

Chen, Y., Wang, Y.-Y., and Horsley, D., An Updated Cooling Rate and Microstructure Model for Pipeline in-Service Hot-Tap Welds, Proceedings of 6th International Pipeline Conference, Calgary, Alberta, Canada, September 25- 29, 2006, Paper no. IPC2006-10496

Abstract

This paper describes an improved numerical model for the predictions of cooling rate and heat-affected-zone (HAZ) hardness for welding onto an in-service pipeline. Compared to the current PRCI thermal analysis software, the improvements in this new model include a new mesh generator for the heat transfer finite element procedure and a dynamically-coupled microstructure model that features a state-of-the-art phase transformation and hardness calculation algorithms. The new mesh generator is capable of producing finer mesh than that in the current PRCI thermal analysis software, particularly in the HAZ region so more accurate temperature field can be captured for the hardness calculation.

To validate the implementation of these improvements in the model, previous measurements by Battelle and EWI have been collected and compared to the predicted results by the new model. These measurements include cooling times from 800°C to 500°C ($t_{8/5}$) for both sleeve and branch configurations, and hardness in the HAZ for some of the sleeve configurations.

Keywords

Cooling rate, Hot-tapping, In-service welding, Microstructure