Machine learning-assisted exploration of microbiologically influenced stress corrosion of pipeline steel

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Abstract Numerous tests have demonstrated the impact of microbiologically influenced stress corrosion (MISC), but the dynamic corrosion process and its influencing variables are still unclear. In this work, corrosion monitoring sensors were used to gather data on materials, microorganisms, and environmental factors. Based on the random forest model, the significant effects of environmental temperature, the quantity of bacteria, kernel average misorientation (KAM), low angle grain boundary (LAGB) and prior austenite grain boundary (PAGB) on MISC were analyzed. The findings demonstrated that, under various loads and structures, the corrosion monitoring sensor can accurately depict the dynamic corrosion process of Bacillus cereus on X80 steel. Following base metal (BM) with stress, coarse-grained heat-affected zone (CG), and BM, the cumulative corrosion quantity of CG with stress during the test period was the greatest. The early stage of immersion was a crucial time that affects corrosion as opposed to the middle and later stages. Temperature, LAGB, and bacterial count were the primary factors influencing X80 steel without stress. The key factors in the stress instance were the quantity of microorganisms, KAM, and PAGB. This served as the theoretical foundation for the explanation of the mechanism by which that nitrate-reducing bacteria promote stress corrosion cracking. The findings will impact upcoming conservation initiatives and advance our understanding of MISC.

Keywords Microbiologically influenced corrosion, Stress corrosion, Machine learning, Nitrate-reducing bacteria.