MICROSTRUCTURE AND EROSIVE PROPERTIES OF COBAL ARC /MILD STEEL SURFACE HARD COATING

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Abstract

The Cobal arc hardfaced Fe-based surface composite coating were fabricated by arc welding technique. Cobal arc electrodes were used for hardfacing on the mild steel substrate. The microstructure, phase structure and erosive properties were investigated by means of scanning electron microscopy and slurry erosion test machine. The results showed that Cobal arc significant improvement in erosive resistance between Cobal arc and conventional weld deposits. The Cobal arc hardfaced material showed better hardness and erosion properties comparable to conventional weld deposit mild steel material.

Introduction

Generally, ceramic materials exhibit superior erosion, abrasion and erosion resistance as compared to metals and alloys [1]. In other hand the weld deposition of ceramic hardfacing alloys is commonly employed in industry to increase the service life of components subject to abrasive erosion [2]. Preparation of hardfacing deposits requires the choice of the welding consumables and a welding procedure [3-4]. Fe base hardfacing deposits are typically applied to a wide variety of worn out surfaces of top bearing plate. These hardfacing deposits usually have one or two layers so that the effect of dilution is significant and cracking can occur as a result of welding contraction strain. This cracking does not necessarily significantly reduce the service erosion life of the component, and indeed is sometimes seen as an advantage in reducing residual stress level [5-7]. The objective of the preset work to increase the erosion resistance by covering MS plates with cobalc electrodes and optimization of hardfacing thickness to the economical feasibility at the end user. .

Experimental studies

Hardness and sand slurry tests were performed on five different thicknesses of Cobal arc iron weld hardfacing alloys, which were deposited by flux cored arc welding technique on a mild steel base plate, typically 10 mm thick. The chemical composition of Cobal arc and base metal is given in the Table. 1. The hardfacing of alloy were fabricated to produce a deposit thickness of 3, 4, 5 and 6 mm along with base metal were compared.

Table 1 Chemical composition of mild steel & Electrode

P	S	Si	C	Mn	Fe	
0.03	0.04	0.2	0.2	0.9	Balance	
V	Ni	Mn	Si	Mo	C	Cr
0.2	0.5	1.1	1.4	1.7	4.8	30.0

Hardfacing electrodes were deposited on the mild steel plate in the flat position by the shielded metal arc welding method. The welding parameters employed for depositing the layers on the mild steel specimen are open voltage of 50V and current of 125 A. The hardness test is carried out using Rockwell hardness tester according to ASTM E 18 and erosion test is carried out using slurry erosion tester. Erodent particles used were alumina of size 50-90 μm.

The erodent particles were dry sieved using sieve shaker to obtain the required fraction.

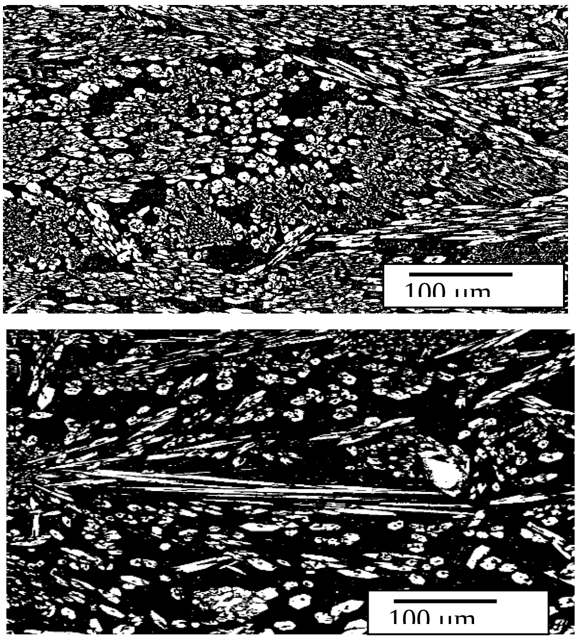

Fig.1. Microstructure of Cobal arc hardfacing a) 4 mm and b) 6 mm thick

Results and Discussion

The microstructure of Cobal arc clad layer consists of uniformly distributed and some needle-like carbide phases and eutectoid matrix with very fine carbide precipitates as shown in Fig. 1(a). But in other hand the microstructure of the Cobal arc clad layer in Fig. 1(b) shows a typical dendritic microstructure. Near the surface of the clad layer, equiaxed dendrite is generally observed, while in the center of the clad layer, the dendritic structure is found to be more columnar.

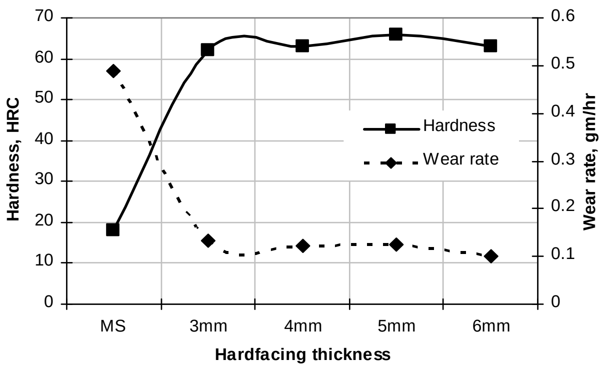

Fig.2 Hardness and erosion rate function of hardfacing thickness

The hardness and erosion rate were plotted as a function of thickness of hardfacing (MS- without coating). The relative erosion rate of Cobal arc layer under thickness condition is plotted in Fig. 2, compared with the as-weld conditions. For the mild steel specimens, the maximum erosion rate occurred, as expected for a ductile metal. The erosion rates of the four different thickness hardfacings show similar erosion rate and even the hardness of these material maintain almost similar values.

The hardness is not the only effect on erosion resistnace of material, but it definitely plays an influential role. Increasing the hardness by adding carbon on the material is highly desired. Although carbon will raise the brittleness, on the one hand, carbon can form carbide with a high hardness with another alloy to prevent abrasive erosion. On the other hand it can induce solid solution strength.

Fig. 3 shows SEM photograph of worn surface mild steel weld and Cobal arc hardfaced weld when eroded with alumina sand particles at a velocity of 50 m /min at normal impact.

The differential hardness of erodent’s with respect to carbides and matrix could very well explain the observed erosion rates of hardfacing alloys. For an erodent particle to be able to indent a target plastically its hardness should be about 1.2 times greater than that of the target [8]. The relative erosion resistance of weld hardfacing mild steel alloy was observed to be 10-12 times better as compared to that alloy weld.

Conclusion

A new Cobal arc hardfacing electrodes was developed by adding niobium as a carbide forming element and molybdenum as a matrix hardening agent and its erosion rate could be reduced to about 1/10th of that of conventional welding.

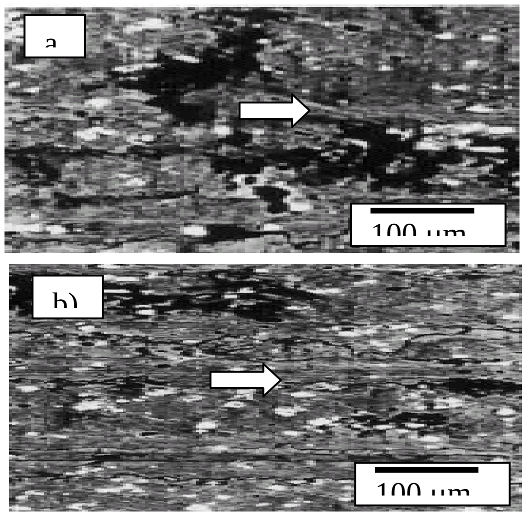

Fig. 3 The worn surface of specimen a) Base alloy & b) 5 mm thickness of hardfacing

References

1. Y.L.Su, K.Y.Chen, Journal of Erosion , Erosion 209 (1997), 160-17
2. Yilmaz Bayhan, Tribology International 39 (2006), 500-574
3. Jun-Ki Kim, Seon Jin Kim, Erosion 237 (2000), 217-222
4. A.N.J. Stevenson, I.M. Hutchings ; Erosion 186-187 (1995)
5. L. E. Svensson, B. Gretoft, B. Ulander, H. K. D. H. Bhandeshia ;Journal of Materials Science 21 (1986), 1015-1019
6. M.F. Buchely, J.C. Gutierrez, L.M. Leon and A. Toro Erosion Volume 259, Issues 1-6, Pages 52-61
7. S. Chatterjee, T.K.Pal ; Journal of Erosion , Erosion 255 (2003), 417-425
8. S.G. Sapate, A.V. Rama Rao ; Erosion 256 (2004) 774–786