Research Field : Mechanical Engineering

Extended Abstract

THE EFFECT OF VARIATION OF FRICTION WELDING PARAMETERS ON WELD MECHANICAL PROPERTIES AND MICROSTRUCTURE IN FRICTION WELDING DISSIMILAR STEEL SUH 3 AND SUH 35

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Abstract- Friction welding is a solid-state welding that produces weld without the addition of filler material. This study presents results of friction welding dissimilar material SUH 3 and SUH 35 with variation of process parameters: spindle rotation speed (v), friction force (F1), and friction time (T1). These parameters are varied to obtain their influence on hardness and microstructure of the weld. The results show that the higher v, F1, and T1, the higher will be the hardness. Some difference in microstructure and grain texture are also detected which is related to a variation of process parameters

Keywords: Friction welding, dissimilar material, hardness, microstructure.

INTRODUCTION

In line with a development of manufacturing industry, welding technology develops simultaneously as well. This is due to industrial demands for renewable method to resolve joining material problems.

Friction welding is one of welding method to join two different material without the addition of filler material. Friction of two materials in contact will generate heat and develop metallurgical bounding as result of simultaneous deformation between two surfaces of the work pieces [1]. Friction welding, as the name implied, use friction to generate heat. When the two workpieces to be joined are placed in contact and set in motion relative one to the other, heat will be generated that is sufficient to put the surfaces of the materials in a forging temperature that consequently will coalesce when the force is applied.

This study investigates the influence of process parameters on the joint SUH 3 and SUH 35 steels by using friction welding.

METHOD

Dissimilar steel SUH 3 and SUH 35 is welded using friction welding machine FW10NC type. Different welding parameters are used in this study. Spindle rotation speed is varied ranging from 2500 to 4500 rpm. Friction force is varied from 6 kN to 14 kN, while Friction time is varied from 0.6 sec. to 1 sec. Parameters such as upset force (F2) and upset time upset time (T2) are held constant of 16 kN and 1 sec. respectively. Welded joints as result of friction welding are tested for hardness on the joint area and extending to the base metal material.

RESULT AND DISCUSSION

SUH 3 and SUH 35 steels are heat-resisting steel which has the advantage of a heat-resistant. Chemical composition of SUH 3 and SUH 35 are shown on Table 1.

TABLE 1. Chemical Composition of SUH 3 and SUH 35

Materials	Chemical Composition									
	C	Si	Mn	P	S	Ni	Cr	N	Cu	Mo
SUH 3	0.42	1.98	0.25	0.27	0.40	0.23	10.18	-	0.10	0.71
SUH 35	0.56	0.21	9.03	0.03	3.67	3.67	20.47	0.41	-	-

Heat generated on friction welding process due to direct friction of two material reached the base material [1]. The weld zone has the highest hardness which could be attributed to a more condensed agglomeration of grain due to the effect of pressure. The heat is spread and distributed toward the base metal with the distribution of hardness values shown in Figure 1. It can be seen in this figure, that the areas not affected by the heat and pressure will have a similar hardness value, which are the hardness of the base material, which gradually changed as it come closer to the weld zone. Figure 1 also shows that steel SUH 3 has consistently a higher hardness compared to

steel SUH 35. Hardness values shown in Figure 1 are obtained in welding using a different spindle speed 2500, 3000, 3500, 4000, and 4500 RPM. The distribution of hardness values with variation of friction force and friction time are shown respectively in Figure 2 and Figure 3.

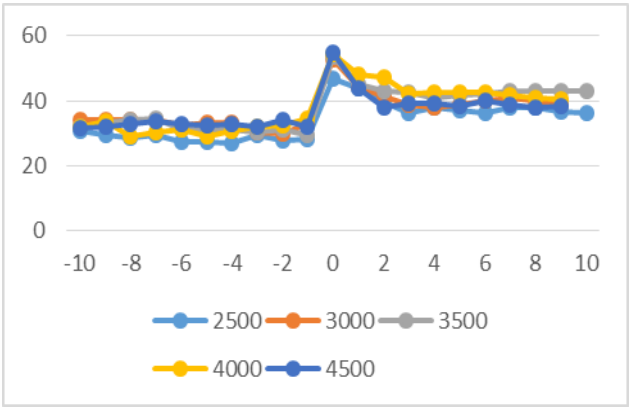

Figure 1. The distribution of hardness values with different spindle rotation speed

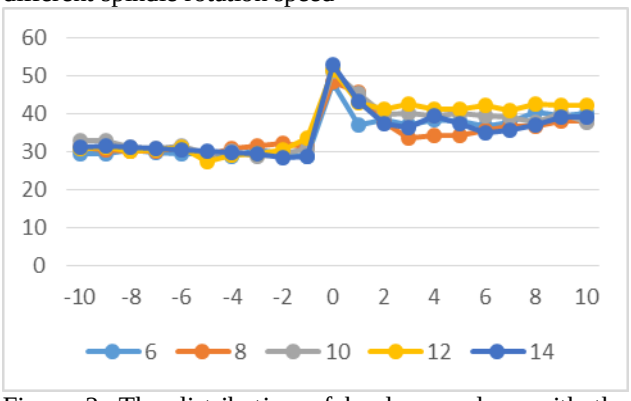

Figure 2. The distribution of hardness values with the variation of friction force

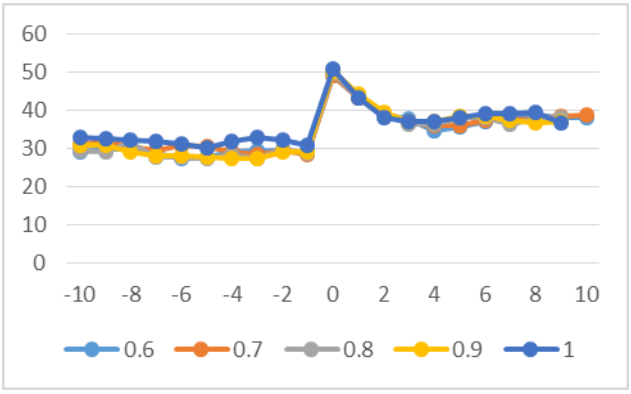

Figure 3. The distribution of hardness values with the variation of friction time

Concerning the influence of welding to the microstructure of the materials, metallographic examinations conducted in an area adjacent to the weld joint shows a texture of grain orientation and a more refined grain structure. Figure 4 a and b shows a metalographic photography of the weld joint, while Figure 4 c, and 4 d, shows respectively the metalographic structrure of steel base material SUH 3 and SUH 35.

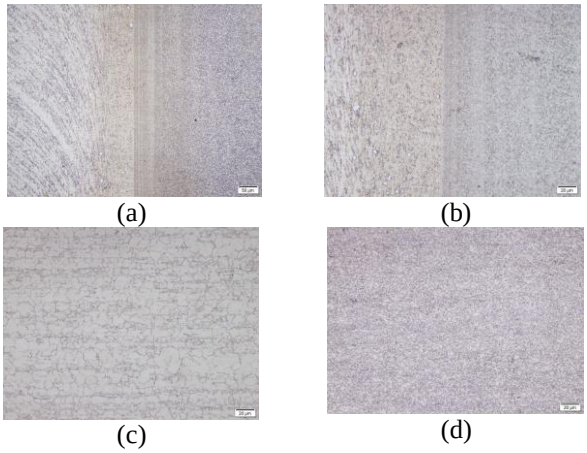

Figure 3. Microstructure of weld joint SUH 3 and SUH 35 (a) and (b), Base metal SUH 35 (c), Base metal SUH 3 (d)

CONCLUSION

The result show that higher v, F1, and T1 will produce a higher hardness of the weld, which probably caused by a higher deformation which occurred in the weld area. A finer grain resulted form the introduction of pressure could have an additional effect.

REFERENCES

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