Corrosion Behavior of P110 Casing Steel in Concrete Exposed to Simulated CO₂-Containing Formation Water at 80 °C

Xingguo Zhang^{1,2}, Bensong Wu^{1,3}, Jiaji Zhang³, Jingxue Li³, Shuliang Wang^{1,3,4,*}, Lijin Dong^{1,3}, Li Liu^{1,3}, Dinghan Xiang⁴

¹ State Key Laboratory of Oil and Gas Reservoir Geology and Exploitation, Southwest Petroleum University, Chengdu 610500, P.R. China

² School of Petroleum Engineering, Southwest Petroleum University, Chengdu 610500, P.R. China

³ School of Materials Science and Engineering, Southwest Petroleum University, Chengdu 610500, P.R. China

⁴ Guangxi Key Laboratory of Information Materials, Guilin University of Electronic Technology, Guilin 541004, Guangxi, China

*E-mail: wsliang1465@126.com

doi: 10.20964/2019.11.04

Received: 27 May 2019 / Accepted: 10 August 2019 / Published: 7 October 2019

Saturated brine cement slurry is widely used to solve the cementing problem in salt–gypsum layers, and the cement and its first interface play a key role in the integrity of oil wells. In this paper, the electrochemical properties, mechanical properties, and microstructure of a saturated brine cement/casing system were studied in simulated formation water containing saturated CO₂ at 80 °C for 10–60 days. The results show that the cement and its first interface were affected by the cement hydration and corrosion due to the CO₂ and Cl[–], resulting in an initial increase and then a subsequent decrease in the performance of the cement matrix and interface transition zone. With an increase in the immersion time, the microstructure of the cement matrix first became dense and then gradually became loose and porous. The casing steel was corroded by Cl[–] and CO₂. At the same time, the CO₂ permeation was faster than the reaction step with the cement matrix, and the first interface was destabilized before the cement stone was severely corroded.

Keywords: Saturated brine cement; CO₂ corrosion; Electrochemistry; Interface; Casing

[FULL TEXT](#)

© 2019 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).