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A Review of Friction Stir Welding (FSW) by using bobbin type tool

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ABSTRACT

Friction Stir welding (FSW) is a novel green assembling technology because of its environment free and energy efficient nature. This strong state joining process includes a cylindrical non-consumable device comprising of a shoulder and additionally a pin probe. The shoulder applies a descending pressure to the work-piece surface, obliges the plasticized material around the pin, produces heat through the erosion and causes plastic deformation in a generally thin layer under the base surface of the shoulder. FSW, has been developed to manufacture composites, locally eliminate casting defects, refine microstructure and/or improve the associated mechanical and physical properties including strength, ductility, fatigue, creep, formability and corrosion resistance. So basically, shoulder and pin geometry influence the properties of the weld zone. This review paper represents the effect of bobbin tool on the properties of the weld zone. Bobbin tool consist two shoulders: one on upper side and second one at below the workpiece which give the support to the weld zone.

Keywords: Friction stir welding, Bobbin tool, Aluminum Alloy

I. INTRODUCTION

This document is a template. An electronic copy can Friction Stir Welding (FSW) was developed by Wayne Thomas at TWI (The Welding Institute), and the first patent applications were registered in UK in 1990's. At starting phase of this technology, this process was concern only with laboratory fabrication work, but in short time it clear that the FSW has the number of benefits in fabrication work of aluminium, magnesium, copper products. Since its invention, this process has received worldwide attention and today FSW is used in research and production in many sectors including aerospace, automation, nuclear waste container, railway, electronic housing, shipbuilding, cooler, heat exchanger, etc.

A. Friction stir welding principle:

Friction stir welding is a process for joining work pieces in the solid-phase, using an intermediate non-consumable tool (we are using a bobbin tool), with a suitably profiled shoulder and probe, made of material that is harder than the work piece material being welded. FSW can be regarded as an autogenously keyhole joining technique, essentially, without the creation of liquid metal. The rotating tool is plunged into the weld joint and forced to traverse along the joint line, heating the abutting components by interfacial and internal friction, thus producing a weld joint by extruding, forging and stirring the materials from the work pieces in the vicinity of the tool.

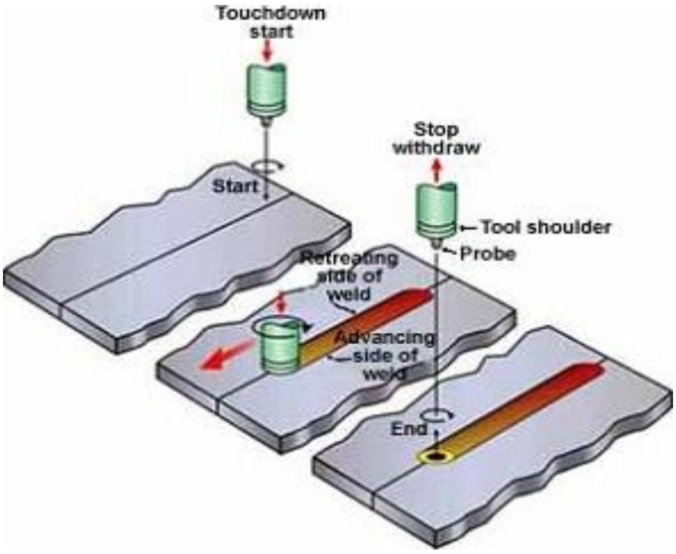

Fig-1 friction stir welding principle [2]

B. Friction Stir Welding Tool Configuration

There are following type of friction stir welding

I. Convectional tool
II. Bobbin tool

C. Bobbin tool

The bobbin friction stirs welding (BFSW) tool has two shoulders with one shoulder on the top surface and the other on the bottom surface of the weld plate, with a pin fully contained inside the material. Figure 2 show the complete schematic design of the bobbin tool design.

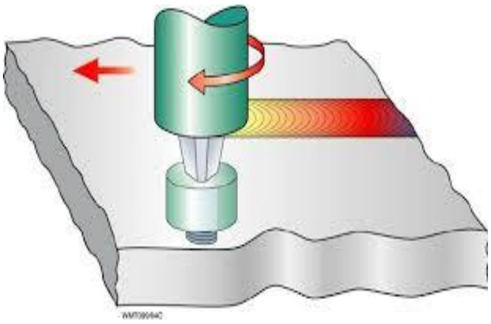

Figure 2: Schematic of Bobbin Tool [1]

This reduces the requirements of extensive clamping and setup prior to welding. The reason is because the normal down force imposed by CFSW is reduced and the reactive forces within the weld are contained between the bobbin shoulders. There are three forms of bobbin tool; fixed bobbin, floating bobbin and adaptive bobbin. The definitions of these variants are explained as follows:

- Fixed bobbin - The gaps are fixed between the two shoulders throughout the process and the normal Z-axis movement of the tool can be either fixed or controlled based on system capability.
- Floating bobbin - The two shoulders have a fixed gap throughout the process and thus produce balanced forces in the Z-axis. However, the tool floats in the Z direction throughout the process.
- Adaptive bobbin: The adaptive technique enables adjustment of the gap between the shoulders during the welding operation while the tool floats in the Z direction.

II. STUDY RELATED TO BOBBIN TOOL

To know the Experimental Analysis carried out in the field of Friction stir welding, particularly for achieving better mechanical properties like tensile strength, hardness, bending strength, and fatigue strength etc. compare to conventional welding process. Before proceeding to actual research work, reviews of literature most related to parameters affecting such were discussed in this chapter.

J.Hilgert et Al.(2015) investigate the material flow around a bobbin tool for friction stir welding. [3]

In this work, the work piece material AA2024-T3 used and the plate thickness is 4mm. The experimental parameter is set as 1000RPM speed of bobbin tool and its feed is 60mm/mi. After studying this research paper, we concluded that the shear layer shape around FSW bobbin tools can be predicted using COSMOL Multiphase and the resulting force also predicted.

J Goebel et al. (2013) done the Semi-stationary shoulder bobbing tool friction stir welding of AA2198-T851. [4]

In this work, AA2198-T851 is used and its thickness is 3mm the performing parameters is set as 400RPM and feed is 1mm/min. From this paper concluded that Semi structure: The microstructure exhibits a cylindrical bore glass with characteristics zones known from FSW. A fine recrystallized layer is from the ultimate tensile strength efficiency 82%.

WY Li, T Fu et al. (2015) checked the effects of tool rotational and welding speed on microstructure and mechanical properties of bobbin-tool friction-stir welded Mg AZ31. [5]

Al-Li alloy AA2198 has been successfully welded by bobbin tool friction stir welding by W.Y. Li after studying research paper we conclude that Symmetrical hardness profiles have been obtained in the thickness direction, which indicates that the joints have homogenous through-thickness mechanical properties. As the rotational speed increases, the average hardness of the stirred zone increases and the hardness profile along the cross section of the joint changes from the U-shaped to W-shaped. The tensile strength of the joint initially increases with rotational speed and then decreases with the maximal strength efficiency reaching 80%.

III. CONCLUSION

At last we conclude from this review paper:

- FSW gave sound good quality weld and good mechanical properties compare to conventional FSW tool.
- Fine grain structure can be achieved by bobbin tool.
- Also, as the welding speed of bobbin tool increase, the tensile strength of the weld zone increases.
- Tool rotation speed and tool traverse rate have only small impact on the yield strength and finite element of the joint.

IV. REFERENCES

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