International Journal of Research in Advent Technology, Special Issue, May 2018
E-ISSN: 2321-9637
3rd National conference on "Emerging Trends in Mechanical Engineering" (NCETM -2018)
Available online at www.ijrat.org

Mechanical Charcterization of Fe-Ni-Co Alloy Based Hardfacing on Mild Steel Using Metal Inert Gas Welding Process

Chowda Reddy C[1], Dr. K M Kenchi Reddy[2], Dr. C T Jayadeva[3], M S Satish[4], Chandrashekar K M[5]
[1]*Assistant Professor, Department of Mechanical Engineering, C Byregowda Institute of Technology-Kolar. Email: chowda.stylus@gmail.com*
[2] *Professor, Department of Mechanical Engineering, Sri Krishna Institute of Technology- Bengaluru. Email: kenreddy@rediffmail.com*
[3] *Principal, Adichunchanagiri Institute of Technology-Chikmagalur. Email: ctjayadeva@yahoo.co.in*
[4] *Associate Professor, Department of Mechanical Engineering, C Byregowda Institute of Technology-Kolar. Email: satish04nihal@gmail.com*
[5]*Assistant Professor, Department of Mechanical Engineering, C Byregowda Institute of Technology-Kolar. Email: chandrashekar.km112@gmail.com*

Abstract- Hardfacing is the process of depositing, by one of various welding techniques, a layer by layers of metal of specific properties on certain areas of metal parts that are exposed to wear by expanding this definition a little further, it can be seen that hard facing has more to offer than most other wear prevention treatment. In this study work hardfacing process, mild steel specimens of size 100x80x10mm is used for depositing the hardfacing layers by MIG welding process, considering and varying the welding parameters such as voltage and current. Composition of Fe-Ni-Co filler material will be employed to investigate the effect of Microstructure and Micro hardness properties. The comparison in the wear test response of hardfaced plate with the bare mild steel plate was also made in actual working conditions.
Key words: Hardfacing, MIG welding, Micro hardness, Microstructure.

1. INTRODUCTION

Hard surfacing is the deposition of a special alloy material on a metallic part, by various welding processes, to obtain more desirable wear properties or dimensions. 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.

2. EXPERIMENTAL MATERIALS

1. 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

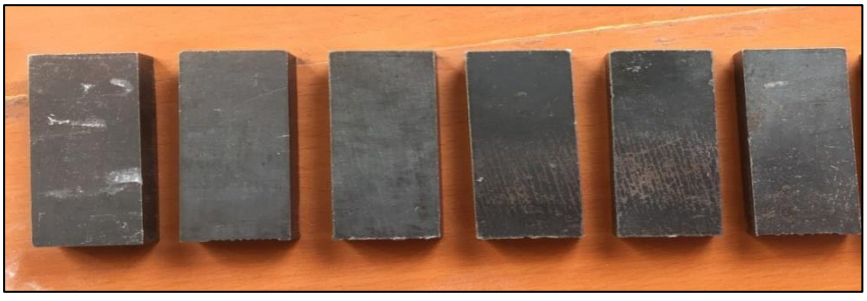


Figure 1 Standard test specimens of size 75×25×10mm

2. 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

3. WELDING CONDITIONS

The standard size test specimens dimensions of 75×25×10mm were selected for the experiment. The following precautions are taken before hardfacing. The electrodes are perfectly dried in the furnace and baked at 250 ^{0}C one hour before the use. Area of the weld is properly cleaned.

4. MACHINE SPECIFICATIONS

TORNADO MIG 630 Arc welding machine is shown in figure 2. It having a current capacity of 100-630 amps, input voltage is 415 volts± 10% / 50-60 HZ / 3 Phase and as machine capacity 50 KVA.

Figure 2 MIG Welding Experimental Setup

5. EXPERIMENTAL SETUP

The experiment is done with two different parameters such as by varying the voltage and current by keeping constant travel speed.

First setup: constant voltage (V) and Varying current (A)

Second setup: constant current (A) and Varying Voltage (V)

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.

Steps performed for in the experimental program are as follows:

(a) The first step should be cleaning the surface of the testing specimen with acetone inorder to remove the impurities on the surface of the specimens for welding.

(b) The second step is preparation of steel plate (low carbon steel) specimen, having dimension of 75×25×10mm

(c) The third steps as 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

6. RESULTS AND DISCUSSION

1. HARDNESS TEST ANALYSIS

Voltage varying:

Table 3 Voltage variation hardness results

TRAIL	CURRENT (A)	VOLTAGE (V)	HARDNESS (BHN)
S1	220	30	140
S2	220	25	162
S3	220	20	187

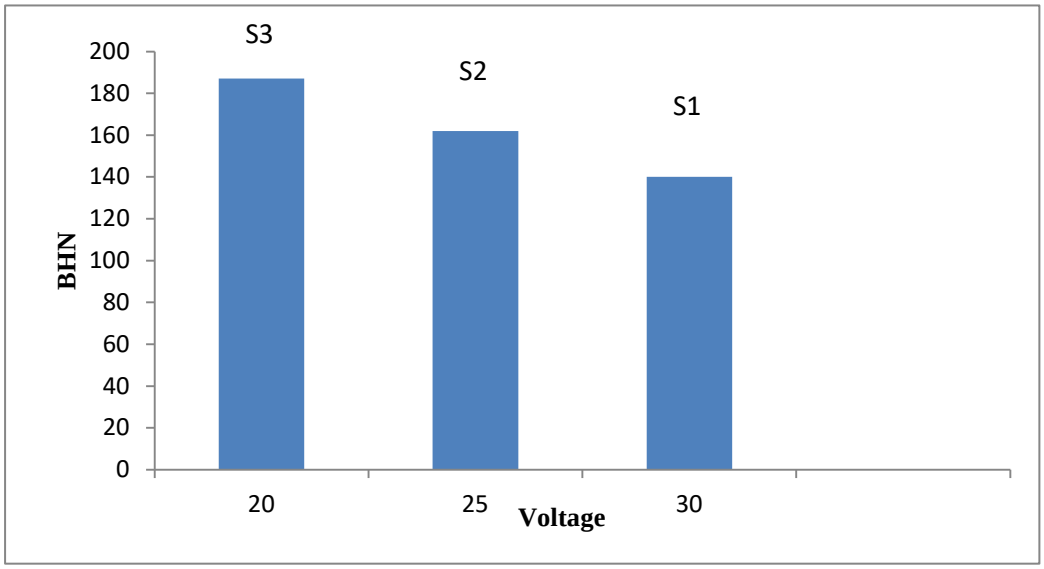


Figure 3 Voltage v/s BHN

Current Varying:

Table 4 Current variation hardness result

TRAIL	CURRENT (A)	VOLTAGE (V)	HARDNESS (BHN)
S1	250	24	145
S2	225	24	150
S3	200	24	161

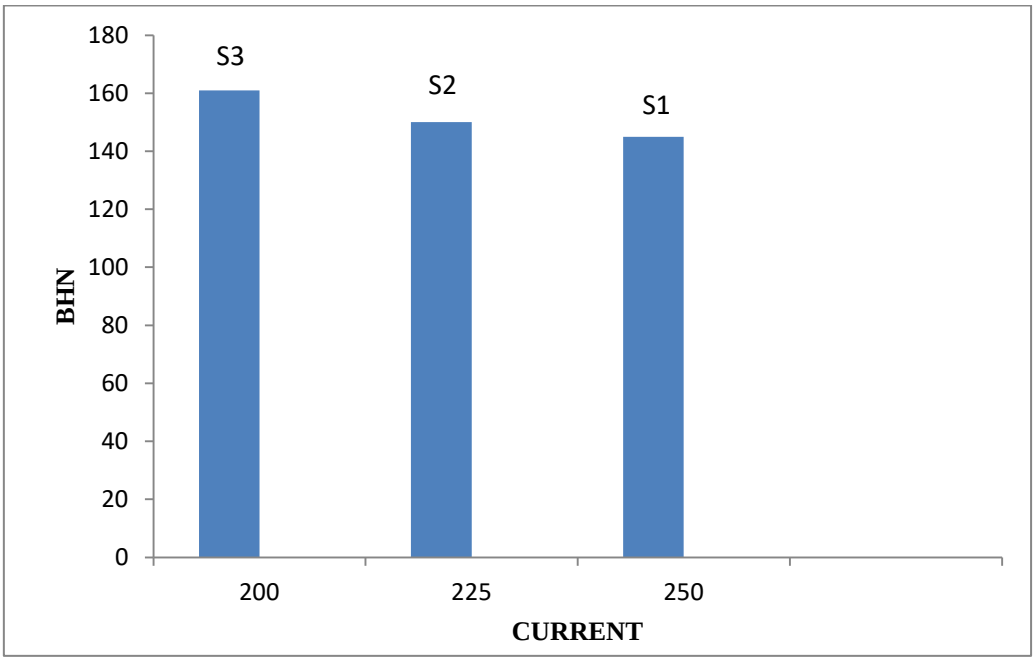
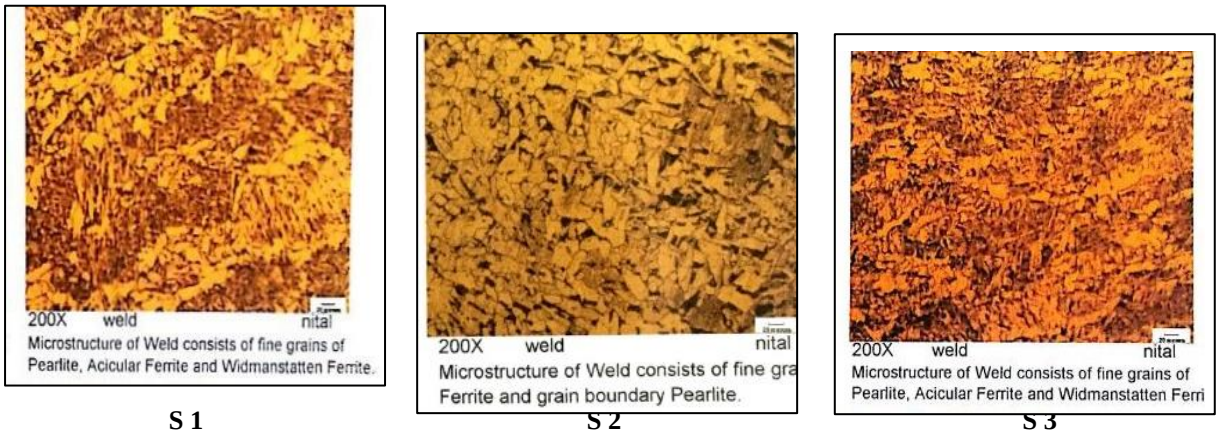


Figure 4 Current v/s BHN

2. MICROSTRUCTURE ANALYSIS

It is appreciated that the microstructure of iron-based hardfacing alloys has a significant influence on the oxidation, corrosion, and abrasive wear resistance. Therefore, it is vital to establish the effect of the welding parameters on the microstructure for achieving the best performance of hardfacing alloys during service. The variation of the microstructure in these alloys depends primarily on the Fe-Ni-Co ratios. In Fe-based hardfacing alloys there is a strong influence of the welding variables such as, the arc current, voltage, polarity, electrode stickout on the microstructure of multilayer deposits. Among these variables, by varying the arc current and voltage were reported to have the most significant influence. For instance, varying the arc voltage changes the microstructure of Fe-Ni-Co hardfacing. The microstructure is mainly low-carbon steel the base metal and hardfaced metals, with varying voltage and current the samples were prepared separately such as S1, S2 & S3 respectively are shown in figure 5a,b,c and 6a,b,c. The weld metals are distinguished from the base metal in microstructures due to different chemical compositions.



S 1 **S 2** **S 3**

Figure 5a, b, c shows the microstructure of hardfaced samples S1 S2 S3 under varying voltage

S 1 **S 2** **S 3**

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

7. 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 MIG 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.

REFERENCES

[1] G.R.C. Pradeep, Dr. A. Ramesh &Dr. B. Durga Prasad "Comparative Study of Hard facing of AISI 1020 Steel by Three Different Welding Processes", vol. 13, 2013
[2] K. Kannoorpatti, M. Vargas & V. Murthy "Studies on the Corrosion Behaviour of Wear Resistant Hardfacing Alloys" School of Engineering and IT, Charles Darwin University, Darwin, Australia
[3] Dr. K. M. KenchiReddyand Dr. C T Jayadeva"A Study on Microstructure and Abrasive Wear Behavior of Fe-Cr-C Based Hard facing Alloys Deposited by SMAW Processes" vol. 3, March-2014. pp 344-349.
[4] Harvinder Singh "Studies the Effect of Iron Based Hardfacing Electrodes on Stainless Steel Properties Using Shielded Metal Arc Welding Process", a UCOE, Punjabi University, Patiala, vol. 2, Apr-2014
[5] E Badischand M Kirchgabner " Influence of welding parameters on microstructure and wear behavior of a typical NiCrBSi hardfacing alloy reinforced tungsten carbide"
[6] Gautamkocher, Om Parkash, SachitVardhan"Hardfacing by welding to Increase wear resistance properties of EN31 by MR 3LH Electrode" vol. 2, Feb-2012.
[7] R I Blombery and C M Perrott" Wear of sprayed tungsten carbide hard facing deposites"