Parametricstudyoffrictionstirweldingofaluminiumall oy6061andaluminium Sic matrix composite

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Abstract: Now, a day's friction stir welding process has many advantages compared to tradinational welding process. The present work aims assign to prospect to weld two work pieces of aluminum alloy 6061 and aluminum silicon carbide composite and study the effect of mechanical properties of welding joints. In this experimental work welding will be carried out by using different welding speed and tool rotation speed. The Hardness, tensile strength and mechanical properties will be carried out by using different mechanical test.

Introduction: Friction stir welding invented by Wayne Thomas at TWI(The Welding institute) Ltd in 1991.It overcomes many of the problem associated with convention joining techniques. Friction stir welding is solid state joining process that uses a non-consumable tool to join two facing work pieces without melting the work pieces material. Heat is generated by friction between the rotating tool and work piece material, which leads to a soften region near the tool. This heat is without reaching melting point and allows traversing of the tool along the weld line. The plasticized material is transferred the front edge of the tool to back edge of the tool of the tool probe and it's forged by the intimate contact of the tool shoulder and pin profile

There are important welding parameters are:

1. Tool design:

The design of the tool is critical factor as good tool can improve both the quality of the weld and the maximum possible welding speed.

2. Tool rotation and traverse speed:

There are two tool speeds to be considered in friction stir welding; how fast the tool rotates and how quickly it traverses along the interface. These two parameters have considerable importance and must be chosen with care to ensure successful and efficient welding cycle.

3. Tool tilt and plunge dept:

The plunge depth is defined as the depth of the lowest point of the surface of the welded plate and has been found to be a critical parameter for ensuring weld quality

Advantage of friction stir welding:

- Good mechanical properties as in weld condition
- Improved safety due to absence of toxic fumes
- No consumables
- Easily automated on simple milling machines
- Can operate on all positions (vertical, horizontal) etc
- Low environmental impact
- High superior weld strength

Disadvantage of friction stir welding:

- Work piece must be rigidly clamped.
- Key hole at the end of each weld.
- Cannot make joint which require metal deposite.

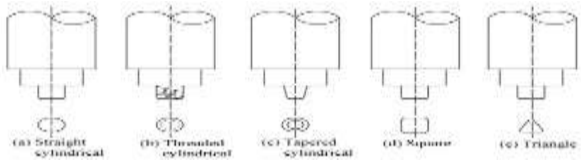
Initial cost of machine is high compare to fusion welding

Applications of friction stir welding:

- Aircraft Industry: - wings, fuel tanks, aircraft structure etc.
- Marine Industry :- Structure work
- Automotive Industry :- wheel rims, chassis, fuel tanks and other
- Chemical Industry :- pipelines, heat exchanger, air conditioner
- Electronic Industry :- Bus bar, aluminum to copper, connectors and other electronic equipment
- It's widely used in Fabrication industry

The material selected for experiment is aluminum alloy 6061 and aluminum silicon carbide metal composite.
It is widely use in the industries of aircraft, automobiles and especially solar vehicles, because of their light density and high specific

strength
Different types of tool in FWS:



The different types of tools are used in friction welding are shown in figure.

- straight cylindrical
- threaded cylindrical
- tapered cylindrical
- square
- triangle

lITERATURE SURVEY

Rajkumar v and venktesh khanna[1] **"**Studies on effect of tool design and welding parameter on the friction stir welding of dissimilar aluminium alloys AA5052-AA6061"This research paper deals with the characterization of friction stir welded dissimilar Aluminium alloys AA 5052 andAA6061. The coupons of above metals were friction - stir welded using cylindrical pin tool using at constant speed of 710rpm and at two different feed rates of 28 and 20 mm/min. Macrographs showed proper mixing due to effective stirring of cylindrical tool pin while keeping the lower feed rate. Further, extensive micro structural examination showed variation ofgrain size in each zone and their influence on mechanical properties. Tensile test and hardness measurements were done as apart of mechanical characterization. Correlating mechanical and metallurgical properties it is deduced that the sample welded at lower feed rate performed better in terms of ductility.The knowledge from this paper is that the Friction Stir Welding sounds promising having demonstrated excellent weldibility and charatestie. Microstructure gives better understanding and their influence on mech. Properties .

Sandeesh p[2] "Studies on friction stir welding of AA 2024 and AA 6061 dissimilar metal" In this research work The joining of dissimilar AA2024 and AA6061 aluminium plates of 5mm thickness was carried out by friction stir welding (FSW)technique. Optimum process parameters were obtained for joints using statistical approach. Five different tool designs have been employed to analyse the influence of rotation speed and traverse speed over the micro structural and tensile properties. In FSW technique, the process of welding of the base material, well below it's melting temperature, has opened up new trends in producing efficient dissimilar joints. Effect of welding speed on microstructures, hardness distribution and tensile properties of the welded joints were investigated. By varying the process parameters, defect free and high efficiency welded joints were produced. The ratio between tool shoulder diameter and pin diameter is the most dominant factor. From micro structural analysis it is evident that the material placed on the advancing side dominates the nugget region. The hardness in the HAZ of 6061 was found to be minimum, where the welded joints failed during the tensile studies The goal of this study is the FSW process parameters were optimized with respect to mechanical and metallurgical properties of the weldments. In addition, tool pin profile has also influenced the weld quality

Heena k Sharma[3] "Experimental analysis of friction stir welding of dissimilar alloy AA6061 and Mg A231 using circular butt joint geometry" The Aluminum alloy 6061 and Magnesium alloy AZ31 plates of 6 mm thickness are welded in circular butt joint geometry by friction stir welding (FSW) process, using CNC vertical milling machine. Process parameters such as welding speed and tool rotational speed play an important role to obtain a better weld joint for dissimilar metals/materials. The friction stir welding tool is one of the critical components to the success of this process. It consists of a cylindrical shoulder and a pin with different geometry. In the experimental work, the said tool has been designed with cylindrical pin having four different geometries for friction stir welding of the dissimilar circular metal plates. Friction stir welding has been carried out at welding speed varying from 10 to 40 mm/min and tool rotational speed from 800 to 2000 rpm. Effects of process parameters on butt welded circular joint were investigated for weld strength. In this research work, it is found that welded joint between dissimilar metals alloys Al 6061 and Mg AZ31 can be formed using friction stir welding by selecting proper tool pin profile and welding parameters. It is suggested that friction stir welding of Aluminium alloy and Magnesium alloy with circular butt joint geometry would be useful in the future for automobile applications by getting the benefits from each material in a functional way.The research paper conclude that As the path of welding is circular, more difficulties have been faced compared to linear path welding. Different tool designs and specifications affect the appearance as well as properties of welded joint. The experiments that lower values of Tool rotational speed and welding speed are better for FSW of dissimilar alloys under consideration when using HCHCr tool material.

Ramaraju ramgopal verma[4] "Mechanical properties of the friction stir welding dissimilar aluminium alloy joint " The present investigation aims in assessment of the mechanical properties of friction stir welded dissimilar metal alloy joints. The optimized process parameters have been predicted for obtaining the strength of the joints in comparable to the base metal. Aluminum 5083 and aluminum 6061 sheets of 5mm thick have been considered for fabricating the dissimilar joints due to their range of usage in most of the engineering applications. Dissimilar FS welded joints were fabricated by varying the process parameters like rotational speed, traverse speed and axial force fixing the Al 5083 on the advancing side and Al 6061 on the retreating side. Two levels of these parameters have been chosen at 1000 rpm and 1600 rpm, 40mm/min and 160 mm/min and 2.5kN and 3.5kN for rotational speed, traverse speed and axial force respectively. Taguchi technique was used to optimize the process parameters by selecting an L-8 orthogonal array consisting of 8 experimental runs. The mechanical properties like the yield strength, elongation, tensile strength and micro hardness of these joints fabricated has been evaluated at all these process parameters. Author conclude that The tensile behaviour and hardness value from the experiment shows incrice in the rotational speed and axial force is keeping weld speed constant There is a decrease inthe same when the weld speed is increased keeping the other parameters constant.

D. murganandam[5] “Review paper on friction stir welding of aluminium and magnesium alloys”The comprehensive body of knowledge that has built up with respect to the friction stir welding (FSW) of aluminum alloys since the technique was invented in 1991 is reviewed on this paper. 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 achieved is discussed. It is demonstrated that FSW of aluminum is becoming an increasingly mature technology with numerous commercial applications.The present review has demonstrated the extensive research effort on understanding the effect of process parameters of FSW on aluminium and magnesium alloys. metal flow modelling may have a role to play here, though capturing this aspect of the thermo mechanical behaviour remains a significant challenge. The macro strure reveals the location of weaker zone.

A. M. Khurshid[6] “Friction stir welding study on aluminium pipe”. The paper shows that Friction stir welding, a solid state joining technique, is widely being used for joining Al alloys for aerospace, marine automotive and many other applications of commercial importance. FSW trials were carried out using a drilling machine on Al 6063 alloy. The tool rotational speeds 485,710, 910, 1120 and 1400 rpm with a traverse speed 4 mm/min were applied. The Mechanical properties of welded joints were investigated using different mechanical tests including destructive test (tensile test, hardness and microstructure). Based on the stir welding experiments conducted in this The resultant microstructure was characterized using optical microscopy This paper presents the optimization of friction stir welding for pipe and also highlights the influence of microstructure and mechanical properties of FSW 6063 Al alloy. The author finds that The FSW welds efficiency increase with increase rotation speed and decrease travels speed because As a result of thermal treatment leads to the fine grain size. Fine grain size microstructure obtained on weld nugget of all FSW joints

Bashar Abdul Wahab[7] “Experimental study of friction stir welding of 6061-T6 aluminium pipe” the author says that Friction Stir Welding (FSW) is a relatively new joining process that has exhibited many advantages over traditional arc welding processes, including greatly reducing distortion and eliminating solidification. The present work aims to determine the feasibility to weld two pieces of aluminium pipe by friction stir welding process and study the effect on the mechanical properties of welding joints. Special welding fixture fixed on conventional milling machine has been conducted to attempt this welding and group of welding parameters. Three tool rotational speeds (500, 630, 800 rpm) with four welding speeds (0.5, 1, 2, 3 mm/sec) for each rotational speed had been used to study the effect of each parameter (tool rotation, weld speed) on mechanical and microstructure properties of welded joints. Mechanical properties of welded joints were investigated using different mechanical tests including non destructive test (visual inspection, X-ray) and destructive test (tensile test, microhardeness and microstructure). Based on the stir welding experiments conducted in this study the results show that aluminum pipe (AA 6061-T6) can be welded by (FSW) process with a maximum welding efficiency (61.7%) in terms of ultimate tensile strength, using 630 (RPM) rotational speed, 1 (mm/sec) traveling speed. FSW defects as indicated on non destructive tests are related to the welding parameters, defect free weld of FSW obtained by using optimum welding parameter. Micro hardness drop was observed in the weld region of FSW joints and an increase in values of micro hardeness when increasing welding speed.

Chinmay Shah and Bhupesh goya[8] of their “Optimizatin of FWS process parameter for Alsic PRMMC using ANOVA” show that In recent years, composite materials have gained more and more attention in aerospace, automotive and structural applications. In many engineering applications, high strength-weight ratio of materials are important while designing the components. Now a days, to fulfil the above requirements conventional materials are replaced by composite materials. In present work, stir casting method is used for uniform distribution of the reinforcement material (SiC) in Aluminium as a matrix material. Friction stir welding (FSW) is a relatively new solid-state joining process. In particular, it can be used to join high-strength aerospace aluminium alloys that are hard to weld by conventional fusion welding. For analysis, L9 orthogonal array is used with four different variables (Wt % of Sic, welding speed, tool rotation speed and tool geometry) for the analysis of UTS. ANOVA is performed for the optimization of the process parameters. Experimental results shows that W% of SiC, transverse , speed, tool geometrspeed influence the tensile strength of FSWUTS of FWS is highly influenced by Wt% of SiC as Wt% of SiC increases UTS increases.FWS done by using threaded tool have more UTS than compare to cylindrical &taper tool.

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