Thendralarasu Udhayakumar et al., J Material Sci Eng 2017, 6:1 (Suppl)
http://dx.doi.org/10.4172/2169-0022.C1.058

Effect of process parameters and post heat treatment in the development of micro alloyed HSLA tubes for torsional applications

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Micro alloyed HSLA steels continue to evolve and grow in application, particularly in automotive industry. Welded tubular components made of micro alloyed HSLA steel grades are highly emerging and manufacturing them is quite challenging. Generally micro alloyed grades exhibit higher strength & formability owing to the presence of fine recrystallized ferritic grains due to thermo mechanical treatment. This study deals with the material characterization and process optimization works involved in the development of electric resistance high frequency welded micro alloyed HSLA steel tubes for twist beam application with enhanced torsional performance. Difficulties in the high frequency (HF) welding of the HSLA tubes have also been discussed. Weld bond width, HAZ width and bond angle are the significant factors that directly influences the weld quality and strength. The effect of key welding parameters like heat input, welding temperature, squeeze roll pressure, vee-angle, vee-length and impeder diameter on the above mentioned significant factors was analyzed. Samples processed with different welding parameters were subjected to critical forming operation and it was seen that narrow bond, minimum HAZ width with pronounced hour glass pattern and optimum bond angle resulted in superior bond strength & formability. Microstructural characterization was done using light optical microscopy and scanning electron microscopy. Residual stress is very critical since the tubes will undergo torsional fatigue during application. Residual stress was determined using X-ray diffractometer and tube slitting method. Higher tensile residual stress of magnitude 200 MPa was observed in the weld region. Since such high magnitude of tensile residual stress is detrimental to torsional fatigue life, stress relieving of the tubes was carried out. Stress relieving was done at different subcritical temperatures 600°C, 650°C & 700°C with different soaking time. Without significant drop in the tensile properties, compressive residual stress of magnitude 129 MPa was observed at a particular stress relieving cycle. This would eventually lead to improvement in fatigue life. Thus, high frequency welded micro alloyed HSLA steel tubes with enhanced torsional fatigue performance were successfully developed.

Biography

Thendralarasu Udhayakumar is a Research Engineer in the field of Materials Science and Metallurgy; he is currently employed at Corporate Technology Centre, R & D division of Tube Investments of India Ltd. His key areas of research interest include “Material selection, heat treatment of HF welded tubes and cold drawn tubes, process optimization for typical tubular components and material characterization”. He is currently working in the development of wear resistant grades for the agricultural industry.

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