

ABSTRACT

Slow strain rate technique (SSRT) has been employed to detect the susceptibility for hydrogen embrittlement (HE) of high strength drill pipes of steel alloys (G105 and E75) in air , in drill fluid having different pH (4 - 10) under hydrogenation conditions , and under controlled temperature .

Most of the structure of drill pipes is fabricated from high strength Fe - alloy . In Iraqi drill company used G105 , E75 , all of which as susceptible to corrosion , particularly to HE , therefore , HE had been reported as the main problems associated with the Fe - alloys used in this industry . Moreover drill pipe may have local regions such as hard spots or pits which are more sensitive to degradation than the bulk of the metal pipe . When steel alloys with strength levels and microstructures similar to those of local hard regions are exposed to hydrogen , they are susceptible to various from delayed of reductions of their mechanical properties to cause HE .

The elongation after fracture (EL %) , reduction of area (RoA) , fracture stress (σ_f) , energy fracture (E_f) , and ultimate tensile stress (σ_{UTS}) have been found as a suitable criteria to describe the HE susceptibility when testing under air conditions . While the elongation (EL %) , reduction of area (RoA) , and fracture stress (σ_f) have been found as

a suitable criteria when testing under bubbling of H_2 - gas of different flow rate ($27 \times 10^6 \text{ mm}^3/\text{h}$, $54 \times 10^6 \text{ mm}^3/\text{h}$, $81 \times 10^6 \text{ mm}^3/\text{h}$ and $108 \times 10^6 \text{ mm}^3/\text{h}$).

Also these criteria had successfully used to observe any effect on susceptibility degree when testing under controlled temperature (0-80 $^{\circ}\text{C}$). In present work , HE susceptibility has been detected by the decrease of mechanical properties like EL% , RoA , f , that occur at the certain strain rate and under certain conditions of environment .

Hardness measurements and metallographic examination are used essential for inter reaction of (SSRT) results and can provide both qualitative and quantitative descriptions of HE severity . Brittle surface fracture provides useful parameter . Therefore fractographic examination is necessary to be sure whether HE has occurred or not .

The results showed that these alloys exhibited increasing susceptibility with decreasing pH , while no susceptibility detected in laboratory air and in drill fluid of high pH . Alloy E75 at different condition exhibits more resistance to HE than alloy G105 . This behaviour has been attributed to the difference in chemical composition which effected on the diffusion control of H_2 into structure since the diffusion and the permeability of H_2 depend on the type of alloy and the condition of the environment .

The (SSRT) , has been found that , it permits an accelerating testing method to detect HE susceptibility for high strength steel alloys at different environments , then the performance of these alloys at different service conditions .