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**Research Project
Report
No. 2003-4-SMRI**



**STATE OF THE ART REVIEW OF THE
UNDERSTANDING, MITIGATION AND MONITORING OF
CORROSION IN BRINE AND WATER PIPING, TUBING AND
CASING AT BRINE PRODUCTION AND HYDROCARBON
STORAGE CAVERN FACILITIES**

prepared by

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EXECUTIVE SUMMARY

Subsurface Technology, Inc. (Subsurface) and their subcontractors, John Smart Consulting Engineers and RT Consultants, were contracted by the Solution Mining Research Institute to perform a state of the art review of the understanding, mitigation, and monitoring of corrosion in brine and water piping, tubing and casing at brine production and hydrocarbon storage cavern facilities. This report presents a comprehensive description of corrosion processes, mitigation measures, and monitoring techniques applicable to the brine production and hydrocarbon storage cavern facilities.

Corrosion in brine solutions is a major cause of equipment degradation, pipeline failure, and downhole tubular failure in the brine mining and hydrocarbon storage industries. The main cause of corrosion is the presence of dissolved oxygen in brine and fresh water. Corrosion rates are highest at about 3% salt, falling to lower rates at higher brine concentrations due to reduced oxygen solubility.

Pitting corrosion is a more rapid penetration form of corrosion caused by oxygen concentration cells under sediment, gas bubbles and possibly microbiologically influenced corrosion. Bacteria do exist which can live in saturated brine solutions, but research to date has not identified halophilic bacteria known to be corrosive.

The most effective method of both general and pitting corrosion control is to deaerate the brine. Inorganic anodic inhibitors, such as polyphosphate, can also be used in brine mining to both control corrosion and to suppress calcium solubility.

A regular pigging program, based on wire brush bi-directional pigs, is recommended to control corrosion, especially pitting in the top and bottom of a pipeline. To ensure the integrity of a pipeline and to reduce risk, a corrosion monitoring program to determine actual corrosion rates should be implemented using the following or a combination of the following:

- coupons,
- linear polarization resistance probes,
- electrical resistance probes, and
- or galvanic probes.

Downhole tubulars should also be regularly inspected using one or more of the following:

- digital caliper tools,
- electromagnetic magnetic flux leakage tools,
- electromagnetic phase shift tools,

- ultrasonic casing inspection tools, or
- downhole video camera.

The understanding of the processes of corrosion, as well as corrosion mitigation, is important to the brine mining and hydrocarbon storage industries as failure of pipelines and downhole tubulars can result in large financial losses, as well as the loss of life.