Effect of Carbonate and Chloride Ions on the Corrosion Susceptibility of Pipeline Steel Samples Artificially Aged

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doi: 10.20964/2018.02.53

Received: 2 October 2017 / Accepted: 30 November 2017 / Published: 28 December 2017

This work deals with the corrosion behavior of pipeline steel samples (API 5L X52 and X70), artificially aged through heat treatment, in the presence of aqueous solutions containing either carbonate CO_3^{2-} , or chloride Cl^- anions, usually present during normal operating conditions. It was found from resistance to polarization measurements that Cl^- ions were more aggressive toward the materials tested than CO_3^{2-} . Furthermore, from thermodynamic predominance zone diagrams, PZD, and SEM-EDS characterization of the surfaces exposed to the corrosion environment, it is shown that Cl^- ions promoted formation of soluble Fe(II) chloro-complexes, which were the species produced during steel corrosion. These facilitated exposure of metal zones that had been first covered with corrosion products that formed under conditions of local chlorides-depletion, although now they had dissolved through the chloride interaction. This in fact eliminates the possibility of consolidating a passive layer. Conversely, when the CO_3^{2-} are present, dissolution of passivating products like insoluble Fe(II)- CO_3^{2-} complexes is less likely to occur, thus aiding to diminish the corrosion rate.

Keywords: artificial ageing; steel; corrosion; carbonates; chlorides; predominance zone diagrams

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