Recently, considerable research in the welding of austenitic stainless steels has again been developed by use for nuclear and the other energy applications. Austenitic Stainless Steel has been widely used as a weld filler to join the low-alloy steel reactor pressure vessel (RPV).

The chemical compositions of low-alloy steel A36 contain 0.22% C, 0.014% S and 0.015% P, and the weld filler austenitic stainless steel E308L contain 19.07% Cr, 9.99% Ni, 0.026% C, 0.534% Si, and the E309L, 23.65% Cr, 12.49% Ni, 0.028% C, 0.421% Si. The welding conditions were chosen based on the construction specifications of the nuclear power plants. The weld deposit a coating of three layers of stainless steel, the first pass with E309L electrode and others two steps with E308L electrode on a carbon steel plate type A36 (figure 1), simulating the properties of the inner lining of a vessel (cladding) of the BWRs reactor. Plate type A36, with dimensions 28.09 x 10.63 x 1.26 cm, were welded under a constrained conditions using shielded metal arc welding (SMAW) (75 A and 22 V), interpass temperature ≤ 90°C.

The metallographic examination of the weld were realized by optical microscopy and scanning electron microscopy (SEM), energy dispersive X ray (EDX), using the microscopes JEOL JEM 6010LV. The specimens were cut from center area of the weld metal (10 mm X 10 mm X 10 mm). The transverse section of the weld were polished, etched with 3 pct Nital for 15 seconds the carbon steel A-36, and the weld metal, heat-affected zone (HAZ) with aqua regia, and then examined [1]. As a result of welding, these materials may, depending on composition, solidify with a structure different. One problem with fusion welding of these materials is their susceptibility to solidification cracking. Cracks have been found in various regions of the weld zone with different orientations in the weld zone (figure 2), such as centerline cracks, transverse cracks, and micro cracks in the underlying weld metal or adjacent or HAZ. The general structure of the first weld pass consists of elongated columnar dendrites at the melt pool, where heat transfer is highly directional, and more equiaxed cellular dendrites in the middle with slower cooling (figure 3 and 4).

The Vickers hardness in the range of 165-220 HV, was increase of the steel plate to third weld pass [2].

REFERENCES

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Fig. 1: Carbon Steel Plate A-36 and austenitic stainless steel Weld metal.

Fig. 2: Carbon steel A36 and stainless steel 304 at 500X.

Fig. 3: Interface Carbon steel A36 and stainless steel, 500X

Fig. 4: Interface Carbon steel A36 and stainless steel