Southwest Research Institute®

Keywords

Sulfide Stress Cracking

Hydrogen Sulfide (H_2S)

High-Pressure High-Temperature Testing

Oil and Gas Production

Nuclear Energy Generation

Evaluation of Material Performance in the Energy Industry

Evaluation of the performance of materials in high-pressure, high-temperature, aggressive environments encountered in the energy industries has been an integral part of Southwest Research Institute® (SwRI®) programs for more than four decades. Programs have included:

- High-temperature, high-pressure tests for nuclear reactor conditions
- High-temperature hydrogen gas testing for refinery applications
- High-temperature testing in coal gasification environments
- High-pressure H_2S testing of full-scale coupling stocks
- Testing of steels and corrosion-resistant alloys in oil and gas production environments

Testing in Upstream Oil and Gas Environments

Stress corrosion cracking (SCC) of corrosion-resistant alloys in completion brines has been a problem in several offshore production areas. SwRI is conducting a joint industry program to develop guidelines for selecting brine compositions and additives to avoid SCC. In many applications steel undergoes multiaxial loading, whereas sour gas application criteria are typically based on uniaxial tests. A program of testing under combinations of internal pressures and external stresses conducted at SwRI is helping to develop better design criteria. As wells become increasingly sour, steels with resistance to highly sour environments need to be developed. SwRI is developing correlations between sulfide stress cracking resistance, microstructure, and absorbed hydrogen using a laser thermal desorption mass spectrometry system.

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Advanced instrumentation is used for both standardized and unique specialized testing. SwRI conducts tests in the presence of high-pressure hazardous gases such as H_2S with state-of-the-art analytical instrumentals.

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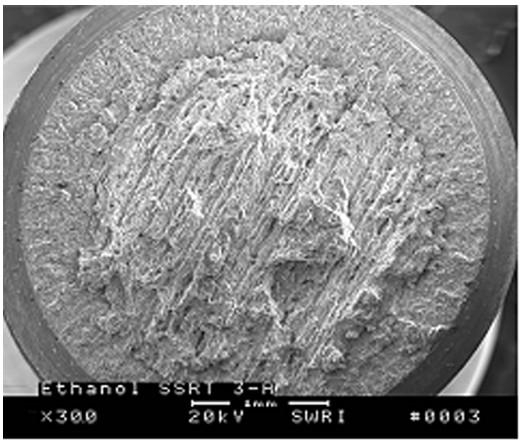
SwRI is investigating sulfide stress cracking resistance at different temperatures and under rigorous deoxygenation using a variety of test methods.

Testing in Downstream Oil and Gas Systems

Stress corrosion cracking of steel in fuel-grade ethanol is an important concern as ethanol is increasingly used to replace other fuel additives. SwRI is conducting a joint industry project to delineate the components in fuel-grade ethanol causing SCC.



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SwRI is evaluating the factors that cause stress corrosion cracking of steel in fuel-grade ethanol. Shown above are fracture appearances of test samples.

Nuclear Reactor Environments

SwRI has evaluated the SCC behavior of nuclear reactor steam generator environments. SwRI investigation of the effects of boric acid leakage in reactor pressure vessel control rod drive mechanism nozzles and other areas led to findings of high corrosion rates that were confirmed by recent findings of such corrosion in operating reactors. SwRI is engaged in further simulated boric acid leakage testing as part of an EPRI-funded program. SwRI is also equipped with a remotely operated hot lab that can accommodate radioactive sources for testing the effects of radiation or radiolysis.

Testing for Offshore Oil and Gas Systems

As offshore production systems move to deeper regions, the challenges to material performance increase. SwRI facilities can simulate the hydrostatic loads encountered in deep ocean fields on electronics packages as well as coating/insulation materials. A recent program investigated the effectiveness of cathodic protection under insulations used in deep waters, as well as the combination of cyclic loads from wave action.

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SwRI is currently undertaking a major joint industry program to evaluate stress corrosion cracking of materials in completion fluids for oil and gas production.

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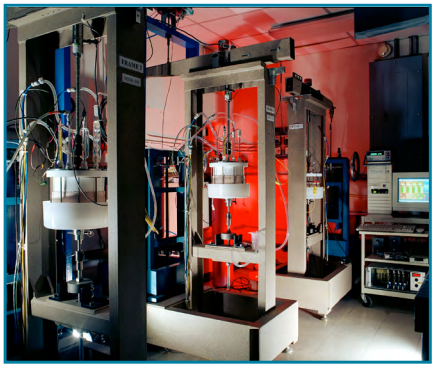
The effect of boric acid leakage from high-pressure, high-temperature fluids in flanged joints leads to deposits of borate and high corrosion rates. SwRI constructed facilities to simulate this process and conducted extensive testing.



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To measure service loads, SwRI-built stress corrosion cracking test frames can simulate a slowly oscillating load superimposed on a static load.

Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,200 employees who perform contract work for industry and government clients.

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