ISSN: 0971-1260
Vol-22-Issue-17-September-2019

A Review Study on Hardfacing of Metal Surfaces Using Welding Techniques.

[1]Jaspreet Singh,[1]Manish Chaudhary, [1]Prashant Baghde,[1*]Mandeep Singh.

[1]School of Mechanical Engineering, Lovel Professional University, Phagwara, Punjab, India.

*CorrespondingAuthor: mandeep.15984@lpu.co.in

Abstract

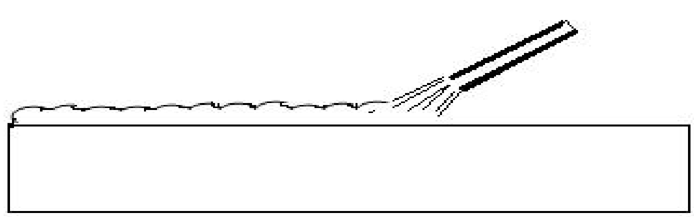
Hardfacing is a methodology used to improve surface characteristics for a material, by depositing an alloy layer on base metal to improve the wear resistance. Wear resistance depends upon type of deposition method and alloy. In the present work, a review on hardfacing had been done to study the hardfacing alloys, the properties to be improved by harfacing. Certain methods to apply hardfacing layers and industrial applications were also discussed.

*Keywords:*hardfacing, wear resistance, hardfacing alloys.

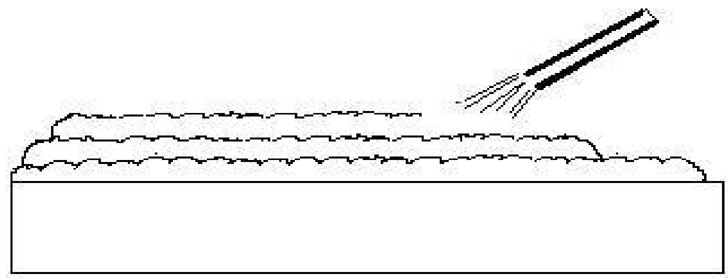
1.Introduction

Hardfacing is the deposition of an alloy on the metal substrate to improve the desired properties such as wear resistance, hardness, stability at high temperature incorporating different methods such as thermal spraying, welding etc.[1]. Figure 1 demonstrates hardfacing as a process to improve surface properties. Hardfacing is more economical as compared to some conventional methodologies to improve the properties of surface rather than treating the entire component for the same, as it involves deposition of a hardfacing layer on the surface of low cost base metal.[2] Since the hardfacingenhances the life span of material, hardfacing alloys must possess below mentioned desired properties [3]:

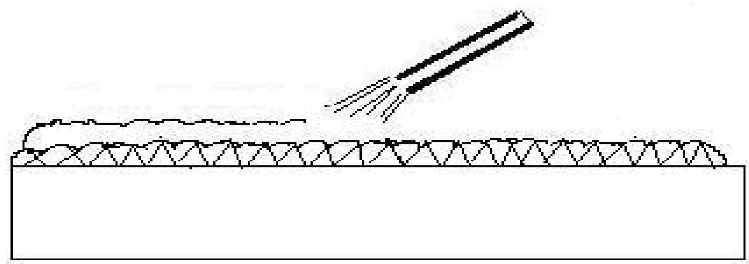
1.1 Hardness
a) Macro-hardness.
b) Micro-hardness (individual material hardness such as that of deposition material).
c) hardness at high temperature.
d) strength for creep (for elevated temperature devices).
1.2 Resistance to Abrasive particles
a) low load abrasive resistance.



(a)



(b)



(c)

Figure1: Layout of hardfacing. Hardfacing materials can be added to base metal as a) a single layer, b) certain layers. And sometimes, c) a buffer layer is pasted onto the base metal before the application of hardfacing alloy to provide better bonding between different layers.

b) high load abrasive resistance.
c) resistance under wet conditions
1.3Resistance to heat
a) Resistance to oxidation.
b) high temperature fatigue.
1.4 Corrosive-resistance
1.5 surface properties
a) Frictional constant.
b) Surface layers.
c) Lubrication.

2.Literature review

BuchelyM.F et al. (2005) made a study for the comparison of material properties and wear resistance for different hardfacing materialsincorporating chromium carbides, complex and tungsten carbides. They used ASTM A36 as base metal to be welded with shielded metal arc welding process and found that 3 layer complex carbides shows best abrasion wear resistance, whereas in single layer, higher dilution increases wear losses. W-rich hardfacing alloy shows good abrasion wear resistance in single layer due to large MC carbide size. Wear mechanisms observed as microcutting, brittle-fracture, ploughing of carbides[1].

Chang C.M et al. (2010) studied the microstructure and abrasionproperties of carbon Fe-Cr-C alloys. ASTM A36 steel plate is hardfaced with GTAW process. They observed that with an increase in carbon content, hardness Increases and chromium carbide refines. Wear resistance

ISSN: 0971-1260
Vol-22-Issue-17-September-2019

increases with carbon content but eutectic matrix damages due to abrasive particles. High carbon Fe-Cr-C alloy possessed excellent wear resistance [4].

Correa E.O et al. (2007) investigated the relation among abrasion wear-resistance and micro-structure of alloy for hardfacing based on Fe-Cr-C-Nb-V system. Alloy-750 demonstrates microstructe for improved wear resistance and resilience as compared to conventional alloys. which is due to distribution of very fineNb rich carbides in an austenitic matrix. Related to above research, alloy 750 is suggested to be used than conventional H.C.O materials for applications subjected to abrasion resistance and impact strength for prolonged lifespan of components[5].

Coronado John J. et al. (2009) studied the effect of welding procedures on abrassion wear. In this work, four kind of hardfacing alloys deposited with two different welding processes viz FCAW and SMAW in the pattern of single and triple layer. Results showed FCAW process presents better wear resistance in single and triple layers. Abrasion wear mechanisms were micro-cutting, micro-ploughing and wedge formation. Carbides and matrix microstructure have more importance than hardness in abrasion resistance of deposits[6].

Choteborsky R. et al. (2008) studied the hardfacing alloy reinforced with primary Chromium carbides and complex carbides for their wear resistance. GMAW process is used for deposition of hardfacing alloy upon low carbon steel plate. They found two layer complex carbide shows best wear resistance whereas MC carbide has decisive influence on abrasion wear resistance and they acts a barriers against the advancement of abrasive particles[7].

3.Hardfacing by welding

3.1 Shielded metal arc welding (SMAW) based hardfacing

Shielded metal arc welding (SMAW) is widely used for thehardfacing, because of its low cost, great versatility, and the availability of a wide range of sizes and type of hardfacing electrodes. The schematic representation of SMAW welding is shown in figure 2.

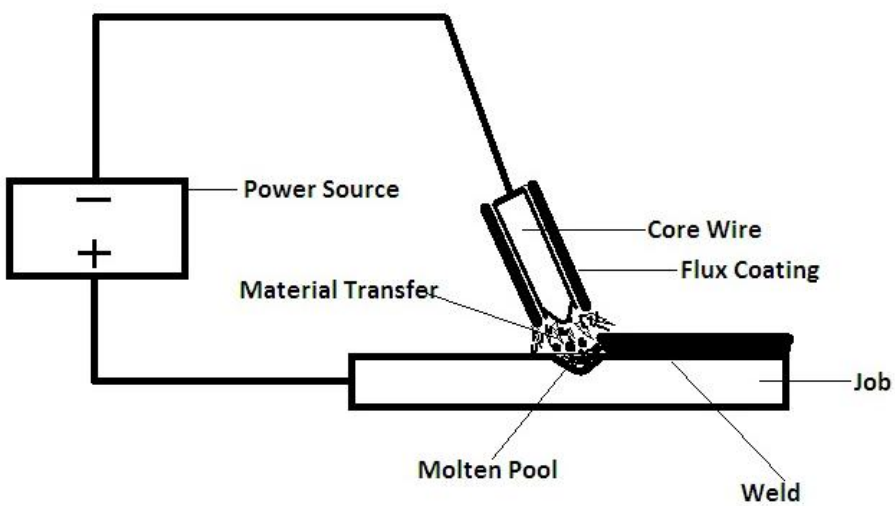


Figure 2: Representation of SMAW set-up.

Welding can be done on any size and shape of job, in any position and at any location [8]. The welder can control heat input rate, dilution by base metal and can easily cover irregular areas. He

ISSN: 0971-1260
Vol-22-Issue-17-September-2019

can use stringer bead technique to minimize heat input or weave technique to maximize heat input. He can direct the arc on the molten puddle and control the size of the puddle to reduce dilution of the base metal (for example, in welding for austenitic manganese steel) [6].

4.Harfacing materials applications

The wide range of applications, starting from the most critical,as in crushing of rock, to the applications for minimizationofdirect metal wear as in valve mechanisms operating under tight clearances[7]. The application of hardfacing alloys for critical components are briefed in figurefigure3 (a and b).

The showel teeth are made of lowalloy cast iron, and sometimes of steel. The working range of new tooth and treated toothcan be enhanced by hard-facing. The hardfacing material provide excellentabrasive resistance for areas, in which the frontal edge isexposed to intensive wear [5]. Nickel and cobalt based hardfacing materials are suitable for high temperature and corrosive stability of the applications. Shearblade figure in 3 (c) and valve seats figure in3 (d) are hard-faced by satellite category of cobaltbased and hastelloybasedNi,Cr alloy to obtain high strength at elevated temperature[9].

(a) **(b)**

ISSN: 0971-1260
Vol-22-Issue-17-September-2019

(c) **(d)**

Figure 3: a) shovel teeth; b) trencher chain, c) hot shear blade; d) valve seats [3]

5.Conclusions

Hardfacing is a methodology used to improve surface characteristics for a material, by depositing an alloy layer on base metal to improve the wear resistance. Wear resistance depends upon type of deposition method and alloy.hardfacing can be carried out by thermal spraying, welding and allied methodologies. Different hardfacing alloys are available to enhance the surface properties of materials for desired operating conditions such as abrasive resistance can be improved by chromium based alloys. Nickel and cobalt based hardfacing alloys can increase wear resistance and corrosion resistance at higher temperature working conditions.

References:

1. BuchelyM.F, GuttierzJ.C and Leon L.M (2005) "The effect of microstructure on abrasive wear of hardfacing alloys." Wear. Vol. 259, pp. 52-61.
2. Gualco A and G HemanSavowada (2010) "Effect of welding procedure on wear behavior of a modified martensitic tool steel hardfacing deposits." Mate. And desig. Vol. 31, pp. 4165-4173.
3. Revesova S. and povel B. (2010) "Selection of materials and techniques for forming the layers resistant to abrasive wear." Fac. Of mat. Sci. and tech. in Trnava, VOL.28.
4. Chang C.M, Chen Y.C and Wu weite (2010) "Microstructural, abrasive wear characterstics of high carbon Fe-based hardfacing alloy." Trib. Int. vol. 43, pp. 929-934
5. Correa E.O, AlkantraN.G and TeccoD.G (2007) "The relationship between the microstructure and abrasive wear of a hardfacing alloy in Fe-Cr-C-Nb-V system." ASM Inter. Vol. 38A.
6. Coronado John j, Caicedo Holman F and Gomez Adolfo L (2009) "The effect of welding processes on abrasive wear resistance for hardfacing deposits." Trib. Int. vol. 42, pp. 745-749.
7. Choteborsky R, Hrabe P, Muller M and Jirka M (2008) "Abrasive wear of high chromium Fe-Cr-C hardfacing alloys." Res. Agr. Eng. Vol. 54, pp. 192-198.
8. Nadkarni, S. V. (1989) "Modern arc welding processes." Pub: oxford and ibh publishing co. pvt. Ltd. New delhi, india 7th edition.
9. Selvi S, Sankaran S.P and Srivastavan R (2008) "Comparative study of hardfacing of valve seat ring using MMAW process." Jour. Of mat. Proc. Tech. vol. 207, pp. 356-362