Novel 15,000 Psi, 350°F Rated Dissolvable Frac Plug With Metal Sealing Element Used In Saudi Arabia, South Ghawar To Improve Well Economics

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Abstract

Objectives/Scope: In 2022 a HPHT sandstone reservoir, in the Kingdom of Saudi Arabia, South Ghawar Field, was stimulated using a novel HPHT capable dissolvable frac plug that contains no elastomers and instead uses metal-to-metal seals to isolate treatment intervals. Historically, in this challenging field, high failure rates had been observed when stimulating with traditional dissolvable frac plugs. Millable frac plugs had been used in the field with some success but it was desired to improve well economics and reduce NPT by using dissolvable plugs.

Methods, Procedures, Process: Prior to being run downhole multiple iterations of the plug were tested at downhole conditions until the plug was successfully tested to 13,000 psi and 350°F for extended periods. The dissolvable frac plugs were ran with a proprietary ceramic and asphaltene coatings to protect them from premature dissolution and were conveyed via e-line pumpdown. The plug run in hole times ranged from 7-12 hours per plug depending on the setting depth due to lack of injectivity rate.

Results, Observations, Conclusions: After setting the plugs e-line was retrieved and a wellhead stinger was then installed. By the time pumping commenced each plug had been in the well for 18 to 30 hours which allowed the plugs to warm up to an estimated temperature of 250-285°F. All plugs held isolation for the length of each treatment and surface pumping pressures ranged from 10,500—13,250 psi. Three days after the last treatment was placed coiled tubing was ran in the well and the top two plugs tagged and milled in 3 minutes and 2 minutes. The remaining plugs were not tagged indicating full degradation and a successful implementation.

Novel/Additive Information: The proposed paper will present the novel elastomer-less plug design with dual coatings of ceramic and asphaltene which is well suited for HPHT completions in the MENA region. Elastomers on traditional plug designs do not perform well at high temperatures and element style elastomers do not perform well at high pressures due to elastomer extrusion past the plug outer diameter resulting in lost isolation of the stimulation. Currently, no other frac plug or well barrier uses a similar metal seal and this technology has many other downhole use cases such as open-hole packers and isolations darts used in interventionless hydraulic fracturing operations.