FRICTION STIR WELDING IN CIRCULAR PIPES

Kishore prasaath. K[1], Manikandan. T[2], Shanmugapraveen. S[3], Ponmurugan. M[4]

[1, 2, 3]UG Student, Bannari Amman Institute of Technology, Sathyamangalam, Erode
[4]Assistant Professor, Bannari Amman Institute of Technology, Sathyamangalam, Erode

---***---

Abstract - *Friction stir welding, a solid state joining technique, is widely being used for joining Al alloys for aerospace, marine automotive and many other applications of commercial importance. The tool rotational speeds 485,710, 910, 1120 and 1400 rpm with a traverse speed 4 mm/min will be applied. The Mechanical properties of welded joints will be investigated using different mechanical tests including destructive test (tensile test, hardness and microstructure). This project presents the optimization of friction stir welding for pipe and also highlights the influence of microstructure and mechanical properties of FSW 6063 Al alloy. The basic principles of FSW are described, followed by process parameters study which affects the weld strength. Tensile strength properties attained with different process parameters are discussed. Friction stir welding is a refreshing approach to the joining of metals. This review deals with the fundamental understanding of the process and its metallurgical consequences. The focus is on heat generation, heat transfer and plastic flow during welding, elements of tool design, understanding defect formation and the structure and properties of the welded materials.*

Key Words: Tool speed, Tool specification, Tensile strength

1. INTRODUCTION

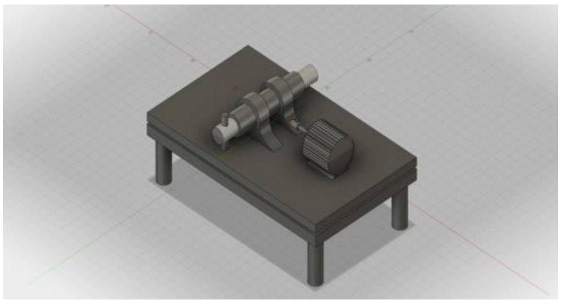
Friction stir welding in circular Aluminium pipes. It is the method of joining two aluminium pipes that can be joined by using the tool. Friction stir welding (FSW) is an effective and consistent materials joining technology which produces high strength and high integrity joints, particularly in aluminium alloys. FSW is also attractive because it is a solid-state process, with temperatures not exceeding the melting point of the work material. However, superb joint quality and low continuing operating costs for the machine mean that this initial expense can often be justified, particularly in vehicular applications (aerospace, automotive, and rail). FSW has been demonstrated on standard geometries like butted, lapped, and T oriented joints. Its implementation on small diameter pipes could extend its use to the petroleum, petrochemical, and natural gas industries where high weld volume would justify the upfront costs of FSW.

2. METHOD OF WELDING

Two tubes to be welded were butted up against each other and clamped down using fixture. Rotational velocity and translational velocity of the tool are set in the adapted drilling machine Figure 2. The tool is then rotated and then slowly plunged into a work piece along the interface of the sheets. The tool creates frictional heat in the work piece until the material becomes plasticized. Heat generated by the mechanical mixing process and the adiabatic heat within the material cause the stirred materials to soften without reaching their melting point. This is a major advantage of friction stir welding. Once the material becomes plasticized the tool traverses along a weld line to bond the two materials together Plasticized material is deformed around the tool and is forged into place by the substantial downward axial force of the tool shoulder. Material then consolidates into the weld joint at the trailing edge of the tool leaving a solid phase bond between the two pieces.

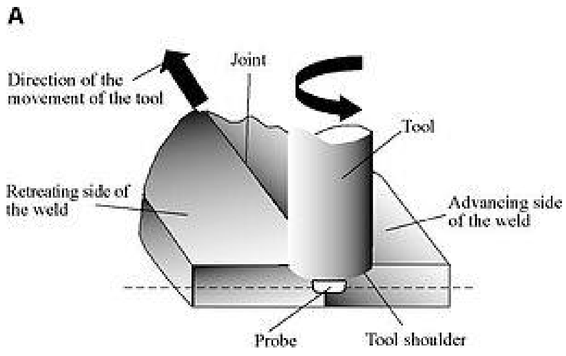
3. MODIFICATIONS IN EXISTING MACHINE

In conventional machines tool is rotated along the work piece in which the work piece is stationary. In our project tool is stationary work is set to be rotated by the handle. This will help to reduction in cost for the friction stir welding in circular pipes



TOOL SPECIFICATION

The design of the tool is a critical factor as a good tool can improve both the quality of the weld and the maximum possible welding speed. It is desirable that the tool material be sufficiently strong, tough, and hard wearing at the welding temperature. Further it should have a good oxidation resistance and a low thermal conductivity to minimize heat loss and thermal damage to the machinery further up the drive train. Hot-worked tool steel such as AISI H13 has proven perfectly acceptable for welding aluminium alloys within thickness ranges of 0.5 – 50 mm



TOOL USED

Tool steel AISI H13

TOOL ROTATION AND TRAVERSE SPEED

There are two tool speeds to be considered in friction-stir welding; how fast the tool rotates and how quickly it traverses along the interface. These two parameters have considerable importance and must be chosen with care to ensure a successful and efficient welding cycle.

TENSILE STRENGTH

Ultimate tensile strength (UTS) or tensile strength (TS) or ultimate strength, is the capacity of a material or structure to withstand loads tending to elongate, as opposed to compressive strength, which withstands loads tending to reduce size. In other words, tensile strength resists tension (being pulled apart), whereas compressive strength resists compression (being pushed together). Ultimate tensile strength is measured by the maximum stress that a material can withstand while being stretched or pulled before breaking.

HARDNESS

Hardness is a measure of how resistant solid matter is to various kinds of permanent shape change when a compressive force is applied. Some materials (e.g. metals) are harder than others (e.g. plastics). Macroscopic hardness is generally characterized by strong intermolecular bonds, but the behaviour of solid materials under force is complex; therefore, there are different measurements of hardness: scratch hardness, indentation hardness, and rebound hardness.

MICROSTRUCTURE

Microstructure is the very small-scale structure of a material, defined as the structure of a prepared surface of material as revealed by a microscop above 25×magnification. The microstructure of a material (such as metals, polymers, ceramics or composites) can strongly influence physical properties such as strength, toughness, ductility, hardness, corrosion resistance, high/low temperature behaviour or wear resistance. These properties in turn govern the application of these materials in industrial practice. Microstructure at scales smaller than can be viewed with optical microscopes is often called nanostructure, while the structure in which individual atoms are arranged is known as crystal structure.

4. MATERIALS USED

ELECTRIC MOTOR

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force. Found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives, electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as from the power grid, inverters or generators. Small motors may be found in electric watches. General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use. The largest of electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors may be classified by electric power source type, internal construction, application, type of motion output, and so on.

BEARINGS

A bearing is a machine element that constrains relative motion to only the Desired motion an reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by Controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

5. ADVANTAGES

Solid state welding can be easily automated. This produces high strength joint without applying external heat. They are used to weld both similar and dissimilar material. Provide good surface finish. They do not use any filler metal or flux as used in arc welding. Mostly these processes do not affect properties of parent.

6. APPLICATIONS

It is used in chemical industries for joining pipelines, heat exchanger, air conditioner etc. Friction stir welding is also used in electronic industries for joining bus bar, aluminium to copper, connectors and other electronic equipment's. It is widely used in fabrication industries.

7. CONCLUSIONS

The designed and formulated a butting on drilling machine module in order to execute the friction stir welding on cylindrical objects. The FSW of Aluminium pipe has been studied. The FSW welds efficiency increases with increase in rotation speed and decrease in travels speed. As a result of thermal treatment leads to the fine grain size.

REFERENCES

[1] Akinlabi E T, Els-Botes A and McGrath P J (2011), ―Effect of Travel Speed on Joint Properties of Dissimilar Metal Friction Stir Welds‖, in Proceedings of 2nd International Conference on Advances in Engineering and Technology (AET), January 30-February 1, Uganda.

[2] Benyounis K Y and Olabi A G (2008), ―Optimization of Different Welding Processes Using Statistical and Numerical Approaches—A Reference Guide‖, Advances in Engineering Software, Vol. 39, pp.483-496.

[3] Friction Stir Welding at TWI, available on http://www.twi.co.uk/content/fswin tro. html Accessed on August 20,2011.

[4] Gerçekcioglu E, Eren T, Yýldýzlý K, Kahraman N and Salamc E (2005), ―The Friction Behavior on the External Surface of the Friction Stir Welding of AA6063-T6 Tubes.

[5] Lienert T J (2003), ―Friction Stir Welding Studies on Mild Steel‖, Welding Journal, Vol. 82, pp. 1-9.

[6] Lim S, Kim S, Lee C and Kim S (2004), ―Tensile Behaviour of Friction Stir Welded Al 6061-T651‖, Metallurgical and Materials Transactions A , Vol.41, PP.550-56.