EFFECT ON TOOL ROTATION SPEED AND DWELL TIME ON MECHANICAL PROPERTIES OF FRICTION MELT BONDED SPOT WELDING OF ALUMINUM WELDED WITH ALUMINIUM FOIL LAYER

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ABSTRACT

The fabrication tab requires a joining process in the battery, which is an essential storage device in renewable energy sectors. The joining process of a battery pack with a pouch cell configuration consists of three levels: cell, module, and pack. The joining of thin aluminium (Al) is essential for the battery production. Al is characterized as high thermally and electrically conductive materials. However, obtaining a quality Al weld using conventional methods is hard and the durability of weldments is uncertain. In order to overcome the aforementioned difficulties, friction melt bonding (FMB) is a liquid state technique used in this work for joining of aluminium alloys. FMB takes the advantage of large differences in the melting temperature of the materials to be joined and promises good weld quality. A different combination of rotational speed and dwell time is used for joining. The findings showed that the tensile shear-fracture load (TSFL) was significantly influenced by the tool's rotational speed and dwell time. The best combination of process parameters for better TSFL is identified and reported here.

Keyword: *Friction melt bonded spot welding, Tensile shear fracture load, Aluminium foil.*

1.INTRODUCTION:

The main objective of our project is to find the effect of tool rotation speed and dwell time on mechanical properties of friction melt bonded spot weld [2,3] of aluminium welded with aluminium foil layer. The scope of our project is in the battery industry [1]. Aluminium is essential in the making of batteries, especially in aluminium-air

batteries and aluminium-ion batteries. Aluminium has a low thickness, is non-toxic, has high thermal conductivity, has incredible corrosion obstruction and can be easily cast, machined and shaped. That is why we chose aluminum.

In this work aluminium alloys AA1100 having dimension of (100X30X0.3) mm is selected and purchased. Different rotational speed or dwell time of FSMB is used for joining. The tool is made of Tungsten Carbide having diameter 18 mm. TSFL is done on the successful weld pieces [4].

2.EXPERIMENTAL PROCESS:

Friction melt spot welding is a process of spot welding that operates joining the two workpieces. The apparatus required are Aluminium coil, aluminium foil, scissor, metal cutting, etc., The aluminium coil is cut into pieces to form a plates and their dimensions are 30x100x0.3 (BxLxW). All Aluminum foil is arranged properly and straightly and top and bottom with aluminium plate. Properly setted the workpiece in the center which is perpendicular to tool. With the help of metal cutting the aluminium coil has been cut into pieces. Now, the aluminium foil is cut into pieces with the help of scissor and their dimensions are 30x30 (LxB). In this process, there two aluminium plates will be taken and 50 pieces of aluminium foil. There are three layer consists of such that upper layer is plate, middle layer is 50 pieces of foil with proper alignment and lower layer is plate. Now we are going to weld these materials with the help of friction melt spot welding. The rotation speed and dwell time are varied accordingly. Now the two aluminium plates with aluminium foil were joined together through welding process. Plates were compressed hardly, and it cannot be removed by manual load.

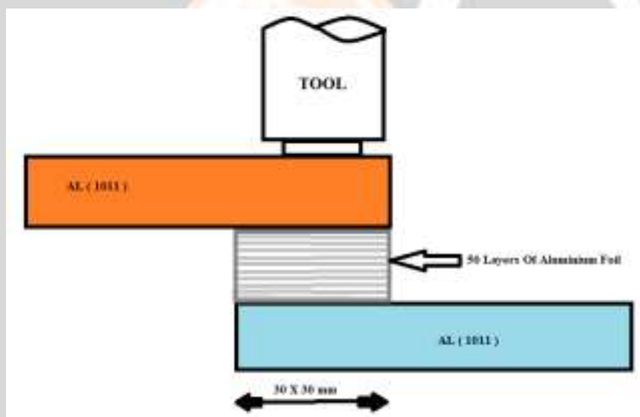

Fig-1: Schematic diagram of the process

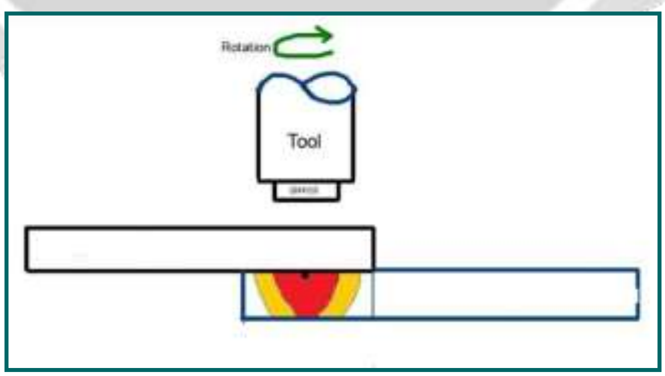

Fig-2: Concept of FSMB

Fig-3: Experimental setup

Table-1: Varying tool rotation speed

Trial	Tool Rotation Speed(rpm)	Dwell Time(sec)
1	600	20
2	800	20
3	1000	20
4	1200	20
5	1400	20

Table-2: Varying Dwell time

Trial	Dwell Time(sec)	Tool Rotation Speed(rpm)
1	10	1000
2	15	1000
3	20	1000
4	25	1000
5	30	1000

3.RESULT AND DISCUSSION:

As per the experimental plan the joining FSMB was done, after welding visual inspection was carried out, no defects were observed as shown in fig-3 and 4. TSFL was calculated for each combination of process parameter and presented in the table 3and 4.

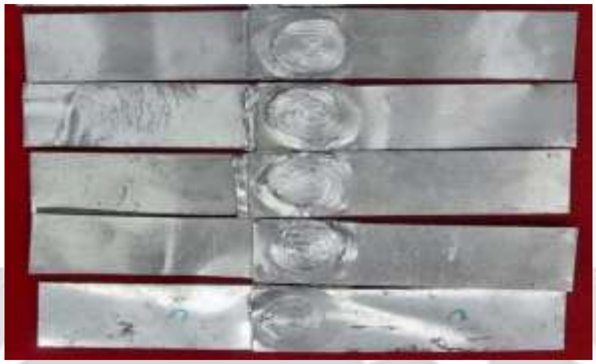

Fig-4: FSMB by altering tool rotation speed.

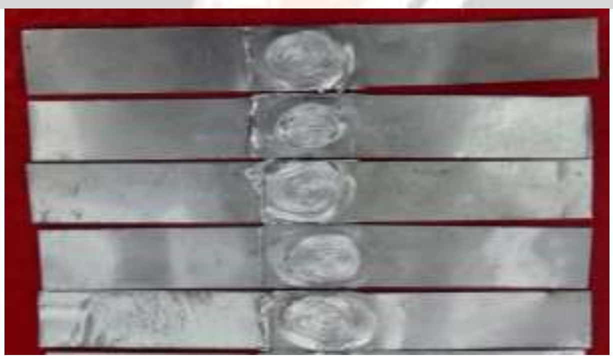

Fig-5: FSMB by altering dwell time.

Table 3: TSFL value for FSMB by varying Tool rotation speed

Trial	Tool Rotation Speed(rpm)	TSFL (kN)
1	600	6.80
2	800	7.57
3	1000	9.23
4	1200	7.21
5	1400	6.51

Table 4: TSFL value for FSMB by varying Dwell time

Trial	Dwell Time(sec)	TSFL (kN)
1	10	7.67
2	15	8.48
3	20	10.31
4	25	7.02
5	30	6.53

Effect of Tool rotating speed on TSFL is shown in Fig-6, rotational speed of 600 rpm to 1400 rpm and Effect of Dwell time on TSFL is shown in Fig-7, Dwell time of 10 sec to 30 sec.

As seen in Figure 6, the lower rotational speeds (600 rpm) produce less TSFL of the FSMB joints. The TSFL increases proportionally with rotational speed starting at 600 rpm and reaches its maximum at 1000 rpm. The TSFL of the joint decreases as a result of the rotational speed continuing to rise above 1000 rpm. The bonded zone is reduced at lower tool rotational speed due to less temperature distribution and low heat input. This low heat input produces weak bonding between the top and bottom plate, so the TSFL is low. It is obvious that the heat input in an FSMB increases as the rotational speed does. The bonding between the top and bottom plates is destroyed by additional heat input. The graphs depicted in Figure 7 make it clear that the dwell time affects the TSFL and the TSFL of the FSMB joint is lower for a lower dwell time (10 sec) compared to 20 sec. The TSFL increases along with the rotatioanl speed. In general, FMB at a higher dwell time in a spot-welding area produces a high exposure duration, adequate heat, and good material flow between plate, which makes the joints stronger compared to low dwell time (10sec).

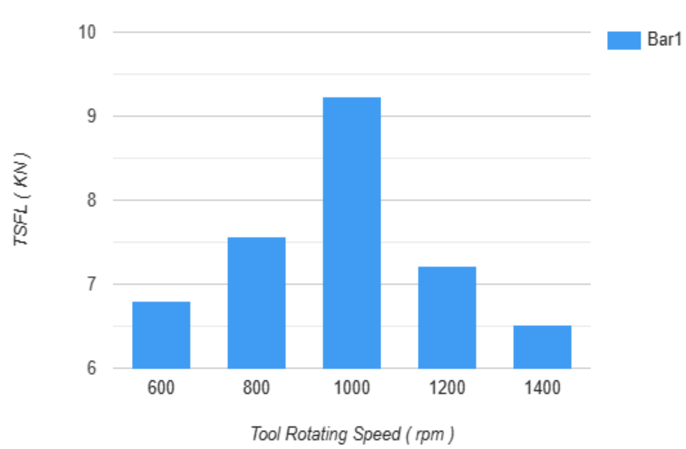

Fig-6: Effect of Tool Rotating Speed on TSFL

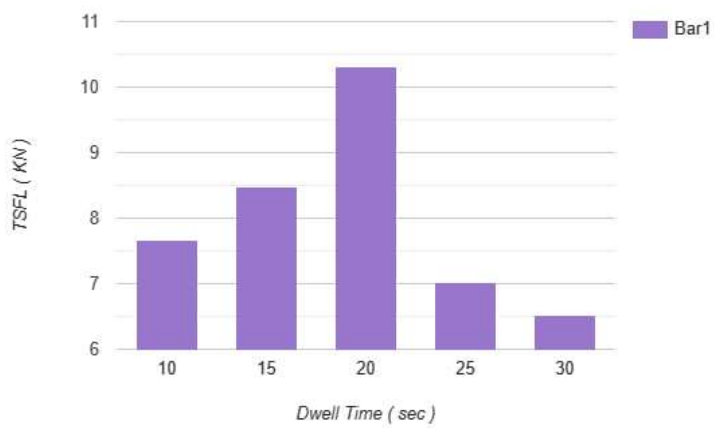

Fig-7: Effect of Dwell Time on TSFL

4.CONCLUSIONS:

Problem is identified as FSMB will be used for joining of thin aluminium alloys. AA 1100 is selected as the material for this project. Process parameter identified as rotational speed and dwell time. Experimental plan is developed for doing FSMB successfully. FSMB technique is applied successfully to join thin aluminium sheets for renewable energy applications. Combination of different rotational speed and dwell time is used as process parameter. Rotational speed and dwell time have significant effect on TSFL of FSMB. Best process parameter for joining of aluminium alloys using FSMB are identified as 1000 rpm and 20 sec.

5.REFERENCES:

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