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Effect in Tensile Strength of Resistance Spot Welding of IS2062A Steel on Preheating and Water Quenching

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***Abstract*: Resistance spot welding is widely used in industries due to its easiness, economy and quick action. IS2062A is a low carbon mild steel which is using for structural purpose in industries. In this study we analyse the effect of preheating combined with water quenching on the tensile strength of spot welded IS2062A steel. The strength of the spot welded samples are tested using the universal tensile testing machine. The tensile strength can be improved by quenching in water.**

***Keywords*: Resistance spot welding, IS2062A Steel grade, Quenching, preheating.**

1. Introduction

For metal joining application several techniques are adopted in industries for joining metals, in which welding provides a high strength, sudden, effective permanent joints to metals. Several welding techniques are available to industries, among which resistance spot welding is important technique used for joining thin sheet of materials. It is popularly employed for joining aluminium, steel sheets in automobile, structural, aerospace industries.

Resistance spot welding is carried out using spot welding machine operating at different ranges of electric currents and heat is carried out using electrodes for fusion and weld is obtained because of resistance of materials. The important feature of resistance spot welding is, it has high energy efficiency, narrow heat affected zone and simple operation. This makes it best choice available for industries. Various parameters that affects the weld in resistance spot welding include electrode tip diameter, force, welding current, hold time etc. In this paper we are analyzing the effect of preheating and quenching in water of a spot welded IS2062A steel for improving the strength and micro hardness of weld. Quenching is the sudden cooling of heated metal using oil bath, water or air as a quenching medium. Water is easily available quenching medium.

IS2062A is commonly used steel in petro-chemical, structural, automobile industries. This is mild steel grade with good formability, weldability and machinability. In this study we are analysing tensile stress and micro hardness of resistance spot welding in IS2062A steel grade at different conditions.

2. Experimental studies

The experiment study was conducted in National Institute of Technology Tiruchirappalli. The experiments was done in 1.6mm thickness mild steel grade, IS 2062A . Table 1 and 2 show chemical composition and mechanical properties of experimental steel respectively.

Table 1
Chemical composition in mass%

C% max	Mn% max	S% max	P% max	Si% max	C.E.% max
0.23	1.50	0.050	0.050	0.40	0.42

Table 2
Mechanical properties

Thickness (mm)	Yield strength (MPa)	Tensile strength (MPa)	EI.%
1.6	230	410	23

Spot welding was performed using a 50-kVA resistance spot welding machine. The parameters consider for the study encompasses the cooling water temperature, holding time, squeeze time, electrode diameter, electrode force and welding current and heating time. Design of Experiments (D.O.E) technique is used to find out the welding parameter for experimental steel. Spot welding trials are carried out using a microprocessor controlled 50-kVA, three phase DC pedestal type resistance spot weld machine operating with a 50Hz as shown in figure 1.

Fig. 1. Resistance spot welding machine

Welding trials are conducted using a class 2 electrode tip diameter of 7mm with 3.2 kN electrode force,81^{0} truncated cone nose of 15 cycle squeeze and holding time facilitates welding

Table 3
welding process parameter

Sample No:	Electrode tip force (kN)	Preheating current (kA)	Preheating time (Cycles)	Welding current (kA)	Welding time (Cycles)	Holding time (Cycles)	Quenching in water
1	3.2	Nil	Nil	13	12	15	Nil
2	3.2	5	12	13	12	15	Nil
3	3.2	Nil	Nil	13	12	15	Yes
4	3.2	5	12	13	12	15	Yes

1.6 mm thick mild steel grade IS2062A sheets. The welding electrodes are shown in figure 2.

Fig. 2. Welding electrode

The welding coupons of 1.6+1.6 mm steel sheets are overlapped with 25mm spacing and subjected to welding. The cooling water temperature is maintained at 20ºC for conducting the experimental trials. The welding parameter obtained from design of experiment is used for performing welding in this experimental steel. The resistance spot welding is performed in samples with dimension as shown in figure 3 using this welding parameter.

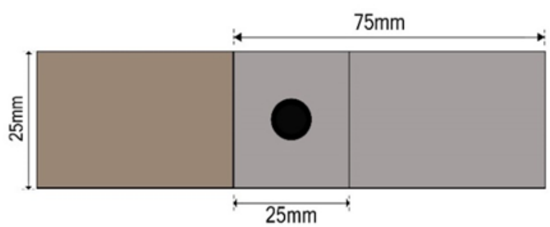

Fig. 3. Welding sample dimension

Four samples were prepared and spot welded with parameters as stated in table 3. The four welded samples are then subjected to shear tensile test in Tinus Olsen universal testing machine with 1mm/min crosshead movement and load displacement graph is plotted.

3. Result and Discussion

This study comprises of four groups of comparative experiments. Four welded sample prepared according to the welding parameters in table 3 are shown in figure 4. The first sample has only a welding current of 13kA and it is cooled gradually in air and not quenched in water. The second sample has an additional pulse current (preheating current) of 5kA along with the welding current and it is cooled gradually in air. Third sample has no preheating current but it is quenched in water after welding. But the fourth sample is preheated with a pulse current of 5 kA and then water quenched after welding. These four samples are undergone shear tensile test in Tinius Olsen universal testing machine. The shear tensile results obtained are analyzed and compared.

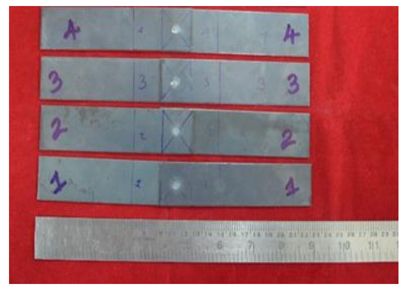

Fig. 4. Welded samples

A. Mechanical Properties

The load displacement graph for the four samples is plotted and it is shown in figure 5.

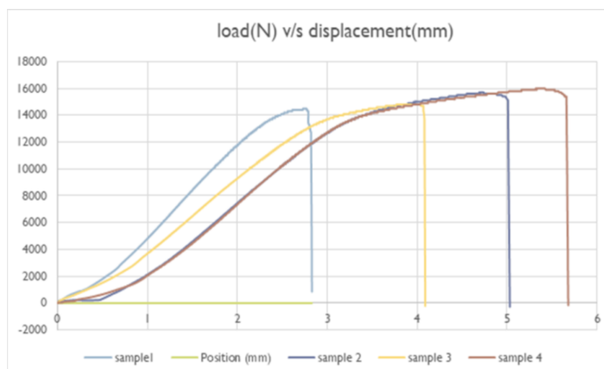

Fig. 5. Load displacement graph

From the load displacement graph we can see that the shear tensile strength increase with preheating current and quenching in water. Sample 1 has shear tensile strength of 14.5 kN, while the shear tensile strength of sample 2, sample 3 and sample 4 are 15.7 kN, 14.8 kN and 16 kN respectively. High shear tensile strength is for the sample 4 which is preheated and quenched in water. Quenching in the water alone can increase the shear tensile strength of the weld slightly. This is evident from the shear tensile strength of the sample 3 which is only quenched in water not preheated.

4. Conclusion

The tensile strength can be increased by adding preheating current to welding spot and quenching weld in water.

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References

[1] M. Pouranvari, H. R. Asgari, S. M. Mosavizadch, Sci. Technol. Weld. Join.12(2007) No. 3, 217-225.

[2] M. Marya, K. Wang, L. G. Hector, X. Gayden, "Tensile shear forces and fracture mode in single and multiple weld specimens in dual-phase steel", J. Manuf. Sci. Eng. vol. 128, pp. 287-298 (2006).

[3] G.R. Speich, W.C. Leslie, "Tempering of steel", Metall. Trans., vol. 3, p. 1043-1053 (1972).

[4] G. Krauss, "Steels Heat Treatment and Processing Principles", ASM International, USA (1990).

[5] A. Joarder, J.N. Jha, S.N. Ojha, D.S. Sarma, "The tempering behaviour of a plain carbon dual-phase steel", Mater. Charact.vol. 25, pp.199-209 (1990).

[6] Hongyan Zhang, Jacek Senkara, "Resistance welding: fundamentals and applications", 1st Edition, Taylor & Francis Group, Boca Raton Fl., p. 105 (2006).

[7] R. D. Stout, "Weldability of steels", Fourth Edition, Welding Research Council, p. 3 (1987).

[8] P. Podrzaj, S. Simoncic, Resistance spot welding control based on the temperature measurement, Sci Technol Weld Join, 18 (2013), 551–557

[9] M. Pouranvari, S. P. H. Marashi, Key factors influencing mechanical performance of dual phase steel resistance spot welds, Sci. Technol. Weld Join, 15 (2010), 149–155.

[10] Ferrasse, S., Verrier, P., and Meesemaecker, F, Resistance spot weldability of high strength steels for use in car industry. Welding in the World, 1998.