The high-pressure flow accelerated corrosion and its migitation at the gradual contraction and gradual expansion pipes

Li Zeng[1,2,*], Tai Ma[2], Dongrun Li[2],Yewei Zhao[2]

[1]*School of Electrical and Information Engineering, Wuhan Institute of Technology, Wuhan, 430205, PR China*

[2]*School of Mechanical and Electrical Engineering, Wuhan Institute of Technology, Wuhan, 430205, PR China*

li_zeng@wit.edu.cn

Abstract: The flow accelerated corrosion (FAC) behavior and the inhibition on FAC of X65 steel gradual contraction and gradual expansion pipes under high-pressure conditions were studied by high pressure dynamic in situ electrochemical methods. The FAC rate is reduced along the flowing direction of gradual contraction pipe. However, the FAC rate is firstly decreased and subsequently increased along the gradual expansion pipe. For the inhibition on FAC, there is no noticeable inhibition effect at extremely low inhibitor concentration. The polarization resistance and inhibition efficiency ascend firstly and then decend along the gradual contraction pipe at low inhibitor concentration. Nevertheless, the polarization resistance is generally decreased along the gradual expansion pipe. At higher inhibitor concentration, the polarization resistance and inhibition efficiency drops overall along the gradual contraction pipe. However, the polarization resistance is enhanced, followed by a fall along the gradual expansion pipe. The FAC rate and inhibition effect at the top of gradual contraction pipe is symmetrical to that at the bottom wall while it is asymmetrical at the top and the bottom of inclination section in gradual expansion pipe. The secondary flow and vortexes is present at gradual expansion pipe while they do not appear at gradual contraction pipe. The distribution of corrosion rate and distinct inhibition effect at different inhibitor concentration are associated with hydrodynamic characteristics at gradual contraction and gradual expansion pipes. The findings could provide theoretical foundation for the protection of flow accelerated corrosion at gradual contraction and gradual expansion pipes in high CO_2 partial pressure environments.

Keywords: High CO_2 partial pressure; flow accelerated corrosion; Gradual contraction/gradual expansion pipes; Hydrodynamics; Inhibition

* Corresponding author.
E-mail address: li_zeng@wit.edu.cn (Li Zeng), pg01074075@163.com (Hanxin Chen)

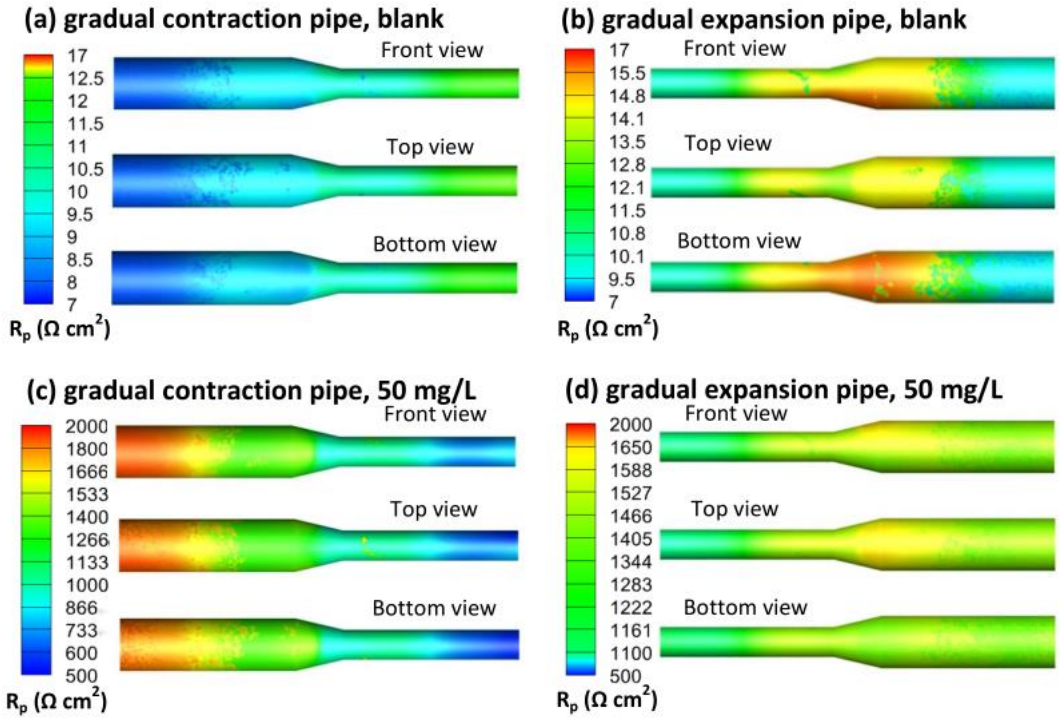

Fig. 1. Contours of polarization resistance distribution at gradual contraction pipe and gradual expansion pipe in uninhibited and inhibited solution: (a) gradual contraction pipe, blank, (b) gradual expansion pipe, blank, (c) gradual contraction pipe, 50 mg/L, (d) gradual expansion pipe, 50 mg/L.

Reference

[1] S. Nesic, K.-L.J. Lee, Corrosion 59(7) (2003) 616-628.

[2] I.B. Obot, I.B. Onyeachu, S.A. Umoren, Corros. Sci. 159 (2019) 108140.