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Research Paper :

Effects of heat input on grain details of multipass submerged arc weld joint

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ABSTRACT

A detailed study on the microstructure, phase analysis and mechanical properties, HAZ width of submerged arc weld metal multi pass joint and heat affected zone of 16 mm thick mild steel plate was carried out using trinacular metallurgical microscopy. The bulk hardness, impact energy and micro hardness of a multipass welded joint were tested by Rockwell hardness testing machine, Charpy V Notch test and Vickers micro hardness test. The various sub-zones in the microstructure were observed in the HAZ of submerged arc weld are Spheroidized, partially transformed, grain refined and grain coarsened. The variation in hardness of weld metal, fractured surface and base metal were compared with the microstructure, to get a defect free weld, and also it was correlated with the microstructure of weld metal and heat-affected zone. The main purpose of present work is to investigate and correlate the relationship between the various parameters; Mechanical properties and microstructure of single "V" butt joint of mild steel plate, and also to perform the phase analysis of the multipass welded joint to get defect free welded structures

Key words : Submerged arc welding, CVN test, Heat affected zone, Micro hardness, Phase analysis

Improvement in the weld quality has been a continuing challenge, as new processes were introduced and existing processes were stretched to their limit. Competition in the field of welding is increasing day-by-day. Fabricators look for welding processes, which are cost effective and are able to give higher deposition rates, better penetration and robust structures. Submerged arc welding is one of the processes having high deposition rate welding speed, deeper penetration - fewer operators fatigue because arc is not visible and welder's manipulative skill not needed. The normal welding variables of submerged arc welding like current, voltage, travel speed and bead geometry are characterized by bead width, height, penetration, hardness and quality. To understand and predict the mechanical properties, a weldement such as strength and toughness, it is important to know the microstructures and micro hardness values of the weld metal and heat affected zone regions. Besides the inclusions ferritic weld plays very important role not only in controlling the microstructures as nucleation sites of acicular ferrite but also in fracture process by acting as sites or cleavage or void formation. The essential requirements of weldable steels are enhanced strength, toughness, better microstructure and durability of the welded structures and economy in fabrication. Toughness is the ability of a metal to resists fracture while being loaded under conditions that are unfavorable for energy absorption and plastic deformation, high toughness of weld and heat affected zone are important characteristics of a weldable steel, high toughness in a certain way ensures good behavior of the welded structures even in case of severe service conditions. Mild steel exhibits good ductility when an ordinary tensile specimen is tested. When the steel contains sharp notch and temperature is low, however, a crack may initiate from the notch, causing brittle fracture of the plate. Alloying elements in the weld metal may come from the base metal, welding electrodes and welding flux. Among these, since the chemistries of the weld metal and welding electrode are generally known, the chemical behavior of welding flux should also be understood for estimating the composition of weld deposit. In multipass SAW there is an inadequate transfer of heat in the fusion as well as in the HAZ and the base metal, therefore, it is necessary to control the microstructure and the various phases of the steel by controlling the welding parameters. Typical microstructure formed in multipass welded regions of base metal and HAZ of mild steel consist of grain boundary ferrite, widmanstatten ferrite, fine pearlite, banite, acicular ferrite and marten site depending on the cooling rate below the AC3 temperature.

Automated submerged arc welding is a versatile process, as it gives best quality, saves time, reduces cost, resurfaces wear surfaces on steel castings, improves repair procedure, process control, increases efficiency and productivity (Kolhe and Datta, 2003; Demis *et al.*, 1999; Richard and Richard, 194). Welding parameters, heat input, alloying elements, filler material and dilution