Study of the Heat Treatment Processes on the High Temperature of Mechanical Properties of Cr-Mo Alloy Steel TIG Weldmen

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ABSTRACT

The manufacturing of large-size precise steam high-pressure container by SAE 4130 can only follow two kinds of processes: AWST (Annealing + Welding + Solution + Tempering) and ASTWR (Annealing + Solution + Tempering + Welding + Stress Relief). However, this precise steam high-pressure container is mostly used in high temperature environment under high pressure, making it easily influenced by high temperature and high pressure during service. Therefore, in this study we conduct simulations of the impacts of two kinds of SAE 4130 welding processes on microstructures and mechanical properties in the high temperature environment with the purpose of using the results as the reference for structural design. The results of this study show that the order of impact toughness against impacts under room temperature is ASTWR >AWST >AST, which has something to do with the microstructure at the preset gap of specimen. During high temperature impacts, they are vulnerable to the effects of precipitated phases and sizes of Si and MnS. The more and larger precipitated phases will lead to decreased mechanical properties. As for the tensile strength in the range of room temperature to 600℃, it ’s AST >AWST > ASTWR which has something to do with the welding process before the test. However, the high temperature tensile strength is susceptible to the effect of Fe2O3 : Fe3O4 ratio, where higher ratios will lead to better mechanical properties and lower ratios will lead to contrary results. As for the impact of the precipitated phase of Si, the impact value will decrease with the reduction of sizes of Si precipitated phases, while the high temperature tensile strength will increase with the increasing sizes of Si precipitated phases. The comparison between the welding processes of AWST and ASTWR in the range of experimental temperature has shown that the ASTWR has higher impact values indicating the capability of withstanding larger instantaneous stress. As indicated by the results of tensile test, the quenching and tempering treatments after AWST welding can lead to higher resistance to steady stress.

Keywords : SAE 4130、High temperature mechanical properties、GTAW、Quenching and tempering treatments、Stress relieving

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