REVIEW OF FRICTION STIR WELDING OF DISSIMILAR ALLUMINIUM ALLOYS

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Abstract:

Friction stir welding is a solid-state joining process carried out with a non-consumable work piece. This paper says about the joining of dissimilar alloys by using H13 tool. In this paper the investigation has been done on mechanical properties, weld quality. Its carryout the critical review of above-mentioned details for friction stir welding and it is helpful for upcoming researchers to optimize the selection of dissimilar alloys under H13 tool.

Keywords: Frictional stir welding, Aluminum alloy, Rotational speed, Transverse speed, welding speed.

1. Introduction:

Frictional stir welding was invented by the welding institute TWI in England during the year of 1991.Friction stir welding is the solid-state joining process carried out with a non-consumable work piece. During the friction stir welding the Frictional heat is produced between the tool and material causing the work parts to soften below the melting temperature, and then physically intermixes the both the metals at the place of the joint, further softened metal due to the high temperature is joined using mechanical pressure applied by the tool. This leaves a solid-phase bond between the two parts. Because temperature below the melting point and joining takes place below the melting temperature of the material, a high-quality weld is created. Friction stir welding produces the stronger weld joint than the original material in the selected parameters, Friction stir welding has spread out quickly since its development in 1991 and has found applications in wide varieties of industries such as aerospace, railways.

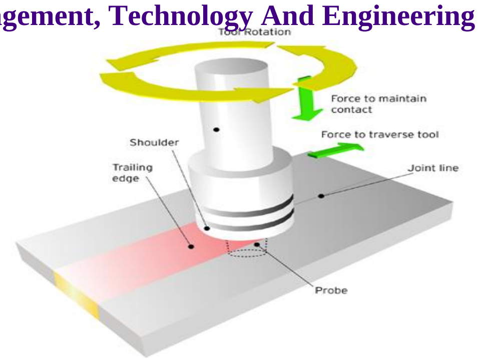

Figure.1. Schematic diagram of Friction Stir Welding

2. Based on Tool material

S.no	Tool material	Aluminum alloy series	Reason
1	H13	AA2024 &AA7075	UTS strength is lower than the strength of the base metals
2	H13	AA5083&AA 6082-T6	Rich zones have been identified to be the regions that are most susceptible to corrosion.
3	H13	AA6061&AA7075	During repeat testing the measured peak temperature was within +or – 5k of the average peak value indicted for each material.
4	H13	AA7075&AA 5083	The mechanical properties were evaluated using hardness test and tensile strength.

5	H13	AA1100&AA6061	Tensile strength of dissimilar joints is less than the stronger base metal alloy.
6	H13	AA2024&AA2198	Micro structural and mechanical characterization of dissimilar friction stir welding is done by butt joints
7	H13	AA7075AA5086	Effect of welding heat input and post weld aging time on microstructure and mechanical properties in dissimilar friction stir welded
8	H13	AA6351-T6& AA5083	The fracture mode was observed to be a ductile fibrous fracture.
9	H13	AA6082-T6&AA5754	The results of the fatigue tests are presented as well as detailed metallographic characterization of the weld zone
10	H13	AA6061&AA5754	During some spot-welding trails and this case, the pin diameter was reduced to 4mm.

3. Based on work piece material:

In this investigation we made a study on different work piece material of aluminums series along with their expansion and their chemical compositions. The work piece plays play's the important role in friction stir welding. The study was about the placement of work piece i.e. 1) Weather the work piece is placed in the advancing side or the 2) Weather the work piece is placed in the retarding side and the investigation is carried out for different types of zones found in the work piece. The work piece carried a different type of loads during the friction stir welding along with their tool rotational speed.

4. Based on process parameters:

In FSW process the parameters also plays important role on weld quality. This investigation was concentrated on parameters like rotational speed, transverse speed, axial speed and grain size.

- AA2024&AA7075. (REF NO.1).
  1. The rotational speed for 2024 and 7075 was in the form of gap and then on analysis it has been converted into the form of tabular column.
  2.

Rotational Speed (In Rpm)	Average Grain Size
400	3
500	4
1500	5.1
1600	5.5

  3. If the rotational speed is high then different type of weld zones.
  4. The recommended rotational speed for AA6061 should be in between 1200-1400rpm.
  5. The nugget zone exposed to excessive plastic deformation and high temperature due to pin rotation.
- AA5083&AA6082. (REF NO.2)
  1. The grain boundary sanitation on the heat affected zone of the alloys, distribution of mg and silicon particles along the boundary between two alloys.
  2. The galvanic interactions between the AA5083 rich zone and the AA6082rich zone were observed to be responsible for the corrosion susceptible welds.
  3. The affected zone of both alloys and the transition regions between the weld joints.
  4. The rich zone has been identified to be the regions the most susceptible to corrosion.

- AA6061&AA7075 (REF NO:3)
  1. The magnesium rich portion of the electric comprising 2 mg solid solution and mg al forms at the temperature of 43degree Celsius.
  2. The test specimen was 25x100mm throughout.
  3. The friction stir welding is carried out using the rotational speed of 1000to 3000rpm.
  4. The axial load up to 12KN.

- AA7075&AA5083 (REF NO:4).
  1. The fracture surface of tensile tested sample was examined using scanning electron microscope.
  2. The micro structural structure and crystal graphics texture of base materials and the welds are investigated using electron backscatter diffraction techniques.

3. The mechanical properties were evaluated using the hard ness test.
4. The tensile strength was also conducted.

- AA1100&AA6101 (REF NO:5)
  1. The maximum hardness as 82. 08hv.ultimate tensile strength as100.49.
  2. It has great mechanical strength and high electrical conductivity.
  3.

Material	Tensile strength
Dissimilar joints	153.33
AA1100	284.4
AA6061	165.00

- AA2024&AA2198 (REF NO:6)
  1. The friction stir welding is done using the but joints.
  2. The aim of the investigation is to evaluate the micro structural features and material flow.
  3. The mechanical and micro structural characterization using butt joints.

- AA7075&AA5083 (REF NO:7)
  1. The mechanical and micro structural aspects of dissimilar friction stir welds of age-hardened and strain hard enable aluminum alloys were investigated.
  2. X-ray diffraction (XRD) residual stress analysis and tensile testing together with optical metallography.
  3. Transmission electron microscopy (TEM) were performed to assess the effects of process parameters on welded joints.
  4. Effect of welding heat input and post weld aging time on microstructure and mechanical properties in dissimilar friction stir welded

- . AA6351-T6& AA5083 (REF NO:8)
  1. The effect of welding speed on mechanical and metallurgical properties was analyzed. It is found that the welding speed of 63 mm/min produces better mechanical and metallurgical properties than other welding speeds.

2. The weld zone is composed of three kinds of microstructures, namely unmixed region, mechanically mixed region and mixed flow region.
3. The fracture mode was observed to be a ductile fibrous fracture.
4. The effect of welding speed on mechanical and metallurgical properties was analyzed.

- AA6082&AA5754 (REF NO :9)
  1. Influence of material properties and tool geometry on weld strength.
  2. The results obtained enabled to conclude that the dissimilar welds strength is strongly dependent on the presence of the well-known hooking defect and that the hooking characteristics are strongly conditioned by base materials properties/positioning.
  3. It is also concluded that the use of unthreaded conical pin tools, with a low shoulder/pin diameter relation, is the most suitable solution for the production of welds with similar strengths for advancing and retreating sides.
  4. It also concluded that the use of unthreaded conical pins tools, with low shoulder diameter.

- AA6061&AA5754 (REF NO 10)

  1. The axial load of 12 KN is applied.
  2. The rotational speed is between 1000to 3000rpm.
  3. The welding range is from 0.1 to10 m/s.
  4. The accuracy is of + or - 0.01while the spindle rpm is measured using a shaft.

5. Conclusion:

The friction stirs welding of aluminum and its alloy with different initial microstructures were carried out under different welding conditions. The microstructural evolution and mechanical properties of weld joints were studied in the above research papers. Some grades of aluminum are difficult to weld by existing arc welding techniques, and a few, such as the very high-strength 2XXX and 7XXX series of alloys, unwieldable. In FSW, its potential benefits in cost reduction, joint efficiency improvement, and high production accuracy make it even more attractive for the non-wieldable series AA2xxx, AA6xxx and AA7xxx. Cavity or groove-like defects caused by an insufficient heat input in the friction stir welding. Cavity produced by the abnormal stirring.

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