RESEARCH ON THE METALLURGICAL BEHAVIOUR OF X70 STEEL SUBJECTED TO MULTI-WIRE SUBMERGED ARC WELDING

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ABSTRACT

The use of High Strength Low Alloy steels (HSLA) in on-shore and off-shore industry has significantly increased in the last years. Due to their special properties such as high tensile strength, good toughness and ductility, these materials can be used in various environments and operating conditions. The HSLA steels are designed to withstand high internal pressures, being recommended for manufacturing by welding of gas and oil pipelines with large diameters and lengths. The research focused on the metallurgical behaviour of API 5L X70 steel subjected to multi-wire Submerged Arc Welding (SAW). The samples welded in five different combinations of hot and cold solid wires were subjected to analysis by optical emission spectroscopy (OES), optical microscopy and micro-hardness testing. Comparing the results achieved in the base material and fusion zone by OES analysis, significant differences caused by different alloying elements levels of the parent material and filler metal, as well as caused by the welding process influence have been noticed. The optical microscopy examination revealed a typical structure in the weld and heat affected zone (HAZ) without brittle compounds. The results of the micro-hardness testing showed values specific to structures of ferrite, perlite, Widmanstatten and fine lower bainite achieved in the welded samples. In conclusion, the investigation on the metallurgical behaviour of API 5L X70 steel confirmed the proper design of the welding procedures specifications (WPSs) in the combination of hot and cold multiple-wire SAW proposed by the authors for the manufacturing of pipelines.

KEYWORDS: submerged arc welding, multi-wire, X70 steel behaviour.

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