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Experimental analysis of friction stir welded aluminum alloys AA5052 – AA6061

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Abstract:

The joining of two different aluminum alloys AA5052- AA6061 plates thickness 6mm is carried out by Friction Stir Welding (FSW) technique. . Input parameters are spindle speed (1000 to 1400 rpm), feed rate (10 to 20 mm/min) and tool profile. By varying the process parameters, defect free and high efficiency welded joints were produced. Optimum process parameters were obtained for joints using statistical approach. Three different tool designs have been employed to analyses the influence of rotation speed and traverse speed over the hardness and tensile properties. Effect of welding speed on hardness distribution and tensile properties of the welded joints were investigated. Hardness studies revealed that the lowest hardness in the weldment occurred in the heat-affected zones whereas tensile failures were observed to take place.

I. Introduction

Friction stir welding is a technique by which it is used to improve strength of the welded area of the wrought aluminum alloy. By using this technique, we will also be able to improve the grain structure of the welded area. Optimization of the parameter in friction stir welding such as tool rotation speed, tool feed rate, axial force will be helpful in obtaining the exact value of process parameters which will result in efficient tensile strength of the welded area. The optimization is carried out by a special technique called as Taguchi method. Taguchi is a modern optimization technique by which the number of experimental methods can be process of aluminum alloys. Friction sir welding is a solid state welding process performed at temperatures lower than melting point of the alloy. The work pieces are rigidly clamped in a fixed position in a fixed position and a specially profiled rotating tool traversed through the joint line produces the friction heating. The tool is crushing tool the joint line, breaking up the oxide film by a mechanical stirring and forging of the hot and plastic material. The resulting joint exhibits a finer grain structure than the base metal. Aluminum is remarkable for the metals low density and for its ability to resist corrosion due to the phenomenon of passivation. Structural components made from aluminum and its alloys are vital to the aerospace industry and are important in other areas of transportation and structural materials. Welding of aluminum alloys is primary interest in today's modern world.

2. Methodology

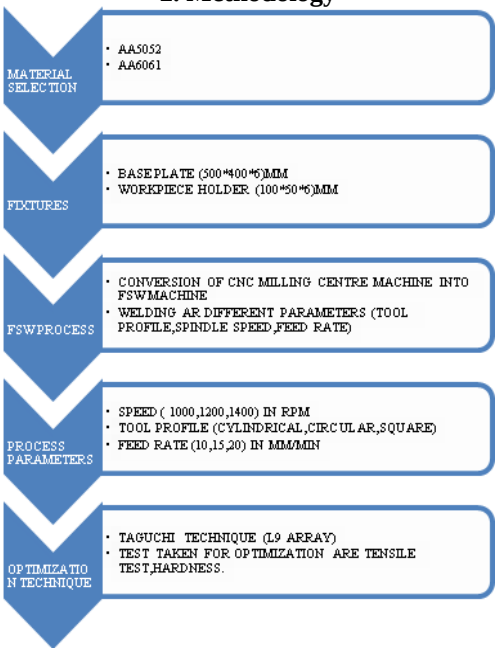

Fig 1

3. Experimental procedures

5052 aluminum alloy and 6062 aluminum alloy plates with thickness of 6 mm were used in the present study and the chemical compositions are listed in table 1 and table 2.

ELEMENTS	Fe	Si	Cr	Mg	Ti	Cu	MN	Zn	Al
WEIGHT PERCENT %	0.7	0.8	0.25	0.1	0.03	0.4	0.15	0.25	bal

Table 1 Chemical composition of 6061

ELEMENTS	Fe	Si	Cr	Mg	Ti	Cu	Mn	Al
WEIGHT PERCENT %	0.4	0.25	0.25	2.8	0.15	0.1	0.1	bal

Table 2 Chemical composition of 5052

In this experiment, the type of materials used for welding was AA5052 and AA6061 aluminum alloy in plate form of thickness 6mm. Each specimen has 100mm long and 50mm wide. In this work the tool was used cylindrical and threaded profile with 15 mm shoulder diameter and pin diameter 5.9mm with a length of 5.9mm respectively. The experiment carried in vertical milling machine.

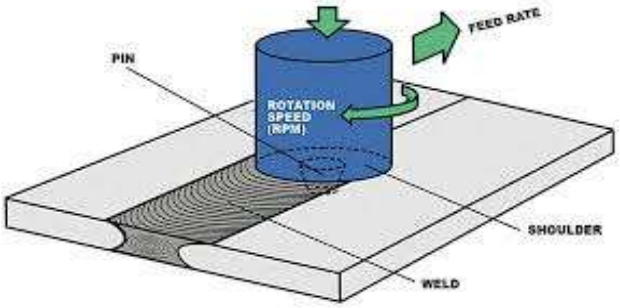

Fig 2: friction stir welding

Experiment number	Factors Tool rotational speed (r/min)	Tool traverse speed (mm/min)	Tool profile
1	1	1	C
2	1	2	CT
3	1	3	SQ
4	2	1	CT
5	2	2	SQ
6	2	3	C
7	3	1	SQ
8	3	2	C
9	3	3	CT

Table 3 The L9 array Taguchi experimental design used in this study

Experiment number	Factors Tool rotational speed (r/min)	Tool traverse speed (mm/min)	Tool profile
1	1000	10	C
2	1200	15	CT
3	1400	20	SQ

Table 4 The actual values of the parameters at their different coded levels.

In this above method, the specimen aluminum alloy AA5052 and AA 6061 are welded together as various parameters have different results and structure is formed. Then the welded specimens are tested by various testing methods tensile and hardness. By using tensile strength and hardness values, optimization are carried out through the Taguchi technique as shows above in fig 3.

2.1 Taguchi analysis of S/N Ratio

Taguchi technique utilizes the S/N ratio approach to measure quality characteristic deviating from the desired value. The S/N ratio characteristic can be divided into three stages: the nominal-the better, the smaller-the better, and the higher-the better when the quality characteristic is continuous for engineering analysis. Since the objective of this study is to

maximize tensile shear force through optimum process parameter in friction stir welding, higher-the better quality characteristic is employed in this study.

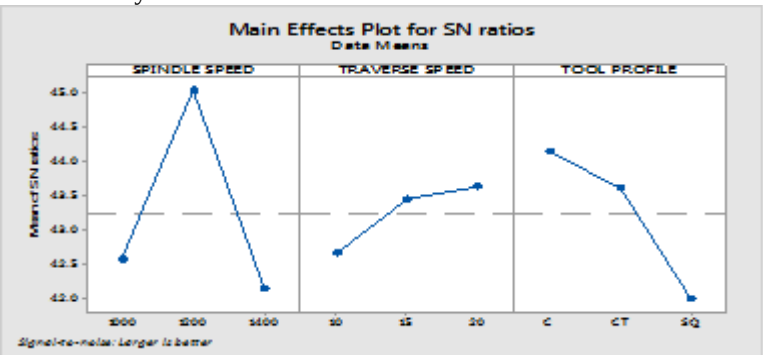

Fig 3: Graph for S/N ratio vs factor effects

3.Experiment results

3.1 Tensile testing

The tensile specimen is fixed between the fixed jaw and the movable jaw. Then the movable jaw is moved downwards opposite to the fixed jaw. When the specimen exits elongation limit leads to break. The point broken taken value is the tensile strength of specimen.

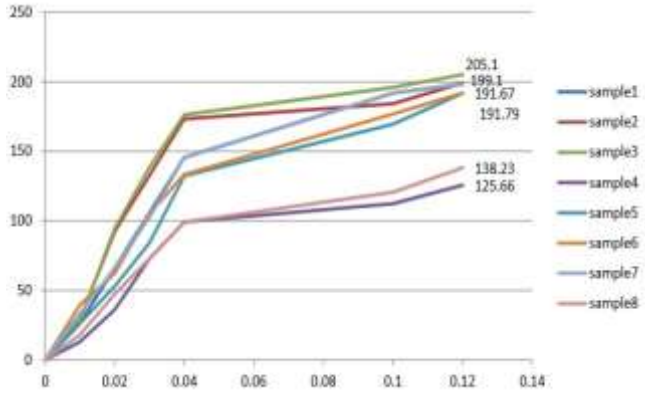

Fig 4: Graph of tensile test

In this test, we found out the highest tensile strength is obtained in sample 3 and lowest strength attained in sample 4. By using this data we can found out the mean of the tensile strength and optimize the parameter through the Taguchi technique. Results show the transverse speed of 15, spindle speed 1200 and tool profile is cylindrical.

3.2 Hardness testing

The Vickers hardness test was carried to measure the hardness of welded parts. The machine has a diamond indenter, a small load which produce an indentation on work piece which is subjected to the hardness test. The depth of indentation, to fix the hardness, likewise, if the indentation is large the material lacking in hardness, is it small the object has more. This test is utilized by more industries to determine the right type of material to use for many applications. A material with ultimate hardness according to its purpose, It should be selected

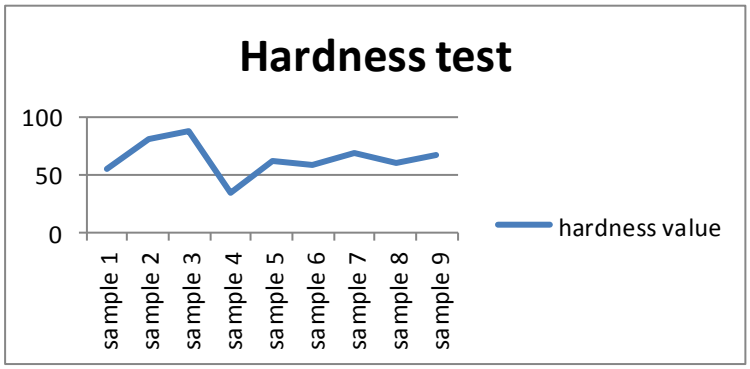

Fig 5

5. Conclusion

In this work, The experimental investigation of a friction stir welding joints between aluminum alloys AA5052 and AA6061 by changing the parameters, tool profiles, speed, feed rate then studied the influences of the friction stir welding on the tensile and hardness of aluminum alloys.

The results are summarized as follows.

1) As for the conditions the best speed is 1200 rpm, welding speed of 15 mm per minute and cylindrical tool profile gives maximum tensile strength of 205.1N/mm2
2) The maximum hardness of 86.7 VHN is obtained at spindle speed of 1200rpm, welding speed of 15 mm per minute and cylindrical tool profile.
3) Here it is concluded that at spindle speed 1200 rpm, feed rate of 15 mm/min and cylindrical tool profile the maximum Tensile strength and hardness are obtained.

6. Reference

[1] Esther T, Akinlabi and Stephen 2012 Friction Stir Welding Process: A Green Technology, World Academy of Science, Engineering and Technology. 6, 11.
[2] GAO Yefei, Tsumura Takuya, Nakata Kazuhiro 2012 Dissimilar Welding of Titanium Alloy and Steels Transactions of JWRI is published by Joining and Welding Research Institute, Osaka University, Ibaraki. 41, 07-12.
[3] Galvão , D Verdera , D Gesto , A Loureiro , D. M. Rodrigues 2009 Analysing The Challenge of Aluminium to Copper FSW AIMEN, Relva 27A Torneiros.36410 Porriño, Spain.
[4] K Kimapong and T. Watanabe, 2004 Friction Stir Welding of Aluminium Alloy to Steel, the Welding Journal, 277 – 282.
[5] R S Mishra, Z Y Ma 2005 Friction stir welding and processing Materials Science and Engineering. 50, 1–78.
[6] K D Bhatt, Bindu Pillai, A M Trivedi 2013 Effect of Size of Tool on Peak Temperature & Viscosity during Friction Stir Welding of AA6061-T6Aluminium Alloy Using Hyper Works International Journal of Innovative Research in Science, Engineering and Technology. 2, 23476710.
[7] R Rai, a De, H K. D H.Bhadeshia and T DebRoy, 2011 Review: friction stir welding tools, Science and Technology of Welding and Joining. 16, 325-341.
[8] Saad Ahmed Khodir and Toshiya Shibayanagi 2007 Dissimilar Friction Stir Welded Joints between 2024-T3 Aluminium Alloy and AZ31 Magnesium Alloy Materials Transactions, The Japan Institute of Metals. 48, 2501 to 2505.
[9] Sajin G Sajan, Manish Meshram, Pankaj, Palli Srinivas, Suhash R. Dey, Friction Stir Welding of Aluminium 6082 with mild steel and its joint analyses, Department of Materials Science and Engineering, Indian Institute of Technology.3,1-6. [10] V Firouzdor And S Kou 2009 Al-to-Mg Friction Stir Welding: Effect of Positions of Al and Mg with Respect to the Welding Tool, Supplement to The Welding Journal, Sponsored by the American Welding Society and the Welding Research Council.