TXM: MAKO-6
2006 – 2008
WELL CONTROL AND SUSPENSION

TXM successfully used high-density cesium formate brine as well-control fluid during the appraisal of an extreme HPHT basin-centred gas accumulation in Hungary. The well was later suspended three times with cesium formate. The longest suspension period lasted about six months.

A 2.145 g/cm^3/17.88 lb/gal cesium formate brine was used as well-control fluid during the appraisal of a basin-centered gas accumulation in Hungary. The appraisal activities involved fracturing various zones in an extreme HPHT well, Mako-6, which had a total depth of 5,000 m/16,400 ft., a BHST of 235°C/455°F and pressures in excess of 96 MPa/14,000 psi.

After drilling operations started in December 2005, the well was completed in July the following year and temporarily abandoned with 1.33 g/cm^3/11.1 lb/gal calcium chloride brine in the hole. Log analyses revealed significant gas from numerous intervals and an extensive fraccing operation was started in spring 2007. As part of this process, a two-metre interval was perforated. Subsequent fraccing saw success, but after discovery of H_2S gas a well-kill operation was initiated with cesium formate brine. A total of 57 m^3/359 bbl cesium formate brine at 2.147 g/cm^3/17.92 lb/gal was bullheaded down the 5$^1/_2$" casing to the bottom of the perforated zone to minimize well-head pressure and enable snubbing of a packer and test string into the hole. The bottom of the column of cesium formate brine was at a depth of 5,300 m with local temperature of 225°C/437°F. High-density cesium formate was chosen because alternative brines with lower densities develop much higher surface pressures, placing more wear and tear on the snubbing equipment and increasing operational risk.

New record set: Highest temperature for cesium formate brine use – six months at 235°C/455°F

After appraisal, the cesium formate brine remained in the well for 39 days before reverse circulation displacement to a packer fluid enabled well test operations to begin. After completion of the well test, the well was killed again with cesium formate brine, and suspended further for 34 days. After this suspension, the well was displaced to fresh cesium formate brine following the appearance of low levels of H_2S gas at the wellhead. This fluid was left in the well for six months before TXM circulated it out in an attempt to recover the mechanically damaged work string.

As this is the highest temperature well formate brine has ever been exposed to, there was some concern about the thermal stability of the brine. Therefore, during all three displacements, the brine was periodically sampled. Despite the lengthy exposure to extreme hydrothermal conditions, extensive laboratory analyses showed no significant changes in fluid properties and composition. During all exposure periods the brine was exposed to a C-steel casing. In addition, during latter exposures, it was also exposed to a low-alloy steel work string.

Don Wright, operations manager for TXM, commented: *"Successfully setting the packer in Mako-6 at a record depth was a significant achievement for us. Cesium formate provided stable well conditions and enabled operations to progress safely and smoothly".*

Literature

Howard, S. and Downs, J.D.: "Formate brines in extreme HPHT well construction operations – Do they have limitations?", AADE-08-DF-HO-11, April 2008.

Howard, S.K. and Downs, J.D.: "Hydrothermal Chemistry of Formate Brine and its Impact on Corrosion in HPHT Wells", SPE 114111, May 2008.

CABOT