



COMPARISON OF SOLID STATE AND FUSION WELDING PROCESS

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Abstract

The aim of this paper is to evaluate the analysis comparison of solid state welding and fusion welding process. Welding is a process of joining the two same or different kinds of materials by solid state or fusion welding. The solid-state welding has good enough properties as compared to fusion welding process. In this work, the rotary friction welding is coming under solid-state welding and arc welding as fusion welding process. The objective this work is to compare the solid state welding and fusion welding with parent metal in hardness and stress wise. The hardness and stress of solid state welding have a maximum value than the fusion welding process due to thermomechanical effect.

Keywords: MS Materials; Welding Process; Hardness; Breaking Stress.

I. INTRODUCTION

Welding is essentially a process of joining two similar or dissimilar metals by means of application of heat at the joint or intersection [1]. Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for centuries to join iron and steel by heating and hammering [2]. Arc welding and oxy-fuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after [3]. Welding technology advanced quickly during the early 20th century as World War I and World War II drove the demand for reliable and inexpensive joining methods [4]. Following the wars,

several modern welding techniques were developed, including manual methods like shielded metal arc welding, now one of the most popular welding methods, as well as semi-automatic and automatic processes such as gas metal arc welding, submerged arc welding, flux-cored arc welding and electro-slag welding [5]. Developments continued with the invention of laser beam welding, electron beam welding, electromagnetic pulse welding and friction stir welding in the latter half of the century [6]. Today, the science continues to advance. Robot welding is commonplace in industrial settings, and researchers continue to develop new welding methods and gain a greater understanding of weld quality [7]. In most of the welding processes, the melting of materials takes place. Those types of welding processes which doesn't involve melting of materials come under solid-state welding processes [8]. Ultrasonic and friction welding is the most famous forms of solid-state welding [9-10]. In the present work, the hardness and stress of solid and fusion welding for two same or different materials were carried out and compared.

II. EXPERIMENTAL WORK

The welding is a technique it can be divided into two groups, one is fusion welding and another one is solid state welding, these techniques were used to join the similar or dissimilar metals with or without application of pressure as shown in Fig.1 & Fig.2. In the present work, the Mild Steel (MS) material has used to carry out experimental work with the round rods of diameters Ø14 mm and 100 mm in length. The varying parameter is rpm of

rotary friction welding. The arc welding machine setup was used to weld the Mild Steel (MS) specimens. After welding has been over the specimens were tested on Rockwell hardness tester to measure the hardness of the specimen and breaking stress on UTM shown in Fig.3to Fig.5.

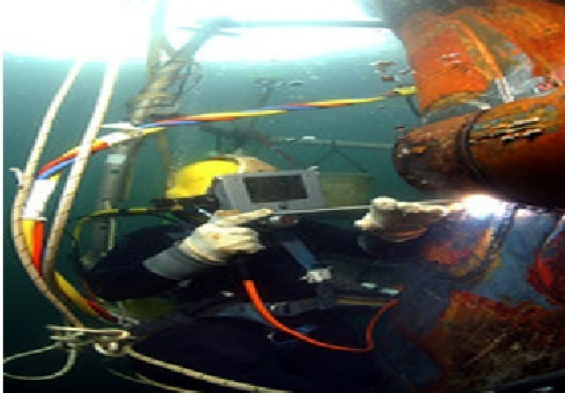


Fig.1. Fusion (Arc) welding process



Fig.4. Rockwell hardness tester

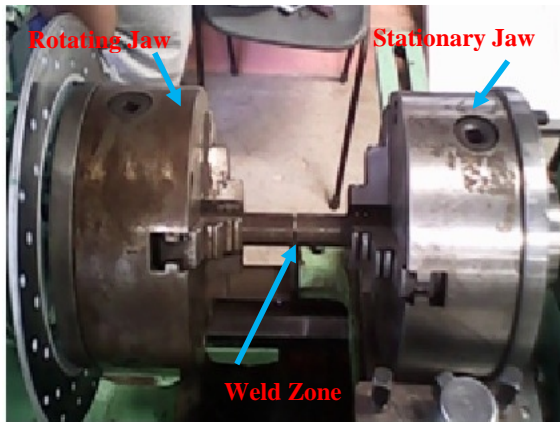


Fig.2. Solid State (Rotary Friction) Welding Process

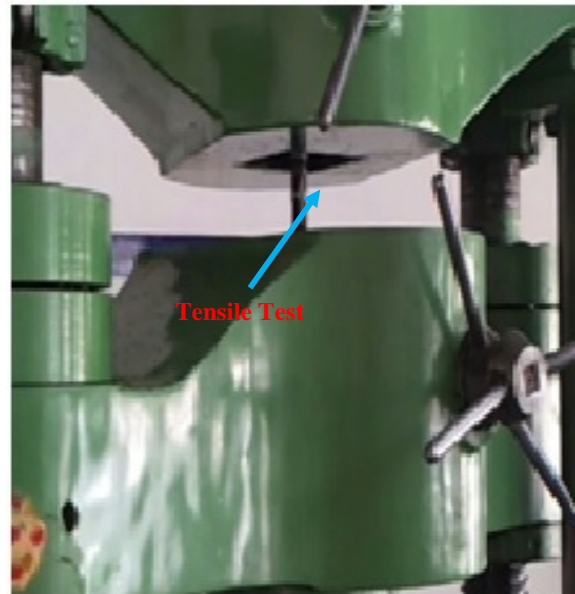


Fig.5. Specimens testing on UTM



Fig.3.a.b. M.S welded Specimens

III. RESULTS AND DISCUSSIONS

An attempt has been made on rotary friction welding and the following results were obtained and tabulated below in Table.1.

Type of welding	Rockwell Hardness Number (RHN)			Break ing Load (kg)	Break ing Stress (MPa)
	Wel d Zone	Awa y from 5 mm	Awa y from 10 mm		
Friction welded at 1600 rpm	22	30	34	3325	211.89
Friction welded at 2000 rpm	23	31	35	3750	238.97
Friction welded at 2350 rpm	24	32	36	4250	270.83
Friction welded at 2700 rpm	25	33	37	4900	312.26
Arc welded specimen	39	40	48	1900	121.08
Base Metal	49			12930	840

From Table.1 the hardness value and breaking stress have a maximum at a speed of 2700 rpm and least one is at a speed of 1600 rpm and ware less than the parent metal. The breaking stress of fusion welding is very less compared to solid rotary friction welding. The breaking stress of both fusion and solid state welding has a lower value as compared to the parent metal.

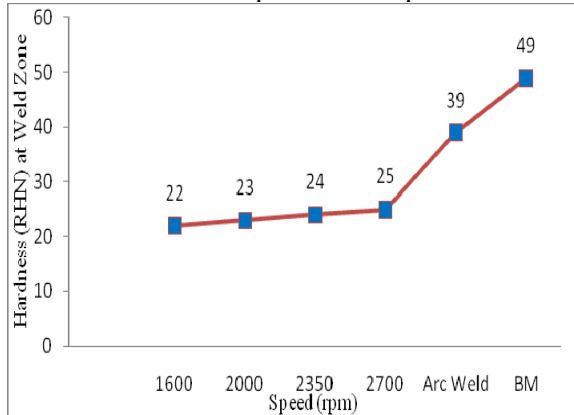


Fig.6. Speed Vs Hardness (RHN) at Weld Zone

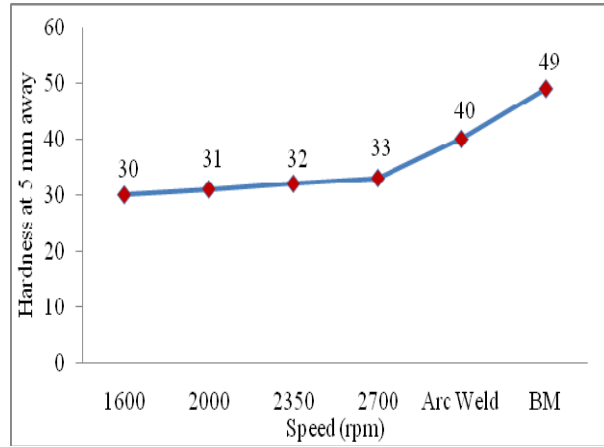


Fig.7. Speed Vs Hardness (RHN) 5 mm away

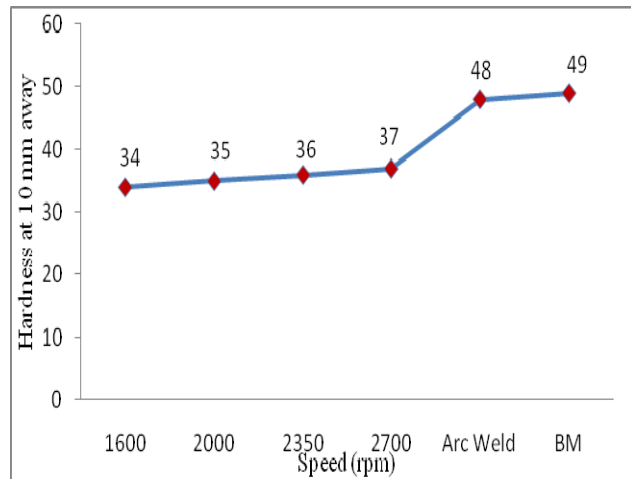


Fig.8. Speed Vs Hardness (RHN) 10 mm away

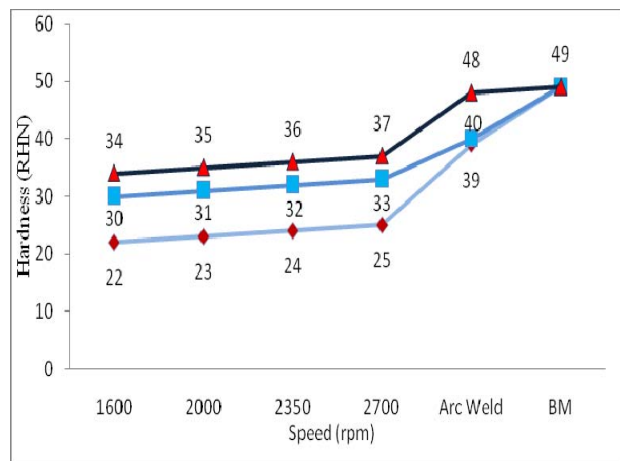


Fig.9. Speed Vs Hardness (RHN) at Various Locations

From Fig.9 it was observed that the value of hardness at weld zone has lower and it increases away from the weld zone. The value of hardness is higher for the base metal as compared to both welded specimens.

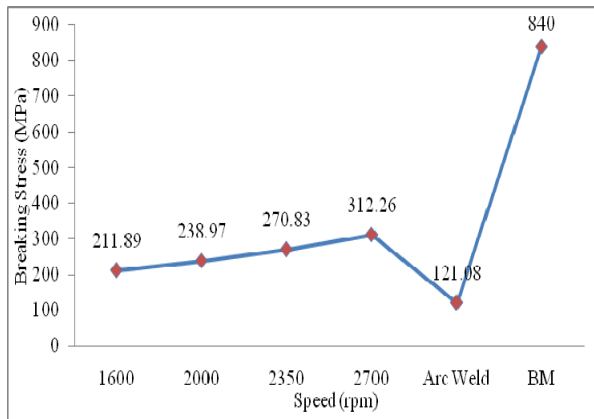


Fig.10. Speed Vs Breaking Stress (MPa)

From Fig.10 it was observed that the value of breaking stress is higher at a speed of 2700 rpm compared to other speeds however it is higher for the base metal as compared with both the welding process.

IV. CONCLUSIONS

- It was concluded that the comparison of solid state welding and fusion welding has been carried out using MS round rod materials.
- The hardness at weld zone has lower and it has increases away from the weld zone.
- The value of hardness increase as the speed increases and it was higher at a speed of 2700 rpm and least at 1600 rpm.
- The value of hardness and breaking stress for solid state (rotary friction) welding has higher as compare to fusion (arc) welding. However, the values of hardness and breaking stress of base metal have higher as compared to both welding process.

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