Corrosion behavior of P110 steel in CO_2-saturation solution with high concentration of Cl^- and Ca^{2+} under high temperature and pressure

Ya-ni Zhang[1], Jin-heng Luo[2], Yan Long[2], Bing-Fan[2]

[1]*School of Materials Science and Engineering, Xi'an Shiyou University, Xi'an 710065, China*

[2] *CNPC Tubular Goods Research Institute, Xi'an 710077, China*

Zhangyn@xsyu.edu.cn

Abstract With the development of oil and gas resources, the formation water with high concentrations of Ca^{2+} and Cl^- has put forward higher requirements for the safe service of tubular columns. In this study paper, the underground environment is simulated using high-temperature and high-pressure autoclave; electrochemical research results are combined; and the effects of Ca^{2+} concentration, corrosion temperature, and corrosion time on the corrosion behavior of P110 steel in CO_2- saturation solution are analyzed. Research results show that the presence of Ca^{2+} promotes the acidification of the solution and accelerate the dissolution of the P110 steel. The trend of corrosion rate and Ca^{2+} concentration in high-Cl^- solution is a “V” curve. The highest corrosion rate of 2.2 mm/a occurs in 1080 mg/L Ca^{2+} CO_2-saturated NaCl solution. As the temperature increases, the corrosion rate of P110 steel decreases. The corrosion rate is approximately at a constant value above 120 °C. In addition, higher Ca^{2+}concentration in the solution increases the probability of pitting for P110 steel. For $Fe_xCa_{1-x}CO_3$ compounds, no strict ratio is observed between Fe and Ca, and the shape of the product depends on the concentration of Ca^{2+} ions in the solution.

Keywords P110steel; High-Cl^- and Ca^{2+} solution; Corrosion growth mechanism; High temperature and pressure