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ABSTRACT Ceocor 2018

Modeling pipeline steel passivation

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Metals that passivate have a low corrosion rate because of the protective film that is formed on the metal surface. Passivity of carbon steel is achieved if the pH at the metal surface is sufficiently high to form a protective layer, as is the case for rebars in concrete and well controlled cathodic protected structures. The protective film however can be destroyed if the electrolyte conditions at the metal surface changes or, if a significant change in polarization potential occurs. As a result uniform or localized corrosion rate increases.

A time-dependent computational model is proposed that calculates the corrosion rates of pipeline steel. The model takes into account the electrolyte chemistry, soil properties, the polarization level of the pipeline, the coating geometry, the electro kinetic Butler-Volmer equations, the formation and destruction of the passive film and the built-up of corrosion products. Simulations are performed for a variety of CP conditions demonstrating the corrosion and passivation behavior of the steel with the corresponding IR-free and current density.