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Joining of Al(6061-T6) and Brass(IS319) by using EN19 Circular Profile Tool through Friction Stir Spot Welding

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Abstract: *Friction stir spot welding (FSSW) is a solid state welding method. Which was industrial as a original technique for joining aluminum alloys. During FSSW, the frictional heat generate at the tool-work piece interface soften the adjacent material, so the rotating and moving pin source material to flow. The forging pressure and mixing of the plasticized material effect in the formation of a solid bond region. In the present work, Aluminum alloy and Brass alloy are joined by friction stir spot welding (FSSW) using EN 19 circular profile tool. It is evaluated that pin tool ,rotating at a constant speed, plunges into dissimilar metals of Al-6061 to Brass-IS319 and Brass-IS319 to Al-6061 specimens, in lap-joint configuration. Test samples showed a Brass-IS319 to Al-6061 specimens of friction stir spot weldment joints of dissimilar metal better than Al-6061 to Brass-IS319.*

Keywords *- Friction stir spot welding; tool design;EN19; Al-6061 and Brass-IS319 alloy; process parameter.*

1 INTRODUCTION

Welding is the course of metal joining by the aid of heat, with or without pressure. Welding is a manufacture or sculptural course to join resources several dissimilar energy source can be used for welding, with a gas flame, an electric arc, a laser, electron beam, friction and ultrasound. as a lot an industrial course, welding can be execute in several different environments, with on open air, beneath water and in outer space. Welding is a dangerous undertaking and defense are necessary to evade burns, electric shock, vision damage, breathing of poisonous gases and fumes and exposure to powerful UV radiation.

2.LITERATURE REVIEW

Friction stir Spot welding (FSSW) is a solid-state joining method (the metal is not melted) to use a third body tool to bond two facing surface. Heat is generated within the tool and material which lead to a extremely soft region by the FSSW tool. Later mechanically intermixes the two pieces of metal can joint, then the lighter metal can be attached by mechanical pressure , like joining clay, or dough. It is mainly use on extruded metals and non-heat treatable alloys, also on structures which require better weld strength without a post weld heat treatment.

Friction stir spot welding (FSSW) produce welds by a rotating, non-consumable welding tool to nearby soften a work-piece, during heat generated by friction and plastic work, allow the tool to 'stir' the joint surfaces. The reliance on friction and plastic work for the heat cause preclude important melting in the work-piece, avoid several of the difficulty arise from a vary in state, such as modify in gas solubility and volumetric changes, which often plague fusion welding process. Further, the condensed welding temperature makes possible dramatically lower distortion and residual stresses, enabling improved fatigue performance, new construction techniques, and making likely the welding of extremely thin and very thick materials.

3. EXPERIMENTAL SETUP

On vertical milling machine friction stir spot welding is performed. The input parameters as mentioned before were taken for machine process parameters. The tools of different profiles were placed on turret of machine.

We have machined our Al 6061-T6 & Brass IS319plates in the size of 100*55mm and 2mm thickness by automatic

showing cutter. After cutting of plates we have finished the edges of plates by rough and smooth files.

Then two plates be clamped on machine bed tightly such that it can resist the force of tool motion without dislocate from its size.

First we have taken taper tool profile and speed of 900 rpm and feed of 38mm per minute. The process of operation is started and the tool penetrated between two plates. At the time of penetration some chips came out, after that the shoulder of tool made the material to stay inside and to form the good weld as the tool advances forward up to the edge.

3.1 TOOL DESIGN: The design of the tool is a critical factor as a good tool can get better both the eminence of the weld and the maximum potential welding speed. It is pleasing that the tool material is adequately strong, tough and hard wearing, at the welding temperature.

Table 1: Chemical composition of EN 19 Alloy Steel

C	Mn	Cr	Mo	Si	S	P
0,35-0.45	0.5-0.8	0.9-1.5	0.2-0.4	0.1-0.35	0.05	0.035

Table 2: Mechanical properties of EN19 Alloy Steel

Tensile N/mm2	Yield N/mm2	Elongation %	IZOD KCV J	Hardness Brinell
850-1000	680	13	50	248-382

3.2 EN 19 TOOL SPECIFICATION

EN 19 also known as 709M40 is a high eminence alloy steel, well-known for its good ductility and shock resistant and its resistance to wear properties. It is suitable for gears, pinions, shafts, spindles. it is now also widely used in the industries of FSW tool including other uses.

EN 19 is normally supplied as high tensile grades EN 19T (709M40T) OR EN 19U. EN 19T has a tensile strength of 850-1000 N/mm^2. For additional wear resistance EN 19T can be nitride. A closely related grade to EN 19 is 708M40. High peak steels can supply EN 19 in bright and black bar form.

3.3 ALUMINUM

It is a chemical element denoted by AI and its atomic number is 13. It is a silver-white, soft, nonmagnetic, malleable metal in the boron group. By mass, Aluminium constitutes about 8% of the Earth's crust; it is the third most plentiful element next to oxygen and silicon and the most plentiful metal in the earth crust, though it is a smaller amount common in the mantle below.

3.4 BRASS

Brass is a metal alloy prepared from copper and zinc; the proportions of zinc and copper can be varied to create a range of brasses with unstable properties. It is a changeover alloy: atoms of the two constituents may substitute each other within the same crystal structure.

Table 3: Chemical composition of Brass as per IS:319

Cu	Pb	Fe	Zn
62-63	0.5 to 1.5	0.20	Balance

Table 4: Mechanical Properties of Brass as per IS:319

Tensile Mpa	Yield Mpa	Elongation %	Hardness HB
285	150	10	90-160

Table 5: The chemical composition of AL(6061-T6)

Al	Cr	Cu	Fe max
95.8 -98.6	0.04-0.35	0.15-0.14	0.7

Table 6:The mechanical properties of Aluminum(6061-T6)

Tensile Ultimate MPa	Yield strength Mpa	Hardness Vickers	Elongation
310	276	107	12%

Table 7: Process variables

Parameters	EN 19
Tool Profile	Circular Tool
Rotational Speed(RPM)	900
Feed(mm/min)	38
Depth of cut(mm)	3.5

Inclination angle	0.5 deg
Tool	

Fig 1. Experimental set up

3.5 MACHINE VARIABLES

3.5.1 Rotational Speed of the Tool:

The Rotational speed of the tool is also known as the machine spindle RPM affect the eminence of the joint. By increase in rotational speed, the heat produced by friction also increases which directly affects the temperature at welding position. For this experiment 900 RPM is selected.

3.5.2 Welding Feed Speed :

The welding feed speed which be able to be termed as tool advancing speed too affects the eminence of welded joints. With decrease in tool rotational speed the tool, the time for which tool is in contact with material increases, so the heat generated by friction also increases which directly affects temperature at welding position. Proper temperature is required for desired welding there for welding feed speed is 38mm/min selected properly.

3.5.3 Depth of Cut(Axial Force):

The depth of cut is also termed as Axial Force required to weld the joint. Based on the thickness of the material this force is selected. There is a limitation of this force based on the machine specifications and thickness of the materials selected, In our case the depth of cut is fixed 3.5 mm.

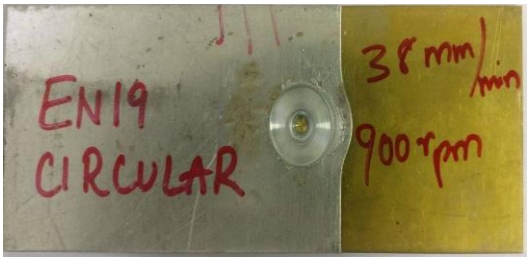

Fig 2:- FSSW of Al(6061-T6)to Brass(IS319)

Fig 3:- FSSW of Brass(IS319) to Al(6061-T6)

4. CONCLUSIONS:

By reviewing literature based on the friction stir pot welding (FSSW) processing Al(6061-T6) to Brass(IS319) and Brass(IS319) to Al(6061-T6) .We get to know the importance of the tool geometry and its material for the friction stir spot processing tool and its effect on base material during the operation. It can be seen that Brass(IS319) to Al(6061-T6) can welded at 3.5 mm and Al(6061-T6) to Brass(IS319) can welded at 3.8 .So, Brass to Al is better joint compare to other joint by using EN 19 circular profile tool. Also, the tool Material selected should not be a source of contamination to the final processed joint. Rate of plastic flow and heat generation in the work piece are greatly affected by the shape and size of the tool pin and shoulder.

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