

SELECTION AND QUALIFICATION OF MATERIALS FOR HPHT WELLS

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ABSTRACT

Interest in sour, high-pressure high-temperature (HPHT) wells and in ultra-HPHT wells, i.e. those with bottom hole temperatures greater than about 300° F (150° C) and wellhead pressures greater than about 10,000 psig (690 bar), is increasing worldwide. Due to the desire to monetize reserves more rapidly and due to the aggressiveness of sour, HPHT and ultra-HPHT environments, these wells are likely be completed using large diameter casing and tubing that is manufactured from solid, high-strength corrosion resistant alloys (CRAs). Wellheads will likely be manufactured from high strength low alloy steel that is clad internally with CRAs.

The combination of corrosion resistance and strength offered by solid CRAs and CRA-clad steels has spurred decisions to produce otherwise uneconomic sour, HPHT and ultra-HPHT wells around the world for several decades now. However, current levels of conservatism in materials selection and evaluation and in design of HPHT well equipment is not likely to be sustainable in the future. Thus, this paper provides a review of the knowledge gained from previous HPHT developments with the dual aims of extending the safe and successful development record of the E&P industry related to HPHT wells and improving the cost-effectiveness of future CRA completion designs.

Increasingly aggressive conditions are beginning to expose limitations in current design methodologies for tubing and casing strings, connections, seals, downhole jewelry, and valves. Linear elastic design methodologies are likely to be supplanted by elastic-plastic, fatigue, and fracture mechanics based methodologies in the near future, and this will likely result in a need for detailed data related to CRA materials properties including flow stress, fracture toughness, and low cycle fatigue resistance, data that is largely nonexistent at present. Therefore, this review also examines the limitations of current CRA test methods and identifies gaps in materials property data...

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