A Study of The Effect of Load on the Depth of Sulphide Stress Corrosion of Steel used in Petroleum Pipelines

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The phenomenon of sulfide stress corrosion (SSC) can result in catastrophic failures in pressurized equipment and piping leading to extensive damages, injuries and possible fatalities. Sulfide stress corrosion, a major degradation process in metals, is commonly associated with the petroleum industry where a high concentration of H_2S is involved. This research focuses on developing a relation between depth of SSC and applied load under a constant H_2S concentration for a given time period. Furthermore, the mechanism of the propagation of sulfide stress corrosion is studied via microstructural analysis. According to the NACE standard solution "B" at the room temperature, the corrosion behavior of pipeline steel was evaluated. A special apparatus according to the NACE standards was fabricated for the testing process. The prepared samples of pipeline steel API 5L Grade B was tested under set of pre-determined loads while maintaining constant H_2S concentration and pH value of 3.0 ± 0.5 for a constant time period. Thereafter, SEM microscopy and EDAX analysis were performed on the cross sections of corroded specimens. Relations of depth of corrosion versus applied load, and load at fracture versus applied load have been developed. Also, an interpretation is given for the propagation mechanism of SCC in terms of microstructural analysis. The ultimate objective of this work is to develop a model to predict the depth of corrosion occurred under different H_2S concentrations, loads/pressure and exposure time periods.

Keywords: Sulphide stress corrosion, API 5L steel, Depth of corrosion, Load at fracture