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Modeling and Calibration for Fracture of Bulk Material with Validation on SENT Compact Specimens

by

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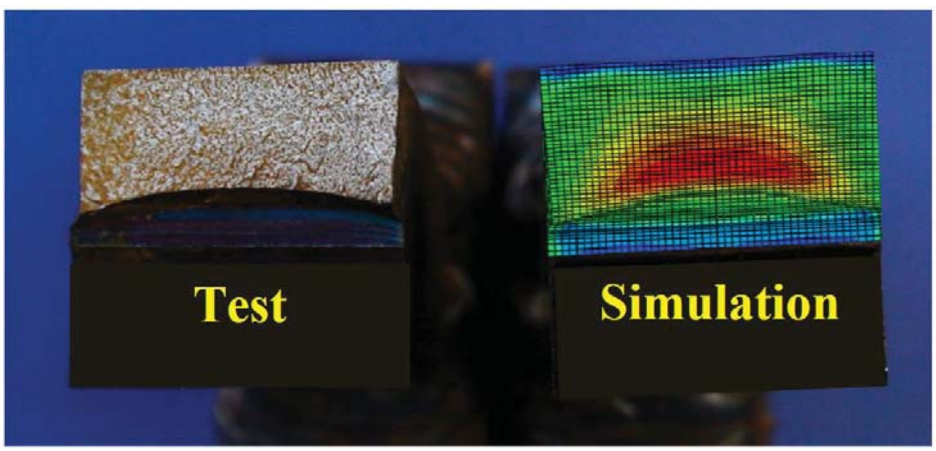

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Modeling and Calibration for Fracture of Bulk Material with Validation on SENT Compact Specimens

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Abstract

This paper provides results from a comprehensive study on mechanical characterization of high-strength pipeline steel, grade X100 using experimental and numerical methods. The material was characterized for anisotropic plasticity, fracture initiation for various states of stress, (pre-cracked) fracture toughness and uncracked ductility. The experimental program included tests on flat butterfly-shaped, central hole, notched and circular disk specimens for low stress triaxiality levels; as well as tests on round notched bar specimens and SENT fracture mechanics tests, for high values of stress triaxiality. This program covered a wide range of stress conditions and demonstrated its effect on the material resistance. Parallel to the experimental study, detailed numerical investigations were carried out to simulate all different experimental tests. Using an inverse method, a 3-parameter calibration was performed on the Modified Mohr-Coulomb (MMC) fracture model. Subsequently, the predictive capabilities of the MMC were evaluated by the comparison to the fracture toughness tests results, used extensively in the pipeline industry. The capabilities of the MIT fracture model have been demonstrated on an example of high strength offshore steel, X100. The outcome of this study was not only to provide, the overall characterization of the fracture behavior of this material as an example, but also to present the methodology on how to use the MMC model as a practical tool in pipeline design.

Keywords: ductile fracture; SENT tests, high-strength pipeline material; X100; Modified Mohr-Coulomb model; triaxiality and Lode angle dependence

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