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Low Alloy Steel Susceptibility to Stress Corrosion Cracking in Hydraulic Fracking Environment

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Definition of terms

- Stress corrosion cracking is defined as the interaction of a tensile stress and aqueous environment acting on a susceptible metallic surface to initiate and propagate cracks.
- Hydraulic Fracking refers to the procedure of creating fractures in rocks and rock formation by injecting fracking fluid at a high pressure in order to allow more oil and gas to flow out of the formation into the well bore.

Electrochemistry Methodology

Cyclic Potentiodynamic Polarization

- Corrosion of low alloy steel in the different environments is determined by polarizing the sample in the anodic direction and the process is also reversed.
- The susceptibility of the sample to localized corrosion in different environments can be deduced from the curve by noting the open circuit, repassivation and breakdown potential.

Potentiostatic Test

- By subjecting the sample to potentials around the breakdown potential over a period of time, the stages leading to the breakdown of this metal is better understood.

Problem: Stress Corrosion Cracks (SCC)

- Pipelines used for the process of hydraulic fracturing constantly operate at very high pressure and thus are highly susceptible to stress corrosion cracking.
- Stress corrosion cracking in buried pipelines is a serious problem that may cause significant economic, environmental and human losses.
- The detection and prediction of SCC damage is becoming increasingly more important to ensure pipeline integrity.

Research Objectives

- Characterize the mode of cracking by the difference in low alloy steel susceptibility to pits and cracks at different pH conditions.
- Relate susceptibility of low alloy steel to chloride ion concentration.
- Compare the effect of different chemicals that perform the same function in fracturing fluid.

Sample after electrochemical testing

pH 5.6

pH 7

Sample after stress test in pH 7 solution

References