Spot Welding of Dissimilar Materials and to Study the Weld Strength, Parameters Affecting on it

Shweta Tille
PG Student
Department of Mechanical Engineering
Dayananda Sagar College of Engineering Bangalore, India

Dr. Aruna Devi M
Associate Professor
Department of Mechanical Engineering
Dayananda Sagar College of Engineering Bangalore, India

Dr. C. P. S. Prakash
Principal & Professor
Department of Mechanical Engineering
Dayananda Sagar College of Engineering Bangalore, India

Abstract

The objective of this study is to study the effect of parameters, such as electrode force, welding current and welding cycles on the weld strength of the weld joint between two dissimilar materials, i.e., Mild steel (ms6240) and stainless steel (ss304). In the present study the electrode force is kept constant i.e., 6KN.A welding current of 1, 1.5 and 2KA, and cycle time of 40, 50 & 60 are used for the weld joint. The specimen is subjected to shear test according to ASME BPVC IX-2015, QW-196.2.1. It is inferred from the results that the weld shear strength of the spot weld joint is increased with the increased welding current and increased welding cycles.

Keywords: Resistance Spot Welding (RSW), Welding Current, Welding Cycles, Electrode Force and Shear Strength

I. INTRODUCTION

Resistance Spot Welding (RSW) is a high speed process, wherein the actual time of welding is a small fraction of second and it is one of the cleanest and most efficient welding process that has been widely used in sheet metal fabrication. The high speed of process, the case of operation and its adaptability for automation in the production of sheet metal assemblies are its major advantages. [1] Limitations of RSW are equipment cost and power requirements, difficulty of disassembly for maintenance or repair of RSW joints, and the nature of the design needed for the process (lap joints are required).

Resistance Spot Welding has steadily gained importance over the years because of its ability to join the variety of materials and complicated shapes with high accuracy and great precision. Resistance Spot Welding (RSW) is a high speed process, where the actual time of welding is a small fraction of second and it is one of the cleanest and most efficient welding process that has been widely used in sheet metal fabrication. The high speed of process, the case of operation and its adaptability for automation in the production of sheet metal assemblies are its major advantages. Over the last few years, the weight of automobiles has increased considerably due to the addition of safety related items, such as impact resistance bumpers and door impact beams, emission control equipment and convenience items, such as air conditioning. At the same time fuel consumption has increased significantly primarily due to emission control equipment [2-3].

Luo et. al in the study concluded that for the RSW of three aluminum alloy sheets, there existed a critical welding time, after which the nugget size remained nearly unchanged. This indicates that a long welding time is unnecessary for the RSW of aluminum alloy [4-5].

Gong Liang et. al in their work have observed that, aluminum alloys such as AA5182 have inferior weldability for forming the joint due to their high reflectiveness to heat and light. Therefore it is necessary to further develop the high performance control strategy and the set-up of a new welding schedule. The welding process identification is an essential issue [7].

II. EXPERIMENTAL PROCEDURE

Figure 1 shows the experimental setup of the Resistance Spot Welding.

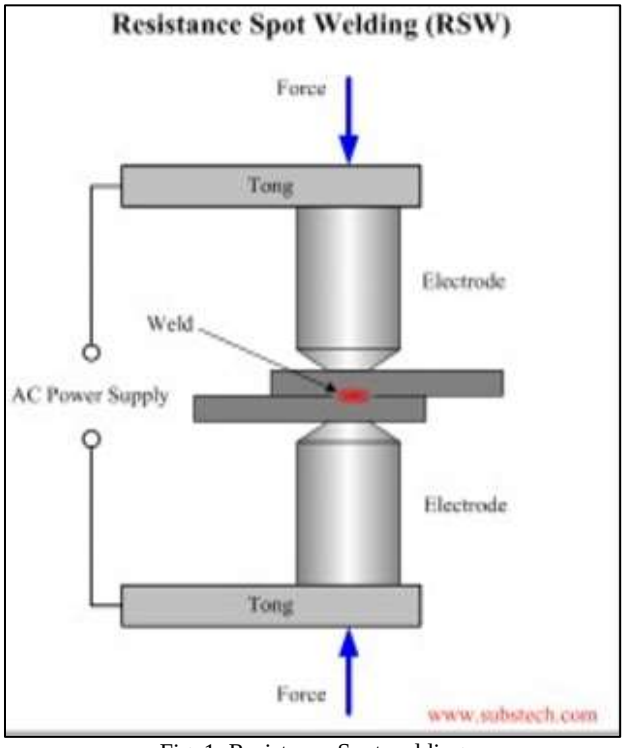

Fig. 1: Resistance Spot welding

Materials used for the experiment are Mild Steel 5083 and Stainless Steel ss304. These materials are selected for study since they are widely used materials in automobiles parts boilers, pressure vessels and many other engineering applications [8-9].

Table – 1
Material properties

Materials	*Density*	*Melting point*
Mild Steel 5083	*7,85g/cm^3*	*1400-1455 ℃*
Stainless Steel ss304	*8.0g/cm^3*	*1425-1540 ℃*

The figure 2 shows the dimension of the specimen for the experiment.

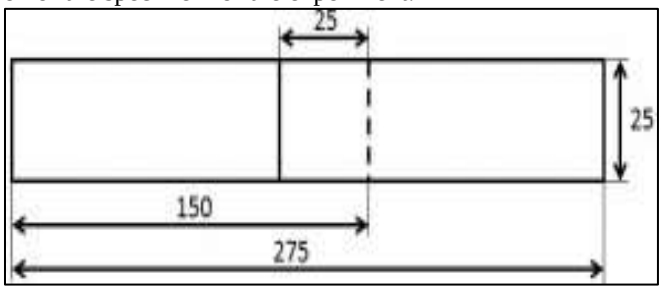

Fig. 2: Specimen Dimensions (All in mm)

Parameters selected for the experiment are weld current and weld cycles, a total of 9 samples are used for the experiment and the experiment is conducted on different levels.

Table – 2
Parmeters and their levels

Samples	*Weld current*	*Weld cycles*
1	*1KA*	*40*
2	*1KA*	*50*
3	*1KA*	*60*
4	*1.5KA*	*40*
5	*1.5KA*	*50*
6	*1.5KA*	*60*
7	*2KA*	*40*
8	*2KA*	*50*
9	*2KA*	*60*

III. RESULTS

The welding current is increases in steps of 0.5KA and for each welding current the weld cycles of 40, 50 and 60 used for the study. The specimens were subjected to weld shear test according to ASME BPVC IX-2015, QW-196.2.1 and the weld shear strengths of the weld specimens are tabulated

The results of the experiment are shown in the table 3.

Table - 3
Shear strength for each sample

Samples	*Weld current*	*Weld cycles*	*Shear Strength KN*
1	*1KA*	*40*	*1.135*
2	*1KA*	*50*	*1.259*
3	*1KA*	*60*	*1.398*
4	*1.5KA*	*40*	*2.983*
5	*1.5KA*	*50*	*3.145*
6	*1.5KA*	*60*	*3.488*
7	*2KA*	*40*	*3.053*
8	*2KA*	*50*	*3.301*
9	*2KA*	*60*	*3.575*

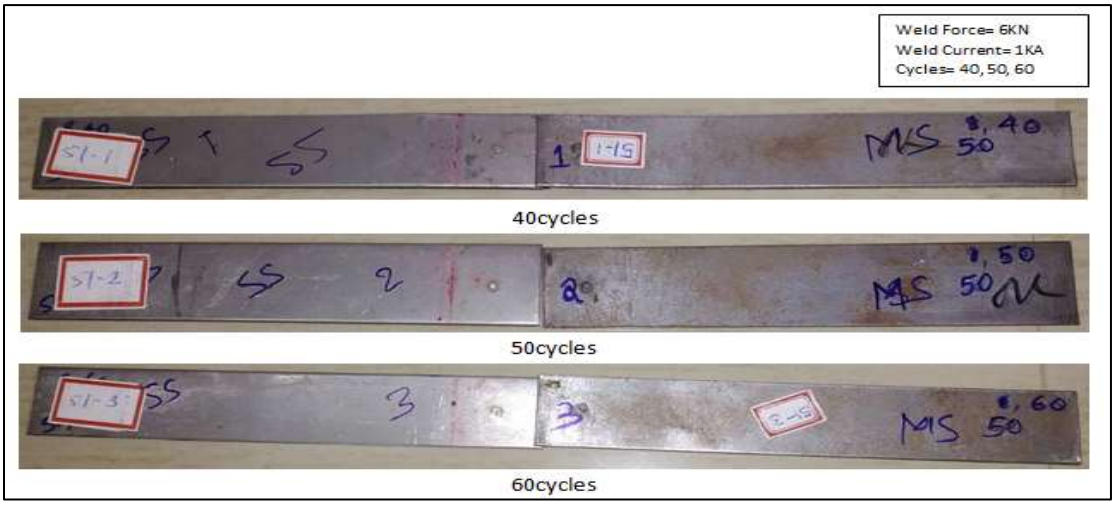

Fig. 3: Samples 1, 2 and 3 after shear test with shear strength 1.135, 1.259 and 1.398KN respectively.

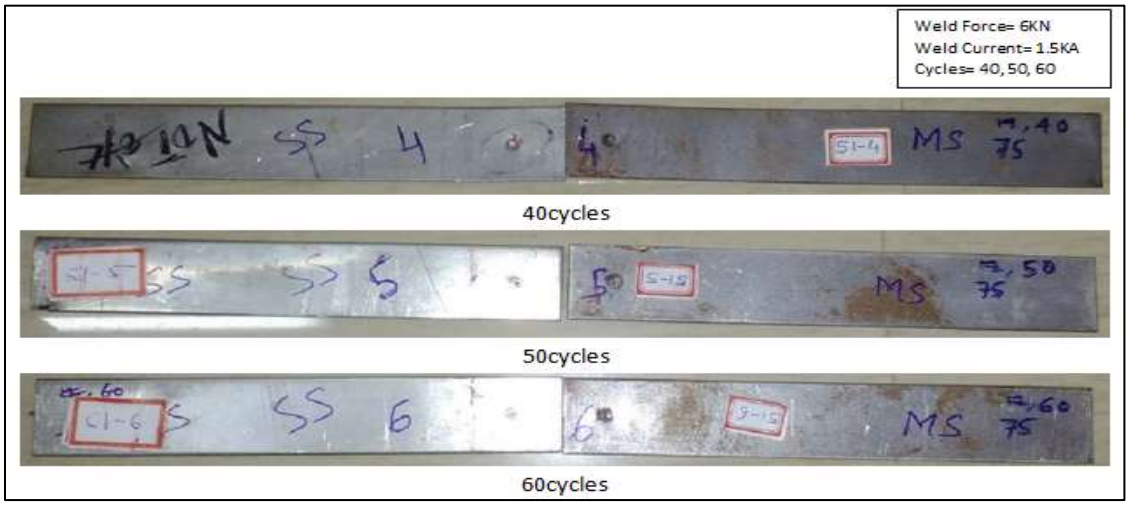

Fig. 4: Samples 4, 5 and 6 after shear test with shear strength 2.983, 3.145and 3.488KN respectively.

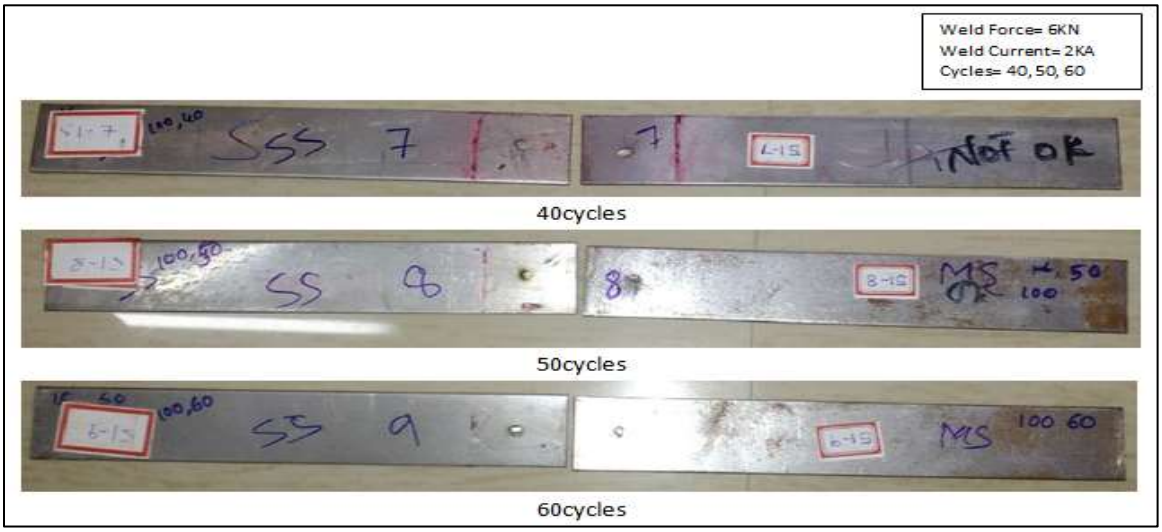

Fig. 5: Samples 7, 8 and 9 after shear test with shear strength 3.053, 3.301and 3.575KN respectively.

From the Graph, It can be inferred that at a constant electrode force the Weld strength increases with the increasing weld current and also increases with the increasing weld cycles

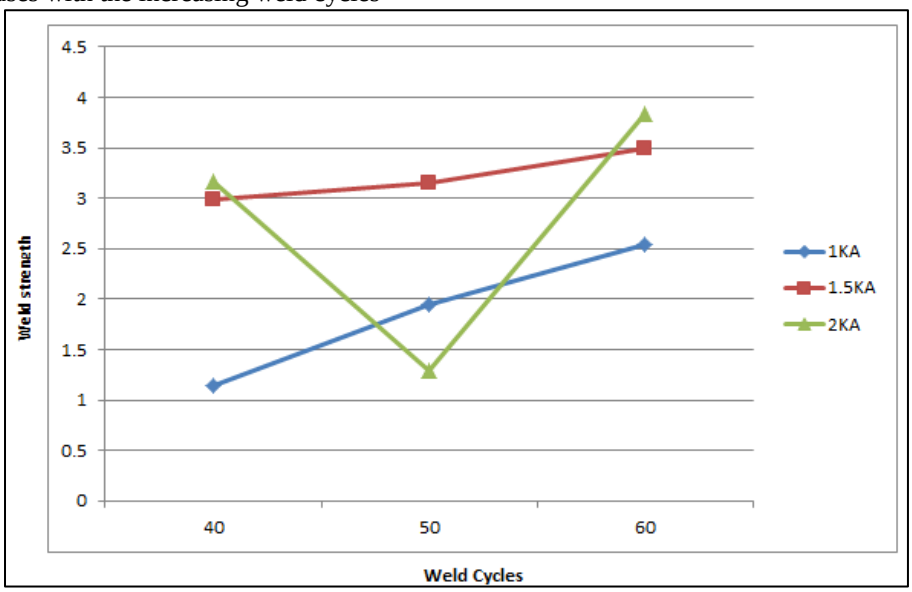

Fig. 5: Weld strength vs weld cycle.

IV. CONCLUSION

The following conclusions can be inferred from the experimental study carried out:

1) The two dissimilar metals, i.e., SS304 and MS6240 can be spot welded together, producing a good weld joint with reasonably good strength.
2) In the Spot weld joint between SS304 and MS6240, the weld Strength increases with Increasing welding Current
3) In the Spot weld joint between SS304 and MS6240, the weld Strength increases with Increasing weld cycles.
4) The weld Strength decreases due the surface flaws such as pin holes cracks etc., in the region of weld joint.
5) The SS304 Stainless steel grade can be used in conjunction with MS6240 in the assembly of different parts pressure vessels and boiler as well as Nuclear power plant vessels.

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