Solutions for Critical Saltwater Disposal Well Challenges

Saltwater Disposal (SWD) is a growing challenge to E&P Companies all over the world. By definition, SWD is the "injection into underground porous rock formations not productive of oil or gas, and sealed above and below by unbroken, impermeable strata."[1] It is one of the most common means to manage non-commercial saltwater (oilfield brine) produced from oil and gas wells.

The industry growth in mature assets such as the Permian and Barnett Shale are driving the need for more critical SWD wells (oilfield brine). A significant factor driving this need is drilling hazards resulting from the years of historical injection into shallower disposal zones. A second factor is the necessity to comply with the growing requirements of all regulatory bodies to ensure safe disposal of oilfield brine. Because of these factors, a growing trend is to drill deeper SWD wells to get to extremely porous and permeable reservoirs for disposal. These factors bring inherent challenges with them such as:

- Higher CAPEX costs to drill and complete
- Larger injection tubing string weights posing a challenge to land rig availability (and cost)
- Operators reliance on a smaller number of wells for the overall disposal volume
- Downtime on SWD's due to corrosion failures causing large volumes of oil & gas production to be shut-in and drive OPEX up with necessary workover repairs

Material selection in the well design phase has become more critical in light of these challenges. Long-term exposure of conventional steel alloys will result in general corrosion, leading to reduction of the pipe wall and eventual failure. It is important to note that saltwater being disposed of likely has the presence of dissolved oxygen, bacteria (SRB or APB), and potentially corrosive production chemicals in the water stream. All of these harmful constituents are treatable with facility processing equipment or vigilant chemical management programs, however, it is very challenging and OPEX intensive to completely prevent corrosion failures of steel tubulars in SWD wells. Choosing the correct corrosion resistant alloys (cra's) for the injection string along with the production casing joints adjacent to the packer set depth will prevent corrosion failures. While these alloys may carry a higher initial CAPEX cost, they will often provide the most cost-effective solution when considering the long-term benefits for critical wells. Advantages to selecting cra's for critical SWD applications are as follows:

- Long-term solution that prevents corrosion failures
- Full ID of tubulars (allows for increase injection) as compared to lined or coated tubulars
- Reduction in long-term OPEX
- Reduced potential for significant lost production or well intervention costs if a failure occurs

While most cra's will prevent general corrosion in SWD wells, some cra's are highly susceptible to pitting corrosion in the presence of chlorides or oxygen. If the oxygen content cannot be maintained below 10 ppb, alloys with a high pitting resistance are required. One measure of an alloys pitting resistance is its Pitting Resistance Equivalent Number (PREN). The PREN can be calculated using the formula;

$$PREN = CR\% + 3.3 \times (Mo\% + 0.5 \times W\%) + 16 \times N\%$$

Material with a PREN > 40, such as 25CR super duplex and CRA 2550E, are therefore recommended for these applications.

To calculate a PREN number using the formula mentioned above, please visit our website https://www.cralloys.com/technical-resources/calculators/pren-calculator/

(1): "What Are Saltwater Disposal Wells," Barnett Shale Energy Education Council, retrieved 11 September 2018 from http://www.bseec.org/what_are_saltwater_disposal_wells