

## OPTIMIZING STEEL WELDING PROCEDURES BY USING NEUTRON AND X-RAY DIFFRACTION

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The carbon manganese steel is widely used as structural material (e.g. alumina production industry) and has a tendency to suffer from caustic stress corrosion cracking (CSCC) adjacent to welds. The susceptibility to CSCC is a function of the residual stress produced as a result of welding and the heat affected zone (HAZ) microstructure. Traditionally the industry uses post weld heat treatment (PWHT) to reduce the residual stresses arising from welding but this is a costly exercise for some of the large plant involved.

A research project has been established to develop a welding procedure that provides the lowest possible as-welded residual stress to potentially avoid having to carry out PWHT. The welding variables being addressed are weld-metal yield strength, weld heat input and pre-heat/inter-pass temperature. An experimental matrix has been established to explore these three variables by means of x-ray and neutron diffraction on the specifically designed test samples in order to incorporate a level of shrinkage constraint similar to that experienced when welding full sized structures. With the help of the diffraction techniques the role of the welding parameters on resultant stress was established, e.g. pre-heat and heat input can have as much effect on residual stress as weld metal (electrode) strength.

The project is being carried out by the Welding Technology Institute of Australia (WTIA), ANSTO, the University of Wollongong and the Australian Alumina Industry through the Industry Cooperative Innovation Program.