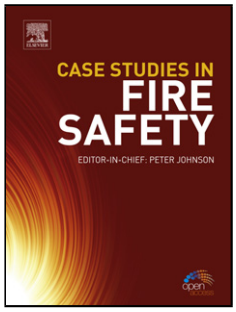

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PII: S0010-938X(16)30400-0
DOI: https://doi.org/10.1016/j.corsci.2018.03.020
Reference: CS 7436

To appear in:

Received date: 25-7-2016
Revised date: 3-3-2018
Accepted date: 13-3-2018

Please cite this article as: Wei L, Pang X, Gao K, Effect of flow rate on localized corrosion of X70 steel in supercritical CO_2 environments, *Corrosion Science* (2010), https://doi.org/10.1016/j.corsci.2018.03.020

Effect of flow rate on localized corrosion of X70 steel in supercritical CO_2 environments

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Highlights

(1) Effect of flow rate on supercritical CO_2 corrosion of X70 steel was studied.
(2) Flow rate changed the predominant corrosion type of X70 steel.
(3) Localized corrosion rate gradually increased with time under dynamic condition.
(4) There were two different localized corrosion mechanisms in dynamic aqueous phase.
(5) Pit diameter for $FeCO_3$ scale growth decreased exponentially with flow rate.

Abstract

The effect of flow rate on localized corrosion of X70 steel in supercritical CO_2-saturated aqueous phase was studied. Results shown that flow rate changed the predominant type from general corrosion (static condition) to localized corrosion (dynamic condition), and the localized corrosion rate gradually increased with time under dynamic condition. The main localized corrosion type initiated at the early corrosion stage the local spalling amorphous layer transformed to $FeCO_3$ scale, and localized corrosion could also occur due to the broken of dense $FeCO_3$ scale. The critical diameter of the pit for $FeCO_3$ scale growth inside it decreased exponentially with flow rate.

Key words: A. Carbon steel; B. SEM; B. XRD; C. Acid corrosion

1. Introduction

Global climate warming caused by CO_2 emission is becoming increasingly significant with the growing demand for fossil energy. Carbon capture and storage (CCS) is considered to be one of the effective options to reduce CO_2 emission [1]. The captured CO_2 is normally injected into the deep geological layers (such as saline formations and unminable coal seams [2]) for permanent storage, or oil/gas fields to enhance oil/gas recovery. In recent years, CO_2-enhanced oil/gas recovery technology has attracted more attentions due to its positive contribution to geological storage of carbon [3]. In addition, as the demand for energy rises expeditiously, the exploitation of deep-water oil and gas fields becomes more valuable, which