Structure Mechanics Analysis of Experiments with Cracks in Dissimilar Welds of Piping
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Dissimilar welds are used for the connection between ferritic and austenitic piping at different positions depending on the plant design. Due to the heterogeneous material sequence with partly strong material property differences the international operating experience shows several incidents with disbonding, cracks or leaks. The goal of the conducted work was to qualify the fracture mechanic assessment methods of such configurations.

> The ADIMEW Experiment
A displacement controlled large scale Four-Point-Bending test was conducted at EdF within the 5th Framework Programme of the EU. The dissimilar weld was manufactured according to French specifications.

The crack loading is determined by the J-Integral. A variation of the virtual crack extension direction shows, that the J-Integral value reaches the maximum at 75-80° direction and not in the original crack direction, which is 65°. The results show, that crack initiation and the direction of the first crack growth can be predicted in agreement with the measurements.

Because no standards are available for the testing of such heterogeneous materials, the tests on small scale specimens show uncertainties for the mechanical characterization and a large scatter for the crack initiation value. The analysis results agree very good in the deformation, but overestimate the load compared to the experiment. The differences are due to uncertainties in the material properties and the definition of the initial conditions at zero load. Therefore the assessment of the analysis results includes a large scatterband.

> GRS Analysis with 3D Finite Element Model
The simulation includes the material sequence with a change in strength of more than two from the austenitic to the ferritic side and was done without crack growth.

> Conclusions
A fracture assessment based on the J-Integral can be done in principle, but there is a need for procedures to get reliable material data from small specimens with heterogeneous material sequences. Also simplified assessment procedures should be further developed.

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