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FRICTION STIR WELDING OF AA 2024 ALUMINUM ALLOY AND EC GRADE COPPER

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Abstract - *Components made by joining different materials are required in various engineering applications. Fabrication of such components is a challenging task due to the vast difference in the mechanical properties of the materials being used. Friction stir welding (FSW) is capable of joining dissimilar materials such as aluminum (Al) and copper (Cu) and therefore researchers have used this novel process for dissimilar joining. Consequently, several works pertaining to dissimilar joining, specifically Al-Cu, are available in the literature but they are scattered in different sources, which makes the task of gathering information about dissimilar FSW of Al-Cu cumbersome. This work has been written with an aim to provide all pertinent information related to dissimilar FSW of Al-Cu at one place to ease the problems of researchers. It comprehensively covers and summarizes the topics such as the effect of tool design and geometry, FSW process parameters, FSW strategies on mechanical properties, microstructure, and formation of defects during dissimilar FSW of Al-Cu. In addition, it also presents and discusses several variants of dissimilar FSW of Al-Cu. Finally, this work not only puts forth major findings of the previous researchers but also suggests future recommendations for dissimilar FSW of Al-Cu.*

***Key Words*: AA 2024 Aluminium alloy, EC grade Copper, FSW of Aluminium and copper, FSW of different materials.**

1. INTRODUCTION

In recent times, the focus has been on developing fast, efficient processes that are environmentally friendly to join two dissimilar materials. The spotlight has been turned on Friction stir welding as a joining technology capable of providing welds that do not have defects normally associated with fusion welding processes. Friction stir welding (FSW) is a fairly recent technique that utilizes a non-consumable rotating welding tool to generate frictional heat and plastic deformation at the welding location, thereby affecting the formation of a joint while the material is in the solid-state. Figure.1 shows the schematic drawing of friction stir welding representing all the relevant parameters of the process.

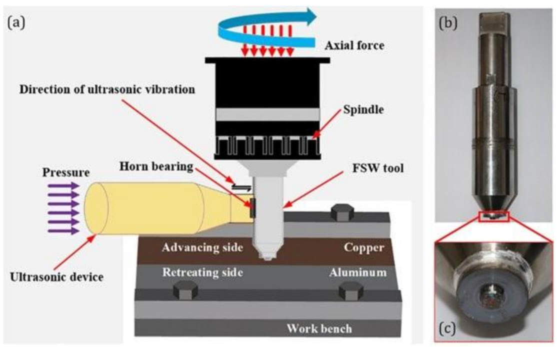

Fig -1: (a) Schematic Illustration of Friction Stir Welding Process (b , c) Tool Used.

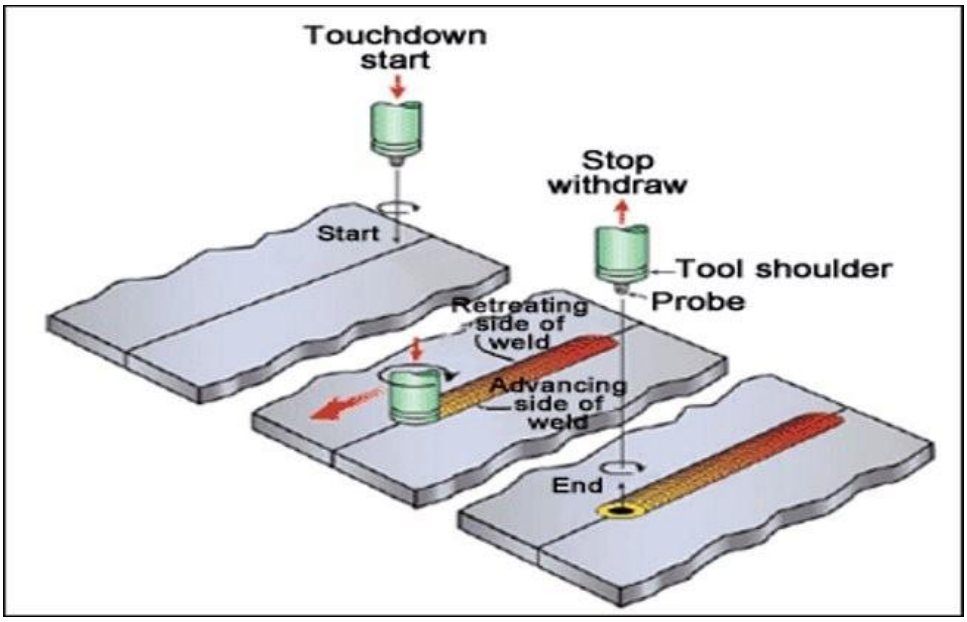

Fig -2: Schematic Illustration of Friction Stir Welding Process in action.

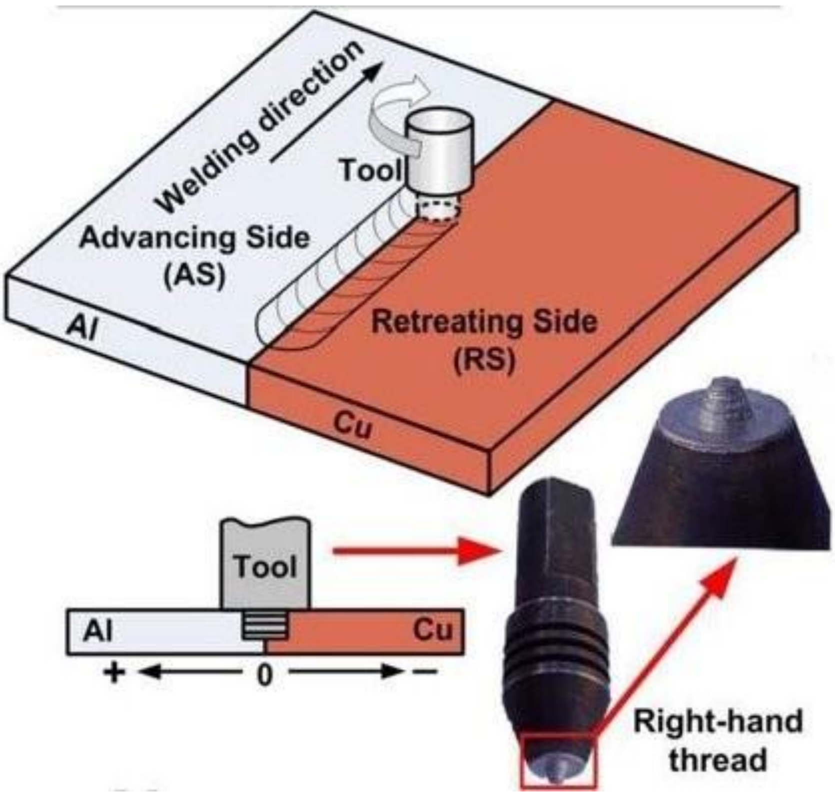

Fig -3: Tool used in the work.

A rotating tool is pressed against the surface of two abutting or overlapping plates. The side of the weld for which the rotating tool moves in the same direction as the traversing direction is commonly known as the 'advancing side'; the other side, where tool rotation opposes the traversing direction, is known as the 'retreating side'.

2. Literature Review

From the book [1] under the title "Materials Science and Engineering," we have reviewed friction stir welding processes and their parameters to perform friction stir welding which was the basic task.

From the research paper [2] under the title "Friction stir welding of aluminum alloys" we have reviewed types of aluminum alloys and their ability to perform friction stir welding which was the minimum requirement.

From the research paper [3] under the title "Experimental study on Friction Stir Welding of copper metals" we have reviewed types of copper alloys and their ability to perform friction stir welding which was the task to consider all factors.

From the research paper [4] under the title "Microstructure and mechanical properties of dissimilar Al–Cu joints by friction stir welding" we have reviewed about types of copper alloys and aluminum alloys and their ability to perform friction stir welding with each other which was the task to consider all outcome affecting factors.

From the research paper [5] under the title "Evaluation of mechanical properties using shear–punch testing" we have reviewed the evaluation of mechanical properties-tensile strength, hardness, impact strength which is the final outcome of our objective.

From the research paper [6] under the title "A Review of FSW Research on Dissimilar Metal and Alloy Systems," we have reviewed the dissimilar metal FSW weld which is the outcome of our objective.

3. Optimization of Parameters

AA2024 and Copper plates of 3mm thickness have been considered for the present study. Experiments are conducted as per Taguchi's L9 orthogonal array. The process parameters considered in this study are:

- SPINDLE SPEED
- WELD SPEED
- TOOL TILT ANGLE
- TOOL PIN PROFILE

4 Results and Discussions:

→ After various trails the sound joint could be obtained with
  - SPINDLE SPEED 1100 rpm
  - WELD SPEED 40 mm/min
  - TOOL TILT ANGLE 2 degrees
  - TOOL PIN PROFILE Conical with threads

→ Base materials positioning has strong influence on butt welds and structure.

→ The welds performed with the aluminum placed at the advancing side of the tool were very irregular due to the expulsion of the aluminum from the weld area.

→ AA 2024/copper-EC welds presented excellent surface finishing.

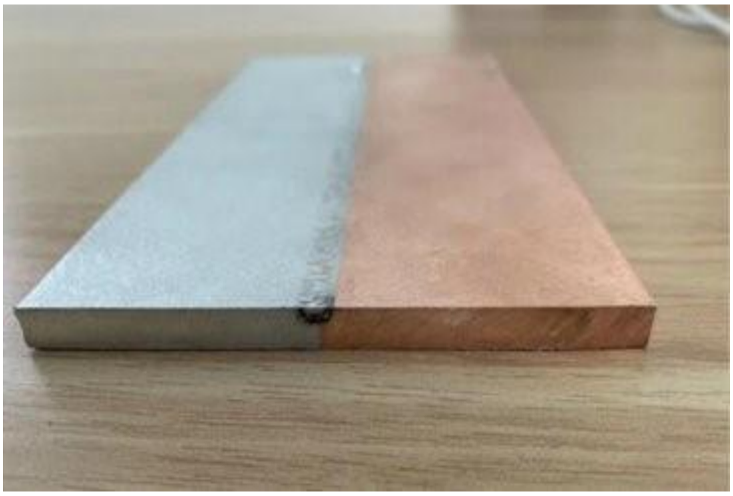

Fig -4: Finished Job.

5. CONCLUSIONS

- 9 Welding jobs were performed with dimensions of 75mm x 150mm x 3mm.
- Each job was performed with different considered parameters.
- The parameters were considered such that they affect the weld quality and mechanical properties.
- The parameters were optimized using trial & error and Taguchi's rule for manufacturing.
- The assumptions were made based on the weld quality obtained while implementing Taguchi's rule for manufacturing.

REFERENCES

1. Materials Science and Engineering: R: Reports, Volume 50, Issues 1–2, 31 August 2005, Pages 1-78, Friction stir welding and processing, author R.S.Mishraa and Z.Y.Mab
2. Journal International Materials Reviews Volume 54, 2009 - Issue 2, Friction stir welding of aluminum alloys, P L Threadgill, A J Leonard, H R Shercliff &P J Withers, Pages 49-93 | Published online: 18 Jul 2013
3. Experimental study on Friction Stir Welding of copper metals. Author Y.M.HwangP.L.FanC.H.Lin Journal of Materials Processing Technology, Volume 210, Issue 12, 1 September 2010, Pages 1667-1672
4. Microstructure and mechanical properties of dissimilar Al–Cu joints by friction stir welding Authors Qiu-zheng zhang, Wen-biao HONG Wei LIU Transactions of Nonferrous Metals Society of China Volume 25, Issue 6, June 2015, Pages 1779-1786
5. Evaluation of mechanical properties using shear–punch testing Authors R.K.Guduru, K.A.Darlinga, R.Kishore, R.O.Scattergood, C.C.Kocha, K.L.Murtya Materials Science and Engineering: Volume 395, Issues 1–2, 25 March 2005, Pages 307-314
6. Acerra.F, Buffa.G, Fratini.L and Troiano.G "On the FSW of AA2024- T4 and AA7075-T6 T-joints: an industrial case study", International Journal of Advanced Manufacturing Technology", Vol. 48, No. pp.1149–1157, 2010.

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