

The Influences of the Friction Stir Welding on the Microstructure and Hardness of Aluminum 6063 and 7075

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Abstract. This research is to study influence of the friction stir welding on the microstructure and hardness of aluminum 6063 and 7075. The parameters which influence on welding are rotational speed of 2000 rpm, welding speed of 50-200 mm/min and tilt angle pin tool of 2°. As the result we found maximum tensile strength is 105 MPa for welding speeds to 100 mm/min. For the hardness test results showed that the highest measured hardness is 152 HV at weld center was welding speed 50 mm/min. The microstructures in area welding have structure of aluminum 7075 which expected to affect the high tensile strength and hardness testing.

Keywords: Aluminium alloy, Aluminium, A friction stir welding, Butt joints, Tensile strength

1. Introduction

For the materials that are difficult to weld by fusion welding (Conventional Fusion Welding) which is a friction stir welding has been used effectively in the industry production of vehicles and vessels. This is where the mechanical properties of the weld in the weld (Weld Zone) compared to the melt. [1] Process of a friction stir welding is shown in Fig. 1

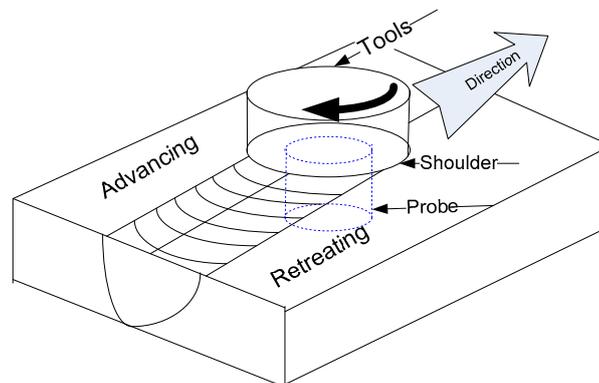


Fig. 1: Show friction stirs welding

Probe is inserted into the seam of the material causes the material to heat and soften, stirring motion around the shoulder of the tool when the tool is moved material weakness and agitation in front of a stir will be transferred to the rear in the direction of rotation of the stirring stick to the retreating side.

It had some of material flow back to the front of advancing side. (The retreating side is the direction of rotation of the stirring, the opposite direction and the advancing side is the direction of rotation of the disperser parallel to the direction of welding) when the material is passed around probe and some will move to the back of the shoulder again. Shoulder of the tool will compress the material back into the cause of a welding together. [2] The current research and applications, the FSW in various grades of aluminium, such as

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study and the influence of the rotation speed of the feed rate. Those affect the mechanical properties of aluminium alloys in AA6056. [3] The study of a stir at the end of the cylindrical cutting curves and straight cuts. That affects the mechanical properties of aluminium alloy AA6063-T6. [4] The size of the shoulder of the tool and the diameter tool affects the grades of aluminium alloy AA6061. [5] For applications in other characteristics welding aluminium alloys dissimilar had welding between the aluminium alloy EN AW 2024-0 and EN AW 5754-H22 [6] studied the mechanical properties of AA 2024 and AA 7075 aluminium alloy. [7] These studies have reported the strength of these butt joints higher than the aluminium used in welding materials.

However, in the case of the aluminium alloys AA6063 and AA7075 also never had a reported and databases in research. For this reason, it is interesting. In the application of a friction stir welding in the different grades of aluminium alloys in this. For examine the microstructure and mechanical properties of the weld to provide information on the application in the industry.

2. Experimental Procedure

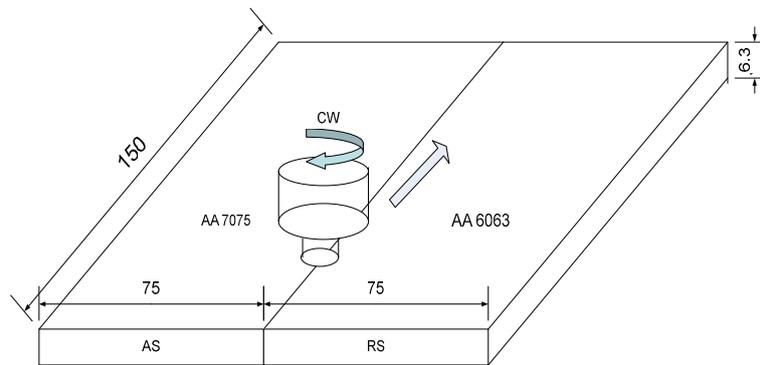


Fig. 2: The dimension of the specimen (unit: mm)

Aluminium alloys AA6063 and AA7075 aluminium alloy with a chemical composition shown in Table 1 and 2 with a thickness of 6.3 mm was cut to 150 mm width and 75 mm in length.

Table 1: Chemical Composition of aluminium alloy AA6063

Chemical Composition	Si	Fe	Cu	Mg	Al
6063	0.35	0.25	0.1	0.45	Bal.

Table 2 Chemical Composition of aluminium alloy AA7075

Chemical Composition	Zn	Mg	Cu	Cr	Al
7075	5.1	2.1	1.2	0.18	Bal.

Then bring to butt joint showed in figure 2 by placing the aluminium alloy AA 6063 in the advancing side and AA 7075 aluminium in the retreating of side which will be taken on jigs to prevent the movement of the piece while welding. Tools made of tool steel in a cylindrical shape SKD11. The shoulder diameter of 0.7087 in, the stirring tool is shaped as a cylindrical helix. 6 mm diameter through the centre lines a distance equal to 1 mm pitch and 6 mm in length. The Z axis is tilted at an angle to the 2 degree of the machines. For stirring speed of 2000 rpm with the direction of rotation clockwise and welding along the path, change the

speed of welding of 50 to 200 mm/min when the welding complete the work will be conducted to test its strength according to AWS D1.2, with the dimensions of test specimens. Direction and the centre of the work piece to be cut and examine the micro-structure, micro-hardness. In the direction perpendicular to the direction of welding will compared the integrity and strength to the joint.

3. Result and Discussion

The results of testing the tensile strength of a 2 ° tilt tools and speed 2000 rpm welding speed to a 50, 100, 160 and 200 millimeters per minute, shown in Fig. 3 show the tensile strength of 105 MPa is maximum for welding speeds to 100 mm/min and tend not to vary when the rate was lower at 50 mm/min. When the rate went up to the trend of tensile strength, it is not much different.

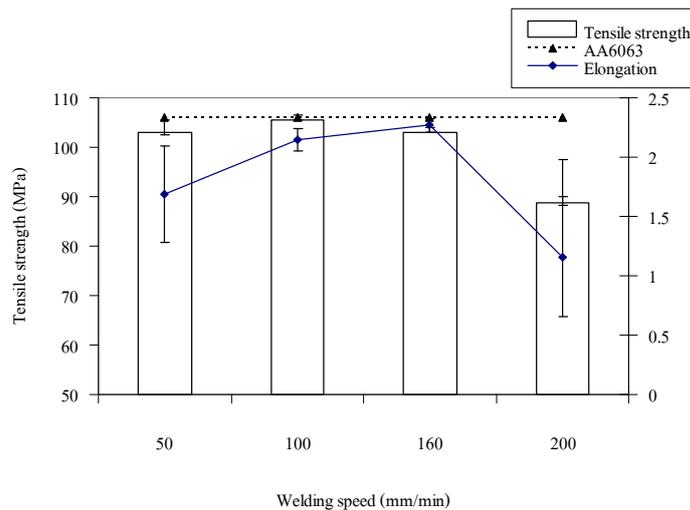


Fig. 3: The relationship between welding speed and tensile strength

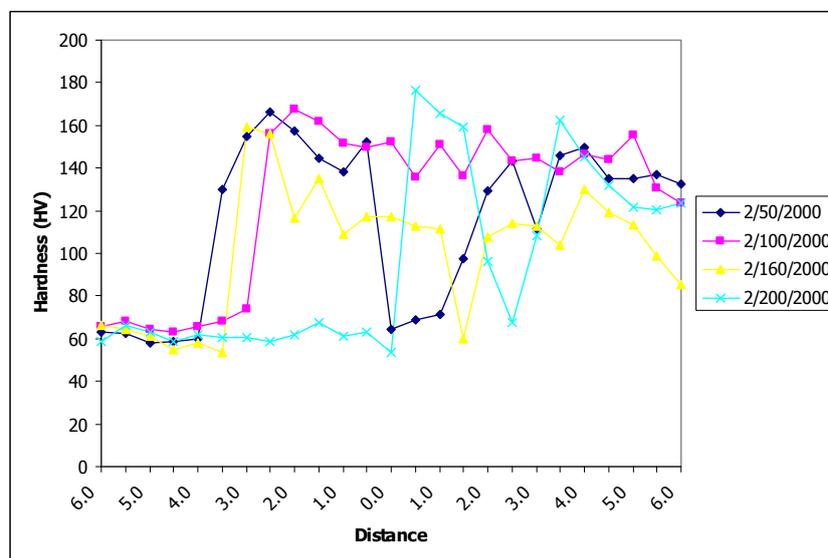


Fig. 4: Results of hardness testing

For the hardness test results showed that the highest measured hardness is 152 HV at weld centre was welding speed 100 mm/min to be observed from Fig.4.35. The right hand side is the side of the aluminum alloy 7075 is quite similar. The center is expected to weld the aluminum alloy 7075, which is not as homogeneous with a 6063 aluminum alloy. Will notice that the left hand side of the AA 6063 is a value that is higher than the center is expected of them as a tool to bring material AA 7075 was merged with the AA 6063, making the show the hardness is high over the center line. For the lowest hardness was 53 HV at the

speed of 200 mm per minute. The observer will notice that the values are close to the base material of aluminum alloy 6063 is expected tools carry material of aluminum alloy 6063 get to this area have volume rather than taking base material aluminum alloy 7075 was included in the center of the weld that made lower hardness.

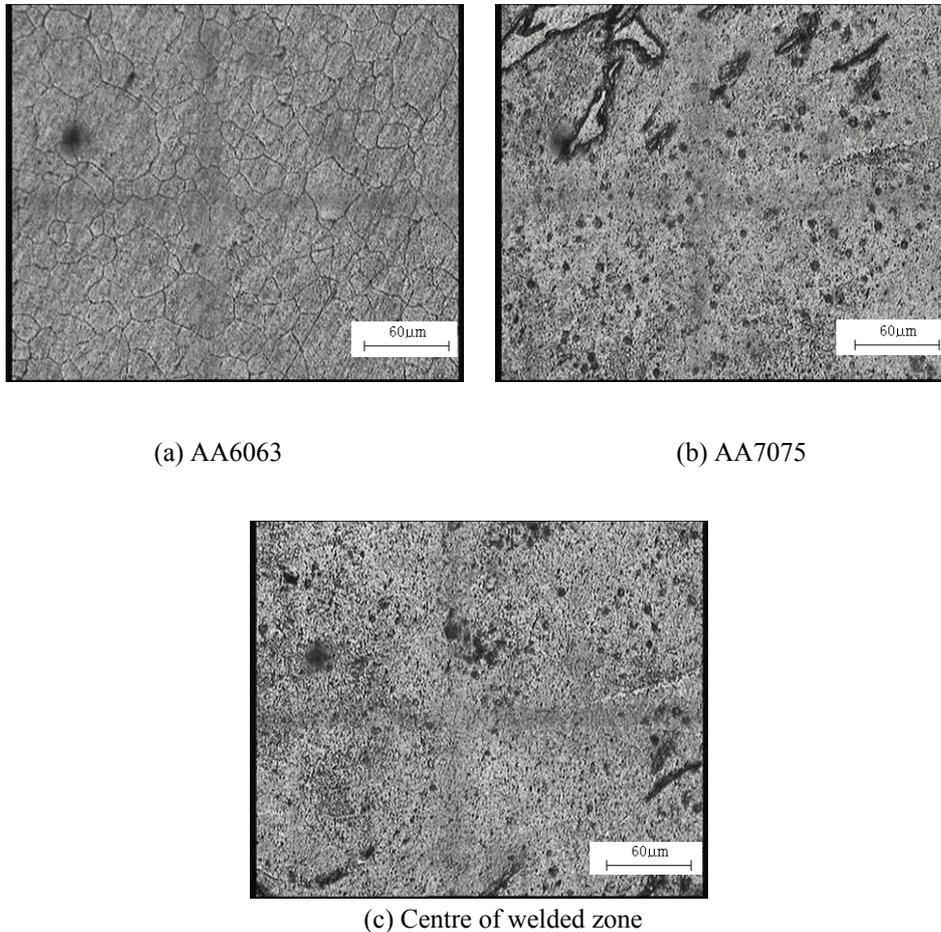


Fig. 5: The microstructure of welding speed to 100 mm/min

Fig. 5 shows the microstructure of the work piece, the speed to 2000 rpm and welding speed to 100 mm/min. Fig. 5 (a) shows the structure of aluminum alloy 6063 of the show noted that the structure grain growth. The structure of this grain growth affects the tensile strength. The erosion of work try to collapse the core material for Fig. 5 (b) shows the microstructure of the weld will notice that some areas of the white on black. A little white space, is expected to be part of the aluminum alloy 6063, which is not included in nugget the aluminum alloy 7075 in the area of welding have effect on the hardness. When testing the hardness of this value was close to where materials are aluminum alloy 6063 Fig.5 (c) shows the microstructure of the group of aluminum alloy 7075, which noted that the grain fine than The microstructure of aluminum alloy 6063 is 66 μm which fine structure is expected to affect the tensile strength and hardness testing then make the test value higher.

4. Conclusions

The experimental application of a friction stir welding of the butt joints between aluminum AA6063 and AA7075 by changing the parameter feed rate then study influences of the friction stir welding on the microstructure and hardness of aluminum 6063 and 7075. The results can be summarized as follows.

1) Conditions, the best speed is 2000 rpm and a welding speed of 100 mm per minute. A stirring 2 degree tilt the weld is complete and tensile strength 105 MPa.

2) The maximum hardness of 152 HV is welding speed of 100 mm / min, which resulted in a high tensile strength.

3) The weld zone was divided into three regions (centre of weld, AA6063 ,AA7075) base on the micro-structure ; the centre of weld had fine grain due to dynamic recrystallization had affect to the tensile strength and hardness testing higher.

5. Acknowledgements

This work was financially supported by Rajamangala University of Technology Rattanakosin and Faculty of Industry and Technology

6. References

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