

Optimisation of Nitrogen as a Protective Gas via the Alternating Shielding Gas Technique in the Gas Metal Arc Welding Process

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Abstract : An increasing concern exists in the welding industry in terms of faster joining processes. Methods such as the alternation between shielding gases such Ar, CO₂ and He have been able to provide improved penetration of the joint, reduced heat transfer to the workpiece, and increased travel speeds of the welding torch. Nitrogen as a shielding gas is not desirable due to its reactive behavior within the arc plasma, being absorbed by the molten pool during the welding process. Below certain amounts, nitrogen is not harmful. However, the nitrogen threshold is reduced during the solidification of the joint, and if its subsequent desorption is not completed on time, gas entrapment and blowhole formation may occur. The present study expanded the use of the alternating shielding gas method in the gas metal arc welding (GMAW) process by alternately supplying Ar/5%N₂ and He. Improvements were introduced in terms of joint strength and grain refinement. Microstructural characterization findings showed porosity-free welds with reduced inclusion formation while mechanical tests such as tensile and bend tests confirmed the reinforcement of the joint by the addition of nitrogen. Additionally, significant reductions of the final distortion of the workpiece were found after the welding procedure as well as decreased heat affected zones and temperatures of the weld.

Keywords : alternating shielding gas method, GMAW, grain refinement, nitrogen, porosity, mechanical testing

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