VOLTAGE-INDUCED VOID FORMATION IN HIGH-TEMPERATURE OXIDE SCALES OF BOILER TUBES

0 Citations

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Rosdin, Muhammad Rafiq Haikal [a]; Bakar, Syed Noh Syed Abu [b]; Hamid, Abd Malek Abdul [a]; Ismail, Ahmad Abdul Mun'im [a]; Ani, Mohd Hanafi [a]

[a] Department of Manufacturing and Materials Engineering, Kulliyyah of Engineering, International Islamic University Malaysia, Selangor, Gombak, 53100, Malaysia

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Abstract

Corrosion monitoring remains a significant challenge at high temperatures. Understanding the varying factors in high-temperature cathodic protection is crucial for developing mitigation strategies and predictive maintenance. This study assesses how cathodic protection influences oxidation in T91 alloys at elevated temperatures by evaluating the effects of exposure duration and voltage-induced void development in the oxide layer. It is hypothesized that polarizing the sample affects the diffusivity of cations and anions in the oxide scale, which is the rate-determining step of the oxidation process. This study measured the number of voids directly on T91 alloys exposed at 823K under various induced voltages. T91 alloy was externally induced with voltages of 0V, 50V, and 300V for 43.2 ks, 259.2 ks, and 432 ks at 923 K in air (P_{O2}= 0.21 atm = 2.1×10^4 Pa). The presence of oxide layers wasanalysed using X-Ray Diffraction (XRD), and the void formed was inspected using Scanning Electron Microscopy (SEM). XRD results reveal that Fe_2O_3, Fe_3O_4, $FeCr_2O_3$, and Cr_2O_3 peaks were formed on all samples. The parabolic rate constant, Kp, was calculated as 3.83×10^{-14} m^2/s, 2.17×10^{-14} m^2/s, and 9.25 × 10-14 m^2/s, respectively, verifying that the reaction occurred by solid-state diffusion. Changes in K_p at different induced voltages are clear evidence that the diffusivity was altered by external electrical potential. It was observed that the overall void formation decreased by 17%. Inducing voltage onto T91 alloy affects the ionic diffusivity. It changes the void formation,

Detailed information

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Authors (5)

Rosdin, Muhammad Rafiq Haikal [a]

Bakar, Syed Noh Syed Abu [b]

Hamid, Abd Malek Abdul [a]