SETUP OF FRICTION STIR WELDING ON DRILLING MACHINE

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Abstract : Friction stir welding (FSW) has produced a great impact in several industries due to the advantages that this process presents. In particular, the automotive industry has developed a variant of the original process, called Friction Stir Welding (FSW), which has a strong interest related to the welding of aluminum alloys and dissimilar materials in thin sheets. Aluminum welding is an actual challenge, being FSW an alternative to produce these joints. However, the information available related to the influence of process parameters on the characteristics of aluminum joint is scarce. The aim of this work was to study the effect of different welding tool and its depth, during friction stir welding (FSW) of overlaps joints of commercial aluminum and then optimize the process parameters of Friction Stir Welding.

FSW was done on drilling machine which never done before. MS tool is used for this study without pin. From the welded specimen Tensile Strength was obtained. It was concluded that the maximum Strength was found 149.5 MPa. The efficiency of FSW at optimum parameters was 79%.

***IndexTerms - Friction Stir Welding; Mild Steel pin less tool; Hardness; Strength; Microstructure*.**

I. INTRODUCTION

One of the most common and effective method for joining metal structures is conventional welding. In conventional welding process such as TIG/MIG, the weight of workpiece increases due to deposition of filler material. Aluminium alloys are extensively used as a main engineering material in various industries such as automotive industries, the mould and die components manufacture and the industry in which weight is the most important factor. These materials help machining and possess superior machinability index. Additionally, due to high thermal and electrical conduction, conventional fusion or resistance welding of aluminium alloys encounters many problems and some aluminium alloys are even regarded as non-weldable due to a risk of hot cracking. For critical applications, aluminium alloys are fusion welded with extreme precautions to avoid possible weld defects such as formation of deleterious oxides, porosity, hot cracking and hydrogen entrapment related delayed cracking.

Friction stir welding (FSW) is a solid-state joining technique that has expanded rapidly since its development in 1991 and has found applications in a wide variety of industries, including aerospace, automotive, railway, and marine. Fig.1 displays a conventional FSW square butt joint. A rotating tool consisting of a probe and shoulder 2 plunges into the work piece, generating heat throughboth friction and plastic deformation, and traverses the joint line.

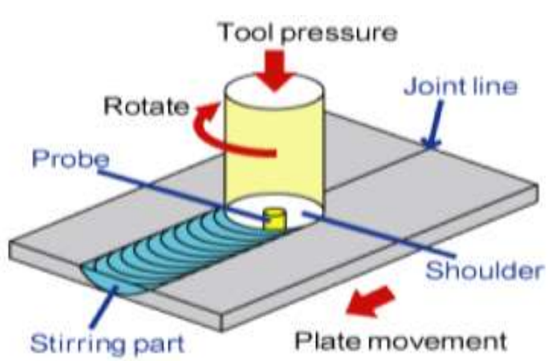

Fig. 1. Principle of FSW process

Frictional heat is generated between the wear-resistant welding tool shoulder and pin, and the material of the work-pieces. The frictional heat and surrounding temperature, causes the stirred materials to be softened and mixed. The bonding is considered a solid state process, since the materials are not melted. However the grains are transformed and relocated. Material flows under the shoulder are similar to the forging process, while the material flows around the tool pin are like an extrusion process. The FSW process exhibits a number of attractive advantages when compared to other welding processes, perhaps the most significant of which is the ability to weld alloys that are difficult or impossible to weld using fusion welding techniques. The FSW process takes place in the solid-phase, at temperatures below the melting point of the material, and as a result does not experience problems related to resolidification, such as the formation of second phases, porosity, embrittlement, and cracking. In addition, the lower temperature of the process enables joining with lower distortion and lower residual stresses. FSW is also an energy efficient process that requires no filler material and, in most cases, does not require the use of a shielding gas. Furthermore, the process lacks the fumes, arc flash, spatter, and pollution associated with most fusion welding techniques. For these and many other reasons, FSW has become an attractive joining process for many manufacturers.

II. LITERATURE REVIEW:

D. G. Hattingh et al. (2008) [1] investigated the effect of tool parameters on forces during welding, the tool torque and tool temperature. The important parameters included flute design (e.g. number, depth, and taper angle), the tool pin diameter and taper, and the pitch of any thread form on the pin. Forces on the tool, applied torque and temperature were monitored and recorded during welding of 6mm thick 5083-H321 aluminum alloy. The lateral reaction forces on each tool and the relative angle of orientation of the peak resultant force are described via a bi-lobed polar plot called the “force footprint” (FF). This provided visual information on the interaction between tool profile and the plastic stir zone, which cannot be obtained purely from force magnitude information.

M Jayaraman et al. (2009) [2] tensile strength of friction stir welded cast aluminum alloy A319. Using ANOVA and signal to noise ratio of robust design, effect on tensile strength of FSW process parameters (tool rotation speed, welding speed and axial force) was evaluated and welding condition for maximizing tensile strength was determined. In order to correlate process parameters with measured tensile strength, a mathematical model had been developed by nonlinear regression analysis.

AvinashS. Pachal1 et al. 2013 [3]studied friction weld element of Aluminum 6351, steel 304 and optimizing the friction welding parameters in order to establish the weldquality. This paper discussed use of Taguchi experiment design technique for maximizing tensile strength of friction welding Al (6061) and steel 304.An orthogonal array of L9 was; Using ANOVA and signal to noise ratio of robust design, effect of tensile strength of friction welding process parameter (Rotational speed, forging force, time) was evaluated and optimum welding condition for maximizing tensile strength is determined.

H. M. Anil Kumar et al. (2014) [4] reviewed the operation of FSW, critical parameters, history, advantages, and limitations were discussed. Further different applications of the process are presented along with critical review of literature; finally recognized areas of research work on materials such as cubic boron nitride, mild steel on tool profiles, boundary etc., and conditions to achieve better quality welds.

III. EXPERIMENTAL METHODS AND MATERIALS:

FSW process with drilling machine is considered for this experimental study.Double sided welding is performed to make a butt joint of aluminium plates. Mechanical properties and microstructure of the weld specimen is compared for both the tools. In this study the specimen are made by using commercial Al plates. The dimensions of the specimen are 150 mm x 50 mm x 3 mm. The chemical composition of Al plates is shown in table1. Table 1. Chemical composition of base metal

Element	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Al
Weight%	0.7-1.3	0.5	0.1	0.4-1.0	0.6-1.2	1.2	0.2	0.1	rest

The welds are developed in square butt joint configuration. The Mild steel Tool used for FSW is shown in fig. 2 and setup of drilling machine shown in fig. 3

Fig. 2.Pin less tool

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Fig.3. FSW machine setup on drilling machine

Tools specifications are shown in table 2.

Table 2. FSW Tool Specifications

Sr. no.	Variable description	Specification of pin less tool
1.	Tool Material	Mild steel
2.	Shoulder diameter	10 mm

After preparation of welding on drilling machine we have find its tensile strength on UTM available at ISB&M SOT, Pune. The available UTM and set up of specimen to find tensile strength for FSW is shown in fig 4.

Fig 4.UTM

IV. RESULTS AND DISCUSSIONS:

All welded specimen are studied for their mechanical property such as tensile strength by employing appropriate tools and techniques.

Table 3. Effect of speed variation on Tensile Strength of Weld

Sr. no.	SPEED rpm	UTM readings KN	Tensile strength Mpa
1.	800	7.05	117.5

2.	1000	8.04	134
3.	1200	8.97	149.5
4.	1400	8.7	145
5.	1600	7.92	132

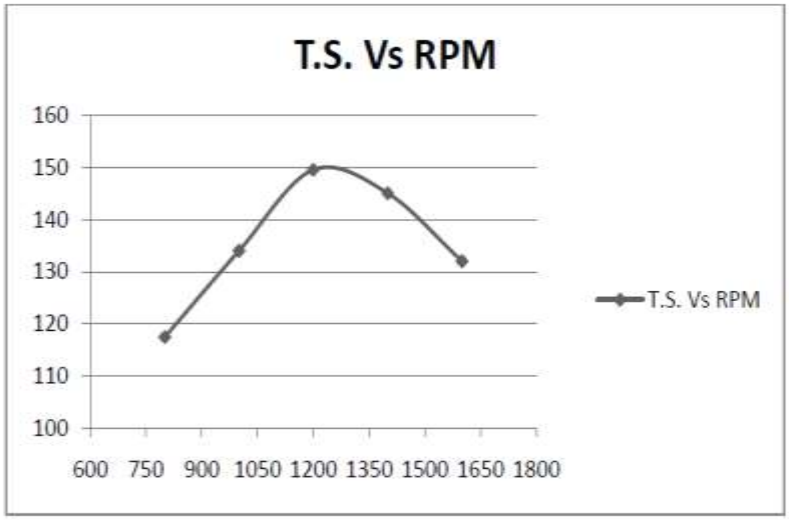

Fig.5 Graph of TS against Speed

V. CONCLUSIONS:

Based on experimental investigation and discussion of results, following conclusions are drawn:

1. FSW can be possible on drilling machine.
2. Welding strength of FSW with MS Tool gives 149.5 MPa i.e. 79% of base metal.

VI.References:

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