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OPTIMIZATION OF FRICTION STIR WELDING FOR TENSILE STRENGTH OF ALLUMINIUM ALLOY

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Abstract

Friction stir welding is a technique in which the work pieces are joined by benefits of frictional warming and plastic disfigurement without a doubt a temperature underneath the liquefying purpose of the material to be joint. It has for the most part great mechanical properties and is warmth mendable and weld capable. Examinations are appeared by changing rotational speed, transverse speed and adjusted shoulder distance across. The Taguchi Method is utilized to discover the mix of the three welding parameters. In this work three parameters are taken and orthogonal cluster are chosen to advance parameters for quality of the welded joint. The Tensile quality is for the most part rich by Tool speed and adjacent to it bear measurement and nourish rate likewise influence to some degree.

Keywords: Friction stir welding (FSW) Tool, simple milling machine, Aluminium alloy , Tensile strength, cylindrical tool.

INTRODUCTION

Friction Stir Welding is the welding procedure in which the warmth required for welding is gotten by erosion between the closures of the two sections to be gone along with .One of the parts to be joined is turned at a rapid close around 3000 rpm and the other part is pivotally adjusted to the second one and squeezed firmly against it. The contact between the two sections raises the temperature of both the finishes. At that point the pivot of the part is halted unexpectedly and the weight on the altered part is expanded so that the joining happens. This is additionally called as Friction Welding.

Friction Welding can be considered as a fashion welding since the welding is done with the use of weight. In rubbing welding the warmth required for the welding procedure is created because of the erosion between two surfaces to be joined. Enough warmth can be created and the temperature of the mating point can be raised to the level where the surfaces subjected to grating may get welded together.

Amid Friction welding various strong state forms happens utilizing the frictional warmth created through the immediate collaboration between moving work pieces, with expansion of a swaging power to plastically diffuse material between the two work pieces. Numerous unalike material blends can be joined and there are various operations in which this can be completed.

LITERATURE REVIEW

In this work it is expected to think about the examination business related to the Friction Stir Welding by various analysts and to propose ideal parameters which influence the proficiency of the Friction Stir Welded joints of Aluminum compound. As the FSW was created in 1991 it is an extremely late strategy and numerous specialists have led test thinks about and have prescribed the FSW as one of the best joining system for joining Aluminum composites. Numerous diagnostic (numerical) techniques were concentrated on by the analysts, yet the thermo-mechanical communications occurring amid the procedure are yet to be seen completely.

Ericsson Metal contrasted MIG and TIG process and Friction Stir Welding process. The FSW is directed with differed weld speeds. Whether the exhaustion quality of FS welds is affected by the welding speed is broke down in the study. The T4-welded AA6082 subjected to post weld maturing treatment is utilized as base material. Because of the expanded measure of warmth provided to the weld per unit length at a lower weld speed, the weariness execution was observed to be expanded. The joints got by MIG heartbeat and TIG welds indicated bring down static and element quality than the joints got by FSW. Thorough overview paper by K.Y. Benyounis et al gives a general survey of research work in FSW. In the present work, based on the models identified with FSW, reported in the writing survey of grating blend welding it might be significantly grouped into classes as said-

1. Models on Tool geometry

2. Investigative Models

3. Improvement of mechanical properties of FSW joints

4. Rubbing Stir Welding in comparable Aluminum Alloys

5. Rubbing Stir Welding in disparate metals

6. Thermo-mechanical demonstrating

2.1 MODELS ON TOOL GEOMETRY

The apparatus geometry on mechanical and smaller scale auxiliary properties of the weld quality is accessible in past studies. The impact of the instrument shape on the mechanical and smaller scale basic properties of rubbing mix welded 1050-H24, 6061-T6, 5083-O aluminium plates were explored by Fujii et al., in which three distinct apparatuses, the most straightforward shape (segment without strings), the standard shape (section with strings) and the triangular crystal shape tests were utilized for study. At the point when the disfigurement resistance is moderately low, the impact on the microstructures and mechanical properties of the joints by apparatus shape were not that huge is the perception made by them. Weldability is observed to be affected by the instrument shape at high rotational speed fundamentally. In this study it has been found that 1050-H24 material joint got by utilizing a columnar instrument without strings delivered the best mechanical properties. At the point when welded at a rotational speed of 600 rpm, the impact of hardware shape on the microstructure and mechanical properties of the joints was observed to be unimportant.

RESULT AND EXPERIMENTATION

4.1. Signal to noise ratio

Taguchi procedure uses the S/N proportion way to deal with measure the quality trademark veering off from the sought esteem. The S/N proportion attributes can be partitioned into three phases: the ostensible the better, the littler the better, and the higher-the better when the quality qualities are consistent for building investigation. Since the goal of this study is to expand tractable shear constrain through ideal process parameters in rubbing blend welding, higher-the better quality trademark is utilized in this study. The equation utilized for computing the SN proportion is given underneath.

$$S/N = -10\log_{10}\frac{1}{N}\sum_{i=1}^{n}\frac{1}{y_i^2}$$

where yi is the estimation of elastic shear compel for the ith test, n is the quantity of tests and N is the aggregate number of information focuses.

Table 1 Result collected for the design of experiment

Ex. No	Tool Rotational Speed(N) in r.p.m	Welding Speed(S) in mm/min	Axial Force (F) in KN	Impact Strength (Joules)	Tensile Strength (K) Joules/mm2	S/N ratio of tensile strength
1	1200	75	5	44	65.44	36.31
2	1200	100	6	29	87.12	41.30
3	1200	125	7	36	111.29	44.25
4	1300	75	6	22	87.37	37.65
5	1300	100	7	32	112.45	43.84
6	1300	125	5	22	104.55	48.28
7	1400	75	7	24	153.44	53.5
8	1400	100	5	41	74.45	41.20
9	1400	125	6	30	79.45	45.38

Average Tensile Strength (K) = 97.28 joules/mm^2

In this research work, the controllable factors taken are Feed rate (A), Flow rate (B) and Voltage(C). since they affect tensile strength in FSW and since these factors are controllable in the FSW, they are considered as **controllable factors**.

4.2 ANALYSIS OF MEANS AND RESPONSE GRAPHS FOR MEANS

4.2.1 Analysis of Means

The analysis of each controllable factor is studied and the main effect of the same is obtained in table 5.44. Main effect of each factor at individual level is equal to the mean of TS of all the experiment with the factor at individual level.

For example

(A) The main effect of the Feed rate on the TS at various level is calculated as follows:

L = (65.44+ 87.12+ 111.29)/3 = 87.95 joules/mm^2
M = (87.37+ 112.45+ 104.55)/3 = 101.45 joules/mm^2
H = (153.44+ +74.45+ 79.45)/3 = 102.44 joules/mm^2

(B) The main effect of the Flow rate on the TS at various level is calculated as follows:

L = (65.44+ 87.37+ 153.44)/3 = 102.08 joules/mm^2
M = (87.12+ 112.45+ 74.45)/3 = 124.67 joules/mm^2
H = (111.29+ 104.55+ 79.45)/3 = 98.43 joules/mm^2

(C) The main effect of the Voltage on the TS at various level is calculated as follows:

L = (65.44+112.45+79.45)/3 = 85.79 joules/mm^2
M = (87.12+104.55+153.44)/3 = 115.03 joules/mm^2
H = (111.29+87.37+74.45)/3 = 91.03 joules/mm^2

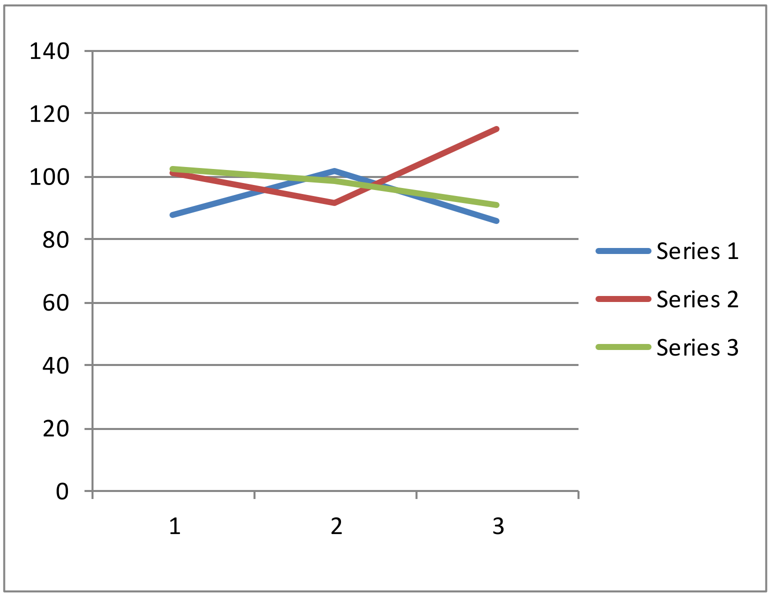
Table 2 Factors Effect Table for FSW

Symbol	**Controllable factors**	**Level I**	**Level II**	**Level III**
A	**Feed rate**	87.95	101.45	**102.44**
B	**Flow rate**	**102.08**	91.34	98.43
C	**Voltage**	85.79	**115.03**	91.03

From the above table the values in bold show the larger the better criteria as proposed by Taguchi method.

4.2.2 Response Graphs for Means

The values obtained from the response table are plotted to visualize the effect of the three factors at three levels. Figure shows the influence of each factors viz. Feed rate (A), Flow rate (B) and Voltage(C) as the higher TS is a better Machining performance. From the Mean response graph,



Graph 1 MEANS RESPONSE GRAPH 5.1 FOR THREE FSW FACTORS A1, A2, A3: FEED RATE, B1, B2, B3: FLOW RATE, C1, C2, C3: VOLTAGE

Observational findings are illustrated as follows:

1. Level III for Feed rate, A3= **102.44** joules/mm^2 indicated as the optimum situation in terms of TS values.
2. Level I for Flow rate, B1= **102.08** joules/mm^2 indicated as the optimum situation in terms of TS values.
3. Level II for Voltage, C2= **115.03** joules/mm^2 indicated as the optimum situation in terms of

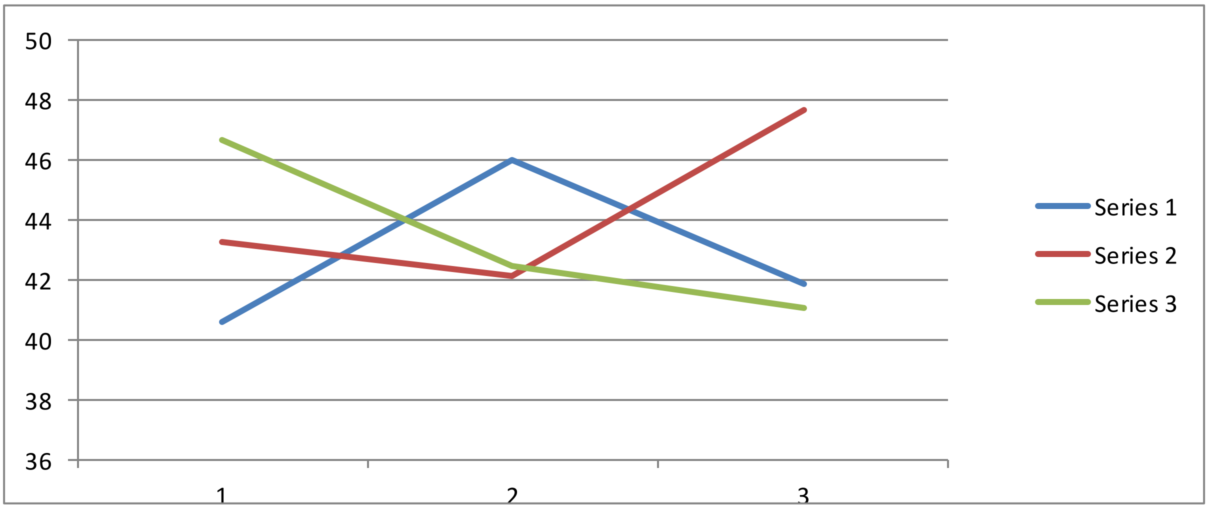
Mean of S/N Ratio (m) = 38.15 dB

4.3.2 Response Graphs for S/N values for TS

The value obtained from the response table are plotted to visualize the effect of the three parameters. Figure shows the influence of each factor viz. Feed rate (A), Flow rate (B) and Voltage(C) on the TS and as the highest TS value is better Machining performance characteristic. From the S/N response graph observational findings are illustrated as follows:

1. Level III for Feed rate, A3= **46.69 dB** indicated as the optimum situation in terms of S/N values.
2. Level I for Flow rate, B1= **45.97 dB** indicated as the optimum situation in terms of S/N values.
3. Level II for Voltage, C2= **47.69 dB** indicated as the optimum situation in terms of S/N values.

Mean Effect Response Due to factor	A1	A2	A3	B1	B2	B3	C1	C2	C3
Mean Effect Response Due to factor	87.95	101.45	102.44						
Mean Effect Response Due to factor				102.08	91.34	98.43			
Mean Effect Response Due to factor							85.79	115.03	91.03
Mean Effect Response Due to factor	97.28	97.28	97.28	97.28	97.28	97.28	97.28	97.28	97.28



Graph 2 S/N graph for tensile strength

S/N Value of Factor Effect	A1	A2	A3	B1	B2	B3	C1	C2	C3
S/N Value of Factor Effect	40.62	43.25	46.69						
S/N Value of Factor Effect				45.97	42.11	42.48			
S/N Value of Factor Effect							41.84	47.69	41.03
Average of S/N Value	38.15	38.15	38.15	38.15	38.15	38.15	38.15	38.15	38.15

CONCLUSION

Friction stir welding is a procedure in which the work pieces are joined by advantages of frictional warming and plastic distortion no ifs ands or buts a temperature underneath the condensing reason for the material to be joint. It has generally awesome mechanical properties and is warmth mendable and weld competent. Examinations are showed up by changing rotational speed, transverse speed and balanced shoulder remove over. The Taguchi Method is used to find the blend of the three welding parameters. In this work three parameters are taken and orthogonal group are propelled parameters for nature of the welded joint. The Tensile quality is generally rich by Tool speed and adjoining it bear estimation and support rate in like manner impact to some degree.

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