



GUJARAT TECHNOLOGICAL UNIVERSITY

(Established Under Gujarat Act No.: 20 of 2007)

ગુજરાત ટેકનોલોજીકલ યુનિવર્સિટી

(ગુજરાત અધિનિયમ ક્રમાંક : ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Abstract of the Thesis



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Discipline/Branch: Mechanical Engineering

Thesis Title: An experimental investigation of friction stir welding on AA 7108 T79 using counter rotating twin tool.

Abstract

In the current research, friction stir welding has been performed on AA 7108 T79 plates and strength has been achieved with the help of a single pass using a counter-rotating twin tool (CRTT). A systematic mathematic approach has been used for the design of a counter-rotating twin tool. The final dimensions of CRTT have been analyzed using three types of materials on Ansys design developer 16.0® to find out the best material for the development of CRTT. The en8 material has been finalized as its results for deformation, equivalent strain, equivalent stress, and strain energy are better compared to other tool steel materials such as scm415 and s45c.

This research attempts to provide enough knowledge to those industries that use the FSW process for making welding joints. Research has also provided optimal process parameters for desired performance evaluation criteria in specific industries application. This prior knowledge reduces the welding time of making joints, increases the tool life and reduces adjusting parameter setting. In addition, it is easily predict the performance criteria by varying the value of the process input parameters with help of regression equation.



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The Conventional fusion welding of aluminium alloys leads to the melting and resolidification of the fusion zone, which results in the formation of the eutectic phase and brittle structure. Friction stir welding (FSW) is a solid-state metallic alloy joining process and thus emerged as an alternative technology used in high strength alloys that are difficult to join with conventional techniques, in which the relative motion between the tool and workpiece produce heat which helps the material of two edges being joined by plastic diffusion. Hybrid friction stir welding improves mechanical properties. It consumes less energy. It produces welds which are high in quality, strength and inexpensive. The twin tool enables the cost reduction for multipass since it consumes time in the process of welding. The twin tool works as a stress-relieving process for the workpiece so tensile strength to be increased. Good microstructure to be taken in welding.

In this investigation, two different types of tool pin geometry such as hexagonal and straight cylindrical have been selected based on the output parameters (tensile strength and hardness). The process parameters such as tool feed and tool rotational speed have been taken with its range to performed experimental work. Numbers of pilot runs have been performed with various fixture facilities before applying the design of experimentation. Full factorial design of experiment used for welding. The joints have been found complete without any un-welded zone resulting from smooth material flow. The mechanical properties-tensile strength and hardness, microstructure, results of radiography, and ultrasonic tests have been considered as performance evaluation criteria. Radiography and ultrasonic testing gave the perfect joint of weld without any defect. Multi-objective genetic algorithm used for the optimization in Matlab 2012a. This optimization gives the value of the tensile strength and hardness for two tools. Regression equations put in the ga-multi inbuilt function. This function has been run then gets optimized value. In this work hexagonal tool has been given the maximum tensile strength.

For validation of the work, again experimentation has been performed with use of optimization results, and found less than 5% error. As per the literature, less than 5% error validated for the experimental work.



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List of publications:

- 1) Design development and finite element analysis of twin tool for friction stir welding: 32 world conference on applied science engineering and technology 2020.
- 2) A review on friction stir welding of various tool geometry: International journal of Production engineering Volume 6 issue 2.
- 3) A review on tool rotational speed and tool transverse speed effects the mechanical properties of friction stir welding: Zeinchen journal volume 6 issue 9 September 2020- Impact factor 4.7 UGC and SCI journal.
- 4) Genetic algorithm-based optimization of friction stir welding process parameters on Aa7108: International Journal of Innovative Technology and Exploring Engineering (IJITEE)', ISSN: 2278-3075 (Online), Volume-10 Issue-8, June 2021, Page No. 47-53 <https://www.ijitee.org/download/volume-10-issue-8>.
- 5) Studies the twin stir technology and welded parameters of friction stir welding on AA7108T79: JXAT journal, volume XIII, issue VI, June 2021. Impact factor 3.7 ISSN: 1006-7930.