

EXPERIMENTAL INVESTIGATION OF ROTATIONAL SPEED DEPENDENT HARDNESS AND TENSILE PROPERTIES OF FRICTION STIR WELDED DISSIMILAR AL-ALLOY (6063 & 6064)

Selvakumar.A.¹

Department of Mechanical Engineering

¹Assistant professor, INFO Institute of Engineering, Coimbatore, India

selvaasn@gmail.in

Kamalesh.N.V.²

Department of Mechanical Engineering

¹Assistant professor, INFO Institute of Engineering, Coimbatore, India

nivathmech@gmail.com

Arunkumar.K.³

Department of Mechanical Engineering

¹Assistant professor, INFO Institute of Engineering, Coimbatore, India

arunmksh@gmail.in

ABSTRACT - FSW of dissimilar al-alloy must be conducted in lower welding speed or in higher rotation speed to increase the heat input during the process. The effect of the tool rotation speed plays an important role in the amount of the total heat input applied during the process; however, this phenomenon is mostly analyzed qualitatively, and the conclusions have been made based on the resultant weld defects. Therefore, the optimum range of the rotation speed will be an important parameter to achieve high quality weld, since the variation of this parameter will affect the thermo mechanical condition for the microstructural changes in the specimen. This optimum range is affected by different parameters such as the thickness of work piece, type of alloy, geometry of the tool, and welding speed. In the present research work proposes, friction stir welding of dissimilar al-alloy plates with the thickness of 4mm in the constant traverse speed of 25 mm/min and 4 different rotation speeds. Vickers hardness tests will be conducted on the weld samples to identify RPM vs Hardness also tensile tests for the same is proposed to identify variation in tensile properties of the material.

KEYWORDS - Frictional stir welding, Al-Alloy (6063 & 6064), Vicker hardness tests, RPM, Hardness, Traverse speed, Thermo chemical

INTRODUCTION

The friction stir welding (FSW) was invented by The Welding Institute, UK, in 1991 for primarily welding of aluminum alloys. In FSW process, a non-consumable rotating cylindrical shouldered tool with a smaller pin is plunged into adjoining parent materials. Frictional heat generated by the tool shoulder causes the work piece materials to soften. Moreover, FSW involves a severe plastic deformation and dynamic recrystallisation in the nugget zone due to the

stirring action of the tool pin. Extensive studies on FSW of aluminum and its alloys have been reported in the literature; however, studies on dissimilar AL-Alloy are very limited. Welding is a fabrication process used to join materials, usually metals or thermoplastics, together. During welding, the pieces to be joined (the work pieces) are melted at the joining interface and usually a filler material is added to form a pool of molten material (the weld pool) that solidifies to become a strong joint. In contrast, Soldering and Brazing do not involve melting the work piece but rather a lower-melting-point material is melted between the work pieces to bond them together. Welding is a material joining process in which two or more parts are coalesced (joined together) at their contacting surfaces by a suitable application of heat and/or pressure. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces. Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding may be performed in many different environments, including open air, under water and in outer space. Welding is a potentially hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation

of poisonous gases and fumes, and exposure to intense ultraviolet radiation. Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for centuries to join iron and steel by heating and hammering. Arc welding and ox fuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after. Welding technology advanced quickly during the early 20th century as World War I and World War II drove the demand for reliable and inexpensive joining methods.

LITERATURE REVIEW

Dr. Muhsin Jaber Jweeg, et. al, (2012), 'Theoretical and Experimental Investigation of Transient Temperature Distribution in Friction Stir Welding of AA 7020-T53', Number 6 Volume 18 June 2012 Journal of Engineering. Finite element modelling of transient temperature distribution is used to understand physical phenomena occurring during the dwell (penetration) phase and moving of welding tool in friction stir welding (FSW) of 5mm plate made of 7020-T53 aluminum alloy at 1400rpm and 40mm/min.

Shrikant G.Dalu, et. al, (2013), 'Effect of Various Process Parameters On Friction Stir Welded Joint: A Review', International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308. This paper is a review of research work in the last decade on friction stir welding.

R. Palanivel, et. al. (2011), 'Development of mathematical model to predict the mechanical properties of friction stir welded AA6351 aluminum alloy', Journal of Engineering Science and Technology Review 4 (1) (2011) 25-31. This paper presents a systematic approach to develop the mathematical model for predicting the ultimate tensile strength, yield strength, and percentage of elongation of AA6351 aluminum alloy which is widely used in automotive, aircraft and defence Industries by incorporating (FSW) friction stir welding process parameter such as tool rotational speed, welding speed, and axial force. FSW has been carried out based on three factors five level central composite rotatable design with full replications technique.

G. Ashok Kumar, et. al. (2013), 'Friction stir processing of intermetallic particulate reinforced aluminum matrix composite', Adv. Mat. Lett. 2013, 4(3), 230-234. Friction stir processing (FSP) is a novel solid state technique to refine the microstructure of metallic materials. The objective of this work is to apply FSP to change the morphology and distribution of intermetallic particles and achieve property enhancement. AA6061/8wt. % Al3Zr composite was produced by the in situ reaction of molten aluminum and inorganic salt K2ZrF6.

R.Palanivel et.al.(2010), 'Influences Of Tool Pin Profile On The Mechanical And Metallurgical Properties Of Friction Stir Welding Of Dissimilar Aluminum Alloy', International Journal of Engineering Science and Technology Vol. 2(6), 2010, 2109-2115. The development of the Friction Stir Welding has provided an alternative improved way of producing aluminium joints, in a faster and reliable manner. In this study the effect of tool pin profile on the mechanical and metallurgical properties of dissimilar AA6351-AA5083H111 joints produced by FSW is analyzed..

Shude Ji, et.al. (2013), 'Design of Friction Stir Welding Tool for Avoiding Root Flaws', Materials 2013, 6, 5870-5877. In order to improve material flow behavior during friction stir welding and avoid root flaws of weld, a tool with a half-screw pin and a tool with a tapered-flute pin are suggested. The effect of flute geometry in tool pins on material flow velocity is investigated by the software ANSYS FLUENT. Numerical simulation results show that high material flow velocity appears near the rotational tool and material flow velocity rapidly decreases with the increase of distance away from the axis of the tool.

Dr.Ayad M. Takhakh, et.al. (2012), 'Experimental and numerical evaluation of friction stir welding of AA 2024-W aluminum alloy', Number 6 Volume 18 June 2012 Journal of Engineering. Friction Stir Welding (FSW) is one of the most effective solid states joining process and has numerous potential applications in many industries.

PROBLEM IDENTIFICATION

Friction Stir welding became the area of interest over the past decade, its increasing popularity is due to its method and effect of material joining. It has been the main joining process of almost all marine and aerospace industries worldwide. Since, from the birth of FSW lots of research are going on, in the stage of developments the research were focused on methods of welding, feasible materials for FWS, the machine structure for FSW, tools for FSW and their shapes were discussed in great details, in the mid phase of the research work the process parameters were went in all direction to find out optimum parameters to achieve best welding results were presented, in the recent past dissimilar alloys, different ferrous and non-ferrous alloys were into the focus of the FSW research, welding and their properties after welding is also of interest for many research works. SEM tests were performed to identify the microstructure of the FSW work pieces to evaluate the penetration of welding is also presented in many research papers, some authors produced articles and papers on FSW facilities and their limitation, the potentiality of FSW is growing and it is clustering into many branches quickly, major automotive are already moved into FWS for their structural welding process.

PROPOSED SOLUTION

In FSW process, a non-consumable rotating cylindrical shouldered tool with a smaller pin is plunged into adjoining parent materials. Frictional heat generated by the tool shoulder causes the work piece materials to soften. Moreover, FSW involves a severe plastic deformation and dynamic recrystallisation in the nugget zone due to the stirring action of the tool pin. Extensive studies on FSW of aluminum and its alloys have been reported in the literature; however, studies on dissimilar AL-Alloy are very limited. FSW of dissimilar al-alloy must be conducted in lower welding speed or in higher rotation speed to increase the heat input during the process. The effect of the tool rotation speed plays an important role in the amount of the total heat input applied during the process; however, this phenomenon is mostly analyzed qualitatively, and the conclusions have been made based on the resultant weld defects. Therefore, the optimum range of the rotation speed will be an important parameter to achieve high quality weld, since the variation of this parameter will affect the thermo mechanical condition for the microstructural changes in the specimen. This optimum range is affected by different parameters such as the thickness of work piece, type of alloy, geometry of the tool, and welding speed. In the present research work proposes, friction stir welding of dissimilar al-alloy plates with the thickness of 4mm in the constant traverse speed of 25 mm/min and 4 different rotation speeds.

METHODOLOGY

This chapter provides a comprehensive diagrammatic view of the research methodology of the project work. The methodology starts from objective formulation and moves towards literature review, where the scholarly reviews are taken for studying FSW parameters like speed, feed and plunge. The reviews provides research gap for research work which is formulated into objective of this research work, rotational speed plays an important role in FSW and is proposed for dissimilar al-alloy. The results will be evaluated for reporting and presentation.

CONCLUSION

The first phase of the research work end with the objective formulation which is followed by literature review on friction stir welding fundamentals, materials and their properties, operating parameters like speed, feed and depth of cut for arriving optimum welding characteristics, review provided the feasibility of problem identification and pushed to formulate research work with friction stir welding limitations, the research gap showed that the importance of welding rpm on material, since this is previously carried on pure materials only is it evident that carrying out FSW on dissimilar alloy to find out optimum rotational speed is vital and the corresponding mechanical properties like impact and tensile properties. In the next phase FSW welding of aluminium alloy (6063 and 6064) will be performed to identify the optimum rotating speed. A total of 6 experiments will be performed with the operating parameters of 600, 800, 1200 & 1400 RPM and at 25 mm/min as feed with 4 mm plates. The results of the FSW will be evaluated to find out the optimum rotating speed for performing FSW on dissimilar al-alloy.

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