

Corrosion Control Planning Is Critical For Extending Life of Injection Wells

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As early as 1875, oil operators concluded that water injection could be used as an effective method for driving oil from within a formation. Other means of recovery have since then been developed. After years of trial and error, however, it has become apparent that water --- either from natural geothermal or surface sources --- is the most economical means of secondary recovery.

Sources For Injector Water:

The following sources of water are typically used for recovery of oil:

• Produced water: often used as an injection fluid. Produced water is a term used in the oil industry to describe water produced along with oil and gas. If the volumes of water being produced are not sufficient, additional "make-up" water must be provided. Mixing waters from different sources exacerbates the risk of corrosion.

• Seawater: the most convenient source for offshore production facilities. At times it may be pumped onshore for use in land fields.

• Aquifer water: from water-bearing formations other than the oil reservoir. Aquifer water has the advantage of purity where available.

Problems Associated With Water For Injector Wells:

Despite the many benefits gained by using water, the quality of the injection water is continuously blamed for failures in the water injection system from the seawater intake facilities to the well bore.

Corrosive damage to the pipe from these waters results in significant costs to the E&P industry. For example: at times repairing wells has resulted in prolonged work-overs and eventual shutdown injection facilities; and can also affect a company's capability to push water into the reservoir to maintain its pressure.

Types of Corrosion Found in Injector Systems

The type of corrosion caused by reservoir water depends on the chemical composition of that fluid. These waters can be composed of a wide range of chemicals including strongly acidic waters containing sulphur and halogen acids which actively corrode most common alloys.

The velocity of injection fluid can also affect the rate of corrosion. As velocity increases, the transport of oxygen to the surface becomes faster, so the corrosion rate increases. Injection velocity can also cause scouring of corrosion products, thus removing the protective film.

Oxygen: The Greatest Concern

The gas that causes real corrosive consequence in this environment is oxygen. Although the solubility of oxygen decreases to a minimum as the temperature rises near 100°C, it is very important to minimize CO2 contact with water. CO2 corrosion attack increases with increase in oxygen concentration, the organic acid by-product is referred to as carbonic acid (H2CO3).

Carbon-Dioxide Corrosion: Still of Concern

Carbon dioxide in water can contribute to corrosion of steel, but at equal concentrations it is much less corrosive than oxygen. The rate and amount of corrosion caused by dissolved carbon dioxide is dependent on the oxygen content, the salts dissolved in the water, temperatures and fluid velocities. Water containing both dissolved oxygen and carbon dioxide is more corrosive to steel than water that contains only an equal concentration of one of these gases.

Hydrogen Sulfide Corrosion

Hydrogen sulfide is often present in oil field production brines that are subsequently disposed by well injection. This practice has resulted in instances of severe corrosion in injection tubing, especially when brines become contaminated with oxygen.

Corrosion rate also increases in water containing hydrogen sulfide and is influenced by the presence of dissolved salts and carbon dioxide.

Chlorides: Causes Stress Corrosion cracking

The presence of chlorides in the well fluids attack pipe material and is influenced greatly by the temperature, chloride concentration and stresses in the metal. The presence of oxygen and low pH value accelerates the attack on the metal.

Elemental Sulfur Corrosion:

Elemental sulfur will be present in some reservoir fluids and is a very strong oxidant. It mixes with the water in the fluid and forms sulfuric acid and reacts to form sulfides. Corrosion due to elemental sulfur increases with temperature.

Methods To Combat Corrosion In Oil & Gas industry

Fighting corrosion continues to be a nightmare for many oil field staff. While there are many methods to prevent corrosion these are the three most common:

• Change the material of construction for the specific application.

• Reduce the intensity of corrosive attack by modifications in corrosive media.

• Create a barrier layer between the material and media to avoid the direct contact.

Corrosion Prevention: The Reality

Mitigating the effects of corrosion found in injection wells harsh environment can reduce expenses, lost revenue, and risks to safety and the environment. Yet, before making any changes to prevent corrosion remember there may be additional cost. It is more important to think in terms of life cycle costing, which may show a longer equipment life and lower maintenance cost in spite of high initial cost. Before any change is made a detailed study of the injector process and operating conditions should be carried out by a professional corrosion engineer.

Fiberglass Liners Prove To Provide One Effective Solution In Harsh Environments

There are effective ways to prevent corrosion in order to extend the life of the tubular. Operators have used a variety of coatings and liners including internal fiberglass lining.

Many major oil companies have found that fiberglass liners offer an ideal solution to prevent damage to pipe. This is due to fiberglass being strong and light weight for easy moving, as well as the material's effectiveness in providing a long-term corrosion prevention solution.

Duoline® Technologies offers a variety of liner selections that match material performance to specific application needs. The unique process of inserting a rigid plastic or GRE composite (Glass Reinforced Epoxy) liner sleeve inside the pipe eliminates the "holiday" potential.

Duoline® fiberglass liners are cured by applying internal heat to a hollow mandrel. This ensures that encapsulated air pockets do not occur on the liner's bodywall --- a major differentiation from liners produced using a thermal cure cycle which cures the outer diameter first and increases the potential for product failure by encapsulating air pockets on the liner's bodywall. This benefit, combined with the high hoop strength of the Duoline® GRE liners provides the most resilient available lining system for high-pressure gas service or water systems with high CO2 or H2S content.

Another important consideration for any corrosion resistant piping system is protection of the connection area, which is the strength of the DUOLINE® process.

Most coated tubing corrosion failures originate in the connection area and this is why Duoline® Technologies employs a reinforced elastomeric corrosion barrier ring (CBR), which is compressed between the liners in the connection make-up process. This compressed CBR is held in place by the liner, and prevents passing fluids from causing the all-too-common coupling failure. Duoline® Technologies employees a metal wire reinforced nitrile elastomer ring for API connections and a teflon glass filled corrosion barrier ring for premium gas tight connections.

Additionally, Duoline® Technologies recommends the presence of a trained DUOLINE® technician when DUOLINE® is installed or repaired at the well site.

For more information on Duoline: www.duoline.com

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A pipe severely compromised from corrosion attack. (click or copy image for hi-resolution version)

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