of 15.6 ppg @ 60°F, the nitrile seals should last for at least two months. However, just to be certain, another test was conducted. No issues were found during this test either.

An additional test was requested by the operator, this time using the zinc bromide blended into the actual completion fluid on the rig. This test revealed adhesion problems between the seal rubber and the metal. This example shows that adhesion tests conducted only with "neat" $ZnBr_2$ do not reflect actual field conditions. The actual field sample contained additional additives that, when all were blended together, dissolved the adhesive. This demonstrates how completion fluid can vary in composition from well to well, and that the final, mixed fluid should be used for elastomeric studies which should also include an adhesion test.

Description of Issue

In addition to the field sample, the manufacturer acquired a "neat" sample direct from the fluid manufacturer Baroid. As can be seen in Figure 1, the two samples appear strikingly different, with the field sample being more opaque. The seal material was found to be unaffected by either sample, so the manufacturer chose to further test the adhesion of the seal rubber to the metal backup material.

Figure 1 - Zinc bromide field sample (left) with the Baroid supplied sample (right).

The manufacturer conducted the study with M1-20 nitrile elements utilizing an immersion test. To conduct this test, adhesive was first applied to 1"x2.5"x0.125" metal coupons and allowed to dry. The coupons were then heated in a mold where, upon reaching proper temperature, nitrile slabs were placed on top of the coupons. The mold was closed and held for 30 minutes at

350°F. After curing to the metal coupon, separate rubber/metal samples were submerged in either the $ZnBr_2$ “neat” sample or the field sample for 24 hours at 134°F (higher than actual temperature to accelerate the effects of exposure).

After removal, the samples were allowed to cool for 30 minutes before being tensile tested to stress the rubber-to-metal bond. As can be seen in Figure 2, the nitrile elements tested with the Baroid sample

Figure 2 – Bonding tests with Baroid sample (left) and the field sample (right)

sheared through the rubber, leaving plenty of rubber material on the metal coupon. This suggests that the metal-to-rubber bond stayed intact. However, in viewing the field sample it is obvious that the adhesive dissolved, demonstrating a total delamination of the metal from the rubber and leaving a nearly bare metal coupon.

For more Tech TidBits or more information or technical questions, you can contact WEST Engineering by email, west@westengineer.com, or call 281-375-5515, or visit our website at www.westengineer.com.