

Some Studies on Shielded Metal Arc Welding Hardfacing on Mildsteel

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ABSTRACT: Hard facing is one of the most useful and economic way to improve the properties and then performance of a component that depends upon the selected alloys for welding process. Many Industries face the problem of wear on components in service. Due to wear the components need replacement, which may costs money and causes downtime of the equipment. To overcome this problem hardsurfacing is carried out. In this work, the hard facing alloys were deposited on mild steel (Base material) by a shielded metal arc welding (SMAW) method. Two different composition of Fe-Co-Ni Hard facing alloy were employed to investigate the effect of the microstructure. The experiment is conducting by varying welding parameters like voltage, travel speed and current. Specimens of size 265×125×12mm were used for depositing the hardfacing layers. Microstructure characterization analysis were made using Metalurgical Microscope, Microhardness test is made using Hardness testing machine.

KEY WORDS: Hardfacing, SMAW welding, Micro hardness, Microstructure.

I. INTRODUCTION

Hardfacing, also known as "Hardsurfacing", is the application of build-up of deposits of specialized alloys by means of welding process to resist abrasion, corrosion, high temperature, or impact. Hard facing is the process of depositing, by one of various welding techniques, a layer or layers of metal of specific properties on certain areas of metal parts that are exposed to wear. The properties usually sought are greater resistance to wear from abrasion, impact, adhesion (metal-to-metal), heat, corrosion or any combination of these factors. A wide range of surfacing alloys is available to fit the need of practically any metal part. Some alloys are very hard, others are softer with hard abrasion resistant particles dispersed throughout. Certain alloys are designed to build a part up to a required dimension, while others are designed to be a final overlay that protects the work surface.

II. EXPERIMENTAL MATERIALS

(A) BASE METAL

The selection of base metal is very essential in deciding what alloy to use for hardfacing deposit. Since welding procedure differs according to the base metal. Mild steel was selected as the base metal for the study which composes the main elements of carbon, silicon, manganese, sulphur, and phosphorous. The chemical composition is given in Table 1 and standard samples shown in figure 1.

Table 1 Chemical composition of mild steel (Carbon steel 1020)

C	Si	Mn	S	P	Fe
0.17	0.35	0.8	0.04	0.029	Balance



Figure 1 Standard test specimens of size 265×125×12mm

(B) HARDFACING ALLOY

In the study, Fe-Ni-Co alloy based hardfacing alloy is used and also it as wide range of mechanical properties. The mechanical strength of the Fe in the alloy binds with the Ni and Co which provides the hard surface for the base materials like Mild steel, Aluminium, Copper and many more for different applications. Chemical compositions of selected materials is shown in table 2.

Table 2 Chemical composition of Fe-Ni-Co hardfacing alloy

C	Si	Ni	Co	Mb	Cu	Fe
0.2	0.6	6.3	2.5	0.3	0.5	Balance

III. WELDING CONDITIONS

The standard size test specimens dimensions of 265×125×12mm were selected for the experiment. The following precautions are taken before hardfacing. The electrodes are perfectly dried in the furnace and baked at 250 °C one hour before the use. Area of the weld is properly cleaned.

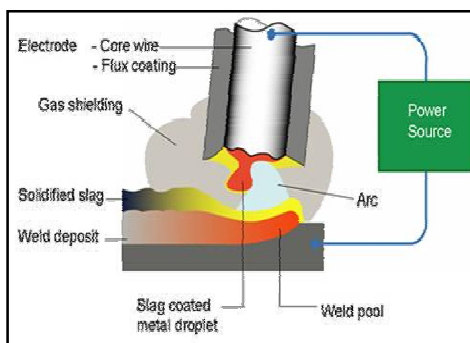


Figure 2 Shielded Metal Arc Welding Process

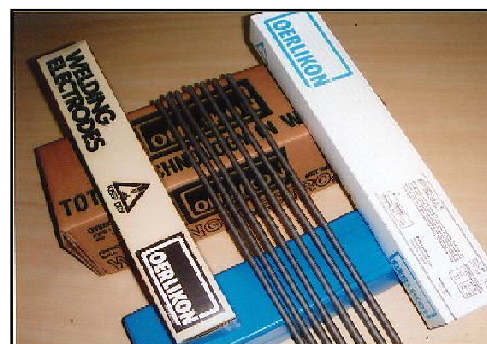


Figure 3 Welding Electrodes

In this process an arc is drawn between a coated consumable electrode and the work piece. The metallic core-wire is melted by the arc and is transferred to the weld pool as molten drops. The electrode coating also melts to form a gas shield around the arc and the weld pool as well as slag on the surface of the weld pool, thus protecting the cooling weld pool from the atmosphere. The slag must be removed after each layer. Manual Metal Arc welding is still a widely used hardfacing process. Due to the low cost of the equipment, the low operating costs of the process and the ease of transporting the equipment, this flexible process is ideally suited to repair work.

IV. SPECIMEN PREPARATION

Low carbon steel plate was machined on Laser cutting machine. The machined specimen were then cleaned with acetone to remove impurities from the surface to make the specimens ready for welding.

In this work, a series of experimental electrodes with different flux compositions was produced. The experimental electrodes were produced in small batches (100g each). Steps performed for in the experimental program are as follows:

- The first step was the machined specimens were then cleaned with acetone to remove impurities from the surface to make the specimens ready for welding.
- The second step was the preparation of steel plate (low carbon steel) specimen, having dimension of 265x125x12mm
- The third steps was to deposits the layers of hardfacing electrodes in machined plates to make the specimens ready for testing are as follows:

- Micro Hardness Test
- Microstructure Test

V. RESULTS

1. HARDNESS TEST ANALYSIS

a) Voltage varying:

Table 3 Voltage variation hardness results

TRAIL	CURRENT (A)	VOLTAGE (V)	HARDNESS (BHN)
S1	220	20	187
S2	220	25	161
S3	220	30	156

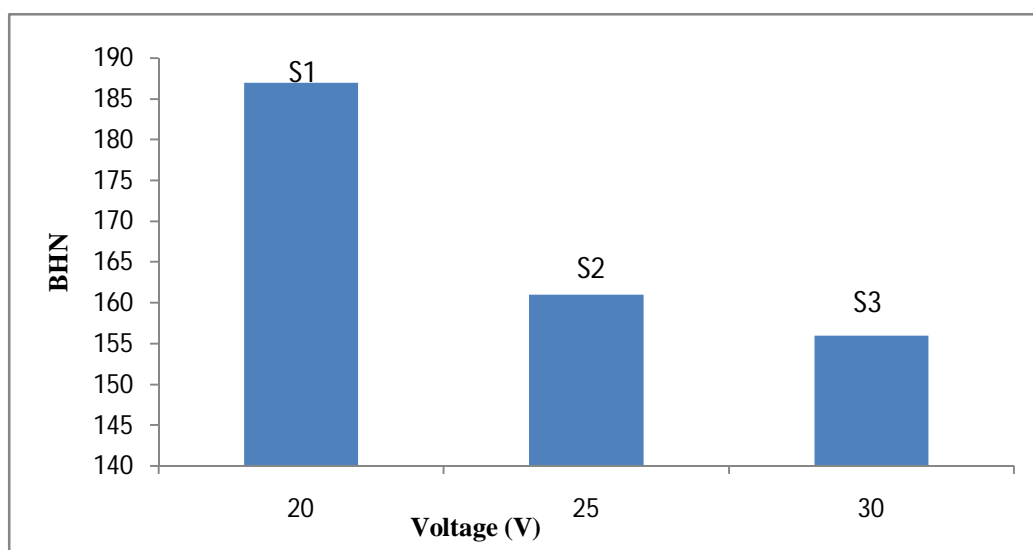


Figure 4 shows the graph of varying voltage v/s Brinell Hardness Number

b) Current varying:

Table 4 Current variation hardness results

TRAIL	CURRENT (A)	VOLTAGE (V)	HARDNESS (BHN)
S1	200	24	156
S2	225	24	145
S3	250	24	140

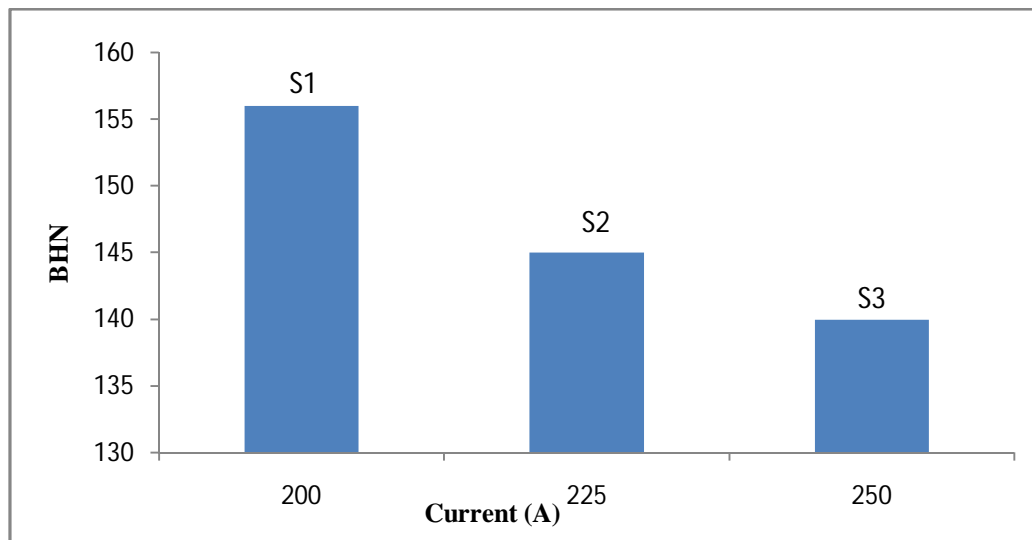
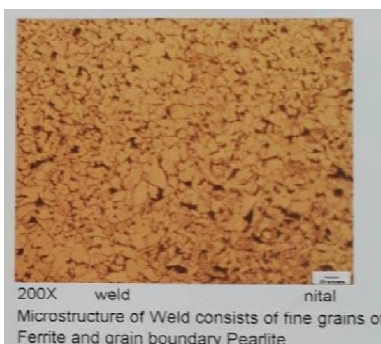


Figure 5 shows the graph of varying voltage v/s Brinell Hardness Number

2. MICROSTURUCTURE

The micrograph of the Fig reveals that there was presence of ferrite - pearlite microstructure. The density of flow lines that banding and morphology of ferrite and pearlite has been found to vary in specimens. The dark regions are the pearlite; it is made up from fine mixture of ferrite and iron carbide, which can be seen as a "wormy" texture. Dark region is not acicular. The light coloured region of the microstructure is the ferrite. The pearlite has a very fine structure, which makes the steel very hard. Unfortunately this also makes the steel quite brittle and much less ductile than mild steel. Some of the micrographs show ductility of the material. There was a deformation of the specimen and the grains in the microstructure fail by void formation as the metal flows around hard particles in the microstructure. This is also known as micro void coalescence. Voids as a dimple can be seen in under high magnification. This absorbs a lot of energy and toughness is high.

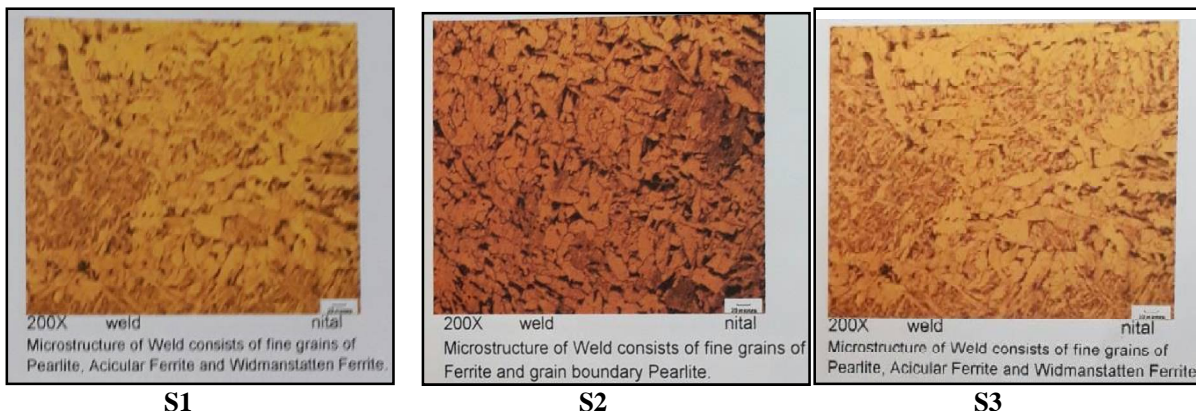


S 1

S 2

S 3

Figure 6 a, b, c shows the microstructure of hardfaced samples S1 S2 S3 under varying voltage



S1

S2

S3

Figure 7 a, b, c shows the microstructure of hardfaced samples S1 S2 S3 under varying current

VI. CONCLUSION

Hardfacing materials may be deposited by a wide range of welding processes, and their properties depend strongly on the welding procedure and conditions used. For example, the arc voltage and current have a significant influence in determining the deposit geometry. The heat input, which is a function of the arc current, voltage and the travel speed is found to increase the weld bead area. A SMAW welding process is feasible for optimized parameters of hardfacing Fe-Ni-Co on mild steel which enables to enhance its properties. The optimized process parameters are very much essential to achieve desired properties on mild steel such as improved mechanical properties, Corrosion properties through hardfacing. An understanding of the effect of the variables which influence the penetration depth is particularly important for hardfacing alloys. The obtained results shows that the hardfaced material can be used in many engineering fields such as aerospace, transportation, automotive etc. since the deposition of Fe-Ni-Co alloy base hardfacing electrode on mild steel leads to high hardness value. The conducted experimentation also shows that optimized voltage and current yields better hardness.

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