

LAP JOINT BY FRICTION STIR WELDING USING MAGNESIUM ALLOY USING (ZE41)

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Abstract

Friction stir welding (FSW) is a solid state joining process originally developed and patented by TWI (The Welding Institute) UK. This procedure is energy efficient, no distortion of the welds, no require of filler material and no gas fumes. The materials are joined due to growth of heat as of friction between tool and work piece. The experiments conduct on a conventional milling machine by using high speed steel Tool (non

consumable Tool) size 2.5mm with circular and taper (probe) profile and work material is Magnesium alloy (ZE41) 160x80x5mm plate and further Tests have been performed to check the Mechanical properties viz Tensile strength, Yield Strength, Hardness are evaluated on the welded joints.

KEY WORDS : FRICTION STIR WELDING, MAGNESIUM

ALLOY (ZE41), NON CONSUMABLE TOOL (HIGH SPEED STEEL) SIZE 2.5 MM,

CIRCULAR PROFILE, TAPER PIN PROFILE.

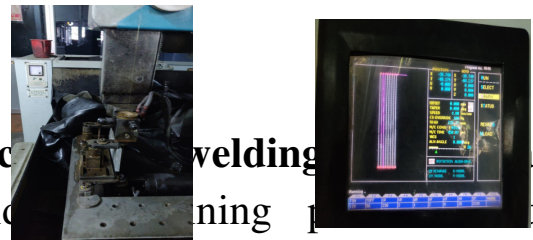
INTRODUCTION

The process is followed by Electric Discharge Machining Cutting (EDM), Milling, Friction stir welding and Test.

Electric Discharge Machining is also known as spark machining is a metal fabrication process whereby a desired shape is obtained by using electrical discharges (sparks).Material is removed from the work piece by a series of rapidly recurring current discharges between two electrodes, separated by a dielectrics liquid and subject to an electric voltage. One of the electrodes is called the tool-electrode, or simply the Tool or electrode, while the other is called the workpiece-electrode, or work piece. The process depends upon the tool and work piece not

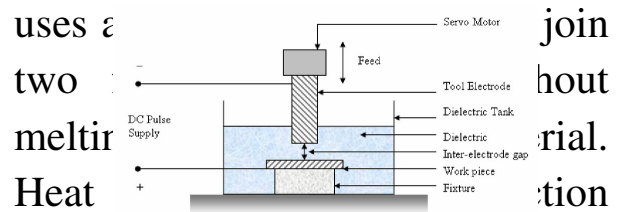
making physical contact. When the voltage between the two electrodes is increased, the intensity of the electric field in the volume between the electrodes becomes greater, causing dielectric break down of the liquid, and produces an electric arc. As a result, material is removed from the electrodes.

Pictorial representation of Electric Discharge Machining :



Friction stir welding solid state joining

uses a rotating tool joint without material. Heat is generated between the rotating tool and the workpiece material, which leads to a softened region near the FSW tool. It was invented and

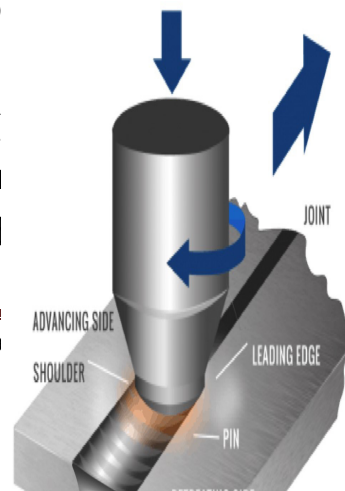


experimentally proven at The Welding Institute (TWI) in the UK in December 1991. TWI held patents on the process, the first being the most descriptive.

A rotating cylindrical tool with a profiled probe is fed into a Lap joint between two clamped workpieces, until the shoulder, which has a larger diameter than the pin, touches the surface of the workpieces. The probe is slightly shorter than the weld depth required, with the tool shoulder riding atop the work surface. After a short dwell time, the tool is moved forward along the joint line at the pre-set welding speed.

Frictional heat is generated between the wear-resistant tool and the work pieces. This heat, along with that generated by the mechanical mixing process and the adiabatic heat within the material, cause the stirred materials to soften without melting. As the tool is moved forward, a special profile on the probe forces plasticised material from the leading face to the rear, where the high forces assist in a forged consolidation of the weld.

Magnesium alloy is a very prominent material. It makes up 2 per cent of the alloy. This alloy is used in the automotive industry for the production of engine parts and



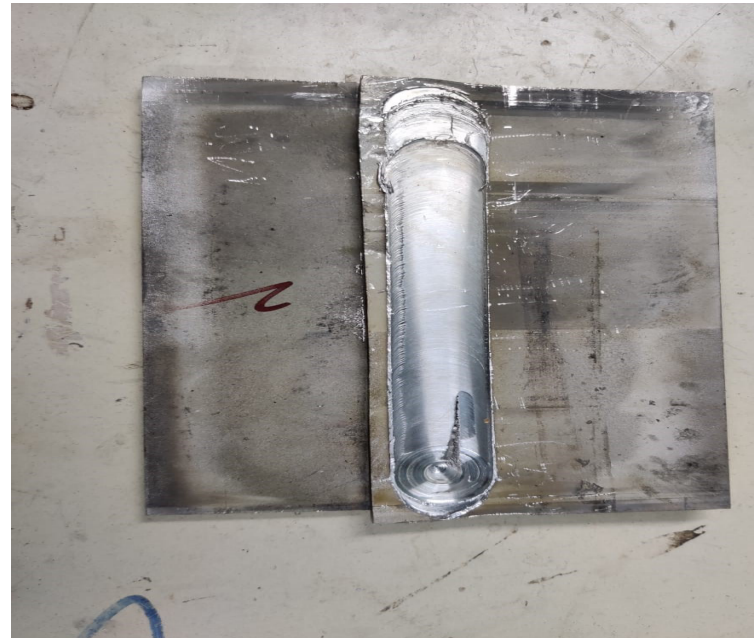
mineral dolomite. This material is reasonably costly, it is most widely used in bullets of most precisely in shooting guns.

Magnesium alloys are mixtures of magnesium with other metals, often aluminum, zinc, manganese, silicon, copper, rare earths and zirconium. Magnesium is the lightest structural metal. Magnesium alloys have a hexagonal lattice structure, which affects the fundamental properties of these alloys.

Magnesium alloys are used for both cast and forged components, with the aluminium-containing alloys usually used for casting and the zirconium-containing ones for forgings; the zirconium-based alloys can be used at higher temperatures and are popular in aerospace.

Material :Magnesium alloy (ZE41)

- Zinc, Zn 3.5 to 5%
- Rare Earth 0.8 to 1.7%
- Zirconium, Zr 0.4 to 1%
- Magnesium, Mg 92.3 to 95.3%
- **Magnesium alloy steel plate after friction stir welding**



Tool : High speed steel (Tool size 2.5mm)



Parameters To Weld

- Tool speed : rpm 710, rpm 1120
- Depth of cut : 2
- Feed : fd30, fd40

The following tests has to be performed after the Friction stir welding process to know the strength and permeability of the welded joints .

- Ultrasonic Inspection
- Radiographic Inspection
- Penetration Inspection

- Microstructure Inspection
- Tensile strength Inspection
- CIM Inspection

Conclusion :

The cutting of the MAGNESIUM ALLOY ZE41 is tough and cannot be done by normal processes. The EDM cutting one of the methods to cut the material and cutting involving quenching process can also be used . The welding process takes approximately 20 min.

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