Effect of Heat Input on the Microstructure and Mechanical Properties of 07MnCrMoVR Weld Joints

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Abstract: As a new type of low cracking suscepbility high strength steel, 07MnCrMoVR steel has excellent weldability, with low carbon equivalent and cold cracking susceptibility coefficient. However, there are still some problems when this steel is on the outdoor actual welding condition, such as having some extend cold cracking suscepbility and embrittlement of heat affected zone. Currently, researching works for the welding of this steel mostly focus on the evaluation the weldability of it, only few works are concentrated in how the heat input affecting the embrittlement of HAZ. The goal of this research is to study the effect of heat input on the embrittlement of the heat affected zone so as to get the optimal welding heat input range for it. In this paper, 38 mm 07MnCrMoVR steel made by Shougang is welded by manual arc welding technology, and the effect of heat input on the microstructure and mechanical properties of weld joints is also investigated by use of optical microscope(OM), scanning electron microscope(SEM), mechanical properties testing machines and Viker hardness tester. The microstructure and fractography observation results and the mechanical properties testing results indicate that the 07MnCrMoVR steel made by Shougang has a wide adaptable range for heat input, and when the heat input is in the range of 15–42 kJ/cm, the toughness of the weld joints is well. With the increase of heat input, the impact toughness of weld zone and heat affected zone decrease, whereas the tensile strength of the weld joints does not change at all. The microstructure of the weld is acicular ferrite with small amount of proeutectoid ferrite, and with the increase of heat input, the ratio of proeutectoid ferrite and the amount of M-A constituent increase, as well as the grain size and the width of the bainite lath in coarsened grain heat affected zone. Fractography results show that with the increase of heat input, the number of dimples in impact fracture specimens decreases, and the cleavage patterns increase, inducing the fracture from ductility to embrittlement. This research provides a theory support for guiding the penstock constructor how to use 07MnCrMoVR steel in actual welding.

Key words: 07MnCrMoVR, heat input, microstructure, impact toughness, heat affected zone

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