Rudland, D., Wilkowski, G., **Wang, Y.-Y.,** Horsley, D., Rothwell, B., and Glover, A., Development of a Procedure for the Calculation of J-R Curves from Pressed-Notch Drop Weight Tear Test Specimens, Proceedings of 4th International Pipeline Conference, 2002, Calgary, Alberta, Canada, Paper No. IPC2002-27028

Abstract

Over the last few years, there have been ongoing efforts funded by TransCanada PipeLines Limited to develop a more fundamentally based procedure to extract a true measure of the dynamic steady-state fracture toughness of linepipe steels. As part of this effort, considerable research has focused on the dropweight tear test (DWTT) specimen as the baseline specimen to be used in this development. Using instrumented DWTT test equipment, dynamic load-displacement histories were extracted from the experiments. In addition, a visual measure of the crack growth, and the crack-tip-opening angle (CTOA) were obtained from high-speed video equipment. A procedure has been developed using detailed three dimensional finite element analyses that calculate the J-integral as a function of crack growth for these dynamic experiments. The results from these analyses have been verified using published procedures on similar scale specimens. This paper presents the development of a procedure for calculating the dynamic J-R curve from the load-displacement trace of a pressed-notch DWTT specimen. The slope of the JM –R curves generated provides technical insight into the range of steady-state propagation that occurs during these experiments. The slope of the JM -R curve (dJM /da) is compared to the visually measured CTOA values and conclusions about the relationship between these parameters and the steady-state propagation energy are made. These results are key in the development of a procedure to predict steady-state fracture propagation from laboratory specimen data.

Keywords

Fracture mechanics, J-R curves, Fracture resistance, Drop-weight-tear test