Analytical Simulation of Hydrogen Induced Internal Loading on Metals

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ABSTRACT

In order to understand hydrogen-induced internal loading on metal, this thesis utilizes CFD (Fluent) software to analyze and simulate the metal system using various parameters including hydrogen diffusion velocity, pressure, concentration and temperature. When the hydrogen diffusion velocity of the boundary condition was set at 0.001 m/s, the analysis and comparisons were done for three metal materials, namely stainless steel (316,314), copper and low-ferritic alloy stainless steel. This result shows that when copper and stainless steel increase their interstitial internal lattice stress at elevated temperature while the low-ferritic alloy stainless steel decreases its stress . When the velocity increases from 0.001 to 0.006 m/s at a fixed temperature of 373K, 873K and 1273K, respectively, the more the velocity increase, the less the stress and internal loading of the stainless steel was observed. The pressure and temperature will be explained in the same time; when the temperature increases the hydrogen atom becomes active, causes mutual collision, and consequently increases the pressure. When the external pressure at the outer surface of the material increases, the relative stress of the hydrogen atom in lattice increases. With respect to the concentration, the simulated concentration from the measured solubility can calculate concentration value, consequently the stress of the material structure can be obtained when the hydrogen enters the material. When hydrogen concentration increases the stress of the hydrogen atom is increased.

Keywords : stress ; simulation ; solubility ; concentration

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