World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:02, 2018

Modeling of Ductile Fracture Using Stress-Modified Critical Strain Criterion for Typical Pressure Vessel Steel

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Abstract : Ductile fracture occurs by the mechanism of void nucleation, void growth and coalescence. Potential sites for initiation are second phase particles or non-metallic inclusions. Modelling of ductile damage at the microscopic level is very difficult and complex task for engineers. Therefore, conservative predictions of ductile failure using simple models are necessary during the design and optimization of critical structures like pressure vessels and pipelines. Nowadays, it is well known that the initiation phase is strongly influenced by the stress triaxiality and plastic deformation at the microscopic level. Thus, a simple model used to study the ductile failure under multiaxial stress condition is the Stress Modified Critical Strain (SMCS) approach. Ductile rupture has been study for a structural steel under different stress triaxiality conditions using the SMCS method. Experimental tests are carried out to characterize the relation between stress triaxiality and equivalent plastic strain by notched round bars. After calibration of the plasticity and damage properties, predictions are made for low constraint bending specimens with and without side grooves. Stress/strain fields evolution are compared between the different geometries. Advantages and disadvantages of the SMCS methodology are discussed.

Keywords : damage, SMSC, SEB, steel, failure
Conference Title : ICFMCP 2018 : International Conference on Functional Materials Chemistry and Physics
Conference Location : Paris, France
Conference Dates : February 19-20, 2018