PROCEEDINGS PAPER

NUMERICAL PREDICTION OF FRACTURE TOUGHNESS OF A REACTOR PRESSURE VESSEL STEEL BASED ON EXPERIMENTS USING SMALL SPECIMENS

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Abstract:

Due to limited availability of irradiated material and safety concerns when testing large, irradiated specimens, a major effort is being made in nuclear materials research to establish small specimen testing techniques for determining the fracture resistance of reactor pressure vessel (RPV) steels. The ASTM E1921 standard is used extensively to estimate fracture toughness of ferritic steels in the ductile-to-brittle transition region. Because of the inherent low constraint of small specimens, many test results exceed the fracture toughness limit specified in the standard, resulting in wasted material. To avoid this problem, finite element analysis using the cohesive zone model is applied to predict the fracture toughness of standardsized specimens based on small specimen test results. Those tests were carried out within the framework of the FRACTESUS project using miniaturized compact tension specimens. The parameters of the cohesive zone model are calibrated by means of a hybrid experimental-numerical approach. After identification of the parameters on small specimens, the simulation of a standard-sized geometry is performed, and the resulting fracture toughness is compared to the small specimen data.

Keywords: Fracture toughness; RPV steel; small specimens; brittle fracture; cohesive zone model.

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