

# EXPLORING THE IMPACT OF APPLYING ACTIVATED FLUXES IN TIG WELDING OF AISI 304 STAINLESS STEEL

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## ABSTRACT

The present work analyses how the multi component activated fluxes affect weld bead geometry during Tungsten Inert Gas (TIG) welding. TIG is widely used for producing high quality, clean welds with good appearance. However, it has a limitation of less penetration in a single pass. Therefore, usually TIG welding of thick materials needs multiple passes thereby reducing productivity and limiting the application of TIG welding in industry. To address this issue, a variant of TIG welding process was introduced, named Activated Flux TIG (A-TIG) welding. Activating fluxes include metallic oxides, halides, etc. in the powder form. A slurry of flux is made by mixing Acetone to apply at the faying surface using a flat painting brush. This investigation focuses on using a flux mixture of different oxides and calcium carbonate. Experimental runs are performed in this work. The Experiment Set uses a combination of SiO<sub>2</sub>, ZrO<sub>2</sub>, CaCO<sub>3</sub> and Fe<sub>2</sub>O<sub>3</sub> flux mixture on AISI 304SS flat through autogenous bead-on plate welding. In this experiment set- A, design of experiment based on two-factor three-level full factorial methodology has been considered where Heat Input is varied from 1.664 kJ/mm to 1.843 kJ/mm and content of CaCO<sub>3</sub> in flux mixture is varied from 2-3 g in wt.%. Best Depth of Penetration of 6.7 mm is obtained in this Experiment Set at a flux ratio of [SiO<sub>2</sub>:ZrO<sub>2</sub>: CaCO<sub>3</sub>:Fe<sub>2</sub>O<sub>3</sub>= 2:2:3:2] and Heat Input of 1.843 kJ/mm. Hence, this condition can be recommended for industrial practice. Artificial Neural Network (ANN) modelling in MATLAB R2024b application software is utilized to optimizing the neural network base on their performance of Levenberg-Marquardt (LM), Bayesian Regularization (BR) and Scaled Conjugate Gradient (SCG) neural network algorithms and varying their number of hidden layers (4, 6, 8, 10 and 12 Nos.) respectively. For Training, Validation and Test 70%, 15% and 15% of data used from total data sets respectively for estimating bead geometry parameters successfully.

**Keywords:** Welding, activated flux, A-TIG welding, AISI 304, stainless steel, penetration, productivity, ANN, neural networks.