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FRICTION STIR WELDING AND ITS RELATED PARAMETER: A REVIEW

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ABSTRACT

Friction stir welding is an advanced solid state joining technique, widely being used in various applications for joining aluminum alloys in aerospace, marine automotive and many other applications of profitable importance. The welding parameters and tool pin profile play a main role in deciding the weld quality. It is an attempt to being made to analyze the effect of tool geometries, the effect of tool rotation and welding speeds on the mechanical properties of friction stir welded joints made for samples of profitable grade aluminum alloys. Moreover, ANSYS is used to compare and prove the attempts made for various analyses.

KEYWORDS: friction stir welding, processing parameters, Tool geometry.

INTRODUCTION

Welding is defined as a joining process that produce coalescence of material by heating them to the welding temperature , with or without the presentation of pressure or by the application of pressure alone , and with or without the use of filler metal. In other words it is the process in which similar or dissimilar material are being connected using heat pressure and filler material. Welding is the process that joins materials, usually metals or thermoplastically, by create fusion, which is distinct from low temperature metal-joining techniques such bronzing and soldering, which do not solidify the base metal.in few technical language, a weld is made when separate part of the material to be joined or form one part piece when heated to a temperature high cause softening and flow together. In some cause pressure may be sufficient to force the separate part of material and foam one piece .if we need a weld a joint .now this whereas we know that intensifying the technics so that are growing the list of material such as glass plastic, ceramics etc. Many disparate energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. Though often an manufacturing process, welding may be performed in many different environments, together with in open air, under water, and in exterior space. Welding is a hazardous undertaking and precautions are required to avoid burns, electrical shock, visualization damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation.one of the process we will discuss this is the solid state welding process. FRICTION STIR WELDING (FSW) was invented at the TWI(UK) in 1991 by Thomas. FSW is an emerging solid state joining process. Friction stir welding (FSW) is a solid-state welding process in which resources used for welding do not exceed their melting points. In this procedure the heat generated during interaction in the middle of the tool and substrate is used to weld the materials. The following features of FSW are as:

- It consumes considerably less energy.
- No shielding gas or flux is used.
- It is a solid-state welding process in which materials used for welding do not exceed their melting points.
- In this process the heat generated during contact between the tool and substrate is used to weld the materials.
- Rotating probe provides friction heat and pressure which joins the material sufficient downward force to maintain pressure and to create friction heat.

Tool geometry s

Tool geometry affected due to the heat generation rate , torque and transverse force and thermomechanical environment experienced by the tool. The flow of material in the workpiece is the affected by the tool geometry also rotational of the tool. These important factor are:

- Shoulder diameter

- Shoulder surface
- Pin geometry
- Shape and size etc.

These are some process parameter and tool nomenclature

- Rotational parameter
- Welding speed
- Tilt diameter
- Pin length
- Axial force
- Shoulder diameter

These are some different tool pin geometry:

- Cylindrical threaded
- Trivex
- three flat threaded
- threaded conical

key benefits of the friction stir welding

Metallurgical benefits	Environmental benefits	Energy benefits
• Solid phase process.	• No defensive gas required	• Improved materials use (e.g., joining different thickness) allows reduction in weight
• Low falsification of work piece.	• No surface cleaning required	• Decreased fuel consumption in light weight aircraft automotive and ship applications
•Good dimensional stability and repeatability	• Eliminate grinding wastes	
• Fine microstructure	• Consumable materials saving, such as rugs, wire or any other gase	
• Absence of cracking		
• No loss of alloying elements		

LITERATURE REVIEW

Ashok Kumar, Harbinder lal, s.s sehgal [8]discussed on the different parameter of the FSW .In this paper analyzed the joint characteristics of similar and different materials used in fabrication industries which are difficult to join by other technique. The analysis was completed with the help of ANSYS software computationally & same was experimentally verified.

B.T. Gibsona,∗, D.H. Lammleinb, T.J. Praterc, W.R. Longhurstd, C.D. Coxa, M.C. Balluna, K.J. Dharmaraja, G.E. Cooka, A.M. Straussa , [5] The basic principles covered include termi-nology, material flow, joint configurations, tool design, materials, and defects. Methods of evaluating weld quality are surveyed as well. The modern applications are discussed, with an prominence on recent advances in aerospace, automotive, and ship building.

Basil M. Darras [4] it has been discussed about the microstructural modifications technique. Reported results showed that for different alloys and also work on the experimental and analytical activity

Dr. M. Lakshman Rao1, P. Suresh Babu2, T. Rammohan3 and Y. Seenaai [1] This paper highlights the role of tool geometry, because tool geometry plays a major role in FSW. Proper selection of a tool material and shape of the pin reduces number of trials and tooling cost. In addition this study also highpoints the wear effect due to friction between sliding surfaces.

G. Elatharasana, V.S. Senthil Kumarb *[11] it has been discussed about that the optimization of the different parameter and developed the mathematical model and study of the analysis of variance(ANOVA).

Puneet Rohilla, Narinder Kumar [3] In this investigation an attempt has been complete to study the effect of tool pin profile (straight cylindrical and square) on the formation of friction stir processing zone in a single and progressive double sided friction stir weld in AA6061.

Patel Chandresh V. [10] the research normally lies on characteristics of FSW tool pin's profile on FSW joint. In present work will be carried out using different tool pin profile like tapper cylindrical, square, tapper hexagonal, and threaded cylindrical. Test specimen will be prepared from acquire results and various tests (tensile and bending test) will be carried out to prove its optimal joints. On the basis of these results and parameters used during experiment the effect of tool pin profile will be understood.

P.Prasanna*Dr.Ch.Penchalayya**, Dr.D.Anandamohana Rao*** [2]The main objective of this article is to discovery the optimum operating situations for butt joint made of aluminum alloy AA6061. Four major controllable reasons each at four levels, namely, rotational speed, welding speed, tool pin length, offset distance are considered for the present study.

S.Ugendera, A.Kumar b , A. Somi Reddy a,b*[7]found that the tool material ana rotational speed have been the impotent parameter and that are effect the stir zone microstructure and properties of friction stir process.

Tran Hung Tra1 [10],has been discussed of the Effect of tool rotation speed and welding speed on the mechanical properties of the FSW joint of AA6063-T5 was investigated. It was also found that the residual stress in and around the welded zone was quite low, in range of ten percent

Sivakumar1*, Vignesh Bose2, D.Raguraman3, D. Muruganandam4 The basic principles of FSW are described, including metal flow and thermal history, before discussing how process parameters affect the weld microstructure and the likelihood of defects. Finally, the range of mechanical properties that can be reached is discussed. It is validated that FSW of aluminum is becoming an increasingly mature technology with numerous commercial applications.

S K Selvam1*and T Parameshwaran Pillai1. In this experimental study, seven different tool materials, viz., Tungsten alloy, Super High speed steel, H13 steel, high carbon high chromium steel, high speed steel, APST steel and EN24 are used. All the seven tools are manufactured with conical threaded profile. Each tool material's feasibility of joining the electrolytic tough - pitch copper plates by friction stir welding has been studied. Attempts were complete to study the effect of friction stir welding of ETP copper on microstructure of the ETP copper weld joints using optical microscope, mechanical properties such as hardness and tensile strength, to find optimization of each tool for defect free welding.

T. Pavan KumarȦ*, A. Venkata VishnuȦ and Rakshit. SȦ The aim of the present work is to study the influence of tool geometry on material flow during friction stir welding in Aluminum & Copper Alloys. Various types of tool geometries are modeled and the resulting flow patterns are analyzed. A FSW process with varying tool geometries and evolving speeds is numerically modeled, and a thermo-mechanically coupled, rigid-viscoplastic, fully 3D FEM analysis is done to forecast the procedure variables as well as the material flow pattern and the grain size in the welded joints. Conclusions are drawn to classify the effect of operating process parameters.

D. VENKATESWARLU, N. R. MANDAL, M. M. MAHAPATRA, and S. P. HARSH The effect of threaded FSW tools on 7039 aluminum alloys were examined using different shoulder diameters, pin diameters, and levels of shoulder surface concavity. A full factorial design matrix was utilized to manufacturing 27 FSW tools having different levels of threaded pin diameter, shoulder diameter, and shoulder surface concavity. Experiments were conducted to study the effect of these tools on AA7039 welds with reverence to weld tensile strength, cross-sectional area, and % elongation. A mathematical model was developed to forecast the effects of the tool geometries on the welds using response surface regression analysis.

Xiaocong Hea, Fengshou Gub, Andrew Ballb S ,[11]This paper reviews the latest developments in the numerical analysis of friction stir welding processes. Numerical analysis of friction stir welding will allow many different welding processes to be simulated in order to understand the effects of changes in different system parameters before

physical testing in this methods used in numerical analysis of friction stir welding are dis-cussed and illustrated with brief case studies. In addition, several important key problems and problems stay to be addressed about the numerical analysis of friction stir welding.

CONCLUSION DRAWN FROM LITERATURE REVIEW

In view of above literature it can be concluded that the Friction stir welding (FSW), similar other friction welding techniques, has the benefit that various of the welding parameters, e.g. tool design, revolution speed and translation speed, can be skillful in a exact manner, thus controlling the energy input into the system. It was also originate that overall mechanical answer depended on the ratio of the tool rotation speed to the tool traverse speed. Hence in this work an attempt is being made to analyze the effect of geometry of the tool, the effect of tool rotation and welding speeds going on the mechanical properties of friction stir welded joints made for samples of profitable grade aluminum alloys. For this purpose experiment work and ANSYS analysis software will be used.

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