

Application of enhanced Gurson-like ductile damage models to simulate cracking in pipeline steels under wide range of constraint conditions

Abstract

The finite element method (FEM) based on an enhanced Gurson-like ductile damage model was used to investigate the ductile crack growth behaviors on X80 pipeline steels. The implemented model can account for several ductile damage anisotropies which cannot be accommodated by the standard Gurson-Tvergaard-Needleman (GTN) model. This limitation narrows the applicability of the GTN model to constraint conditions similar to the data used to calibrate the model. It is demonstrated in the study that the implemented enhanced model significantly improves upon the GTN model and can accurately predict the ductile fracture behavior over a wide range of constraint conditions based on the same calibration data. The ductile damage model was used to analyze ductile crack growth behaviors in single-edge notched bending (SENB) and single-edge notched tension (SENT) specimens. A wide range of SENT crack geometries were analyzed. These specimens represented a wide range of constraint conditions. The numerically calculated crack growth resistance curves were compared to the experimental J-R curves and curves developed using the GTN model.

Bio - Arnav Rana

I am a PhD candidate under the supervision of Dr Xin Wang and Dr Ron Miller. I also work as an engineering specialist at BMT Canada. I have been working in the oil and gas pipeline industry for the past 8 years, providing consulting services regarding pipeline integrity management. The research I have been conducting focuses on studying various anisotropic aspects of ductile fracture in pipeline steels. The objective of the research was to develop an anisotropic numerical ductile damage model applicable to a wide range of pipeline steels and crack constraint conditions.