SURFACE HARDENING ON EN31 BY 3LH HARD ELECTRODE TO ENHANCE WEAR RESISTANCE

Om Parkash*

Sachit Vardhan*

ABSTRACT

In this paper an effort is made to decrease the wear surface from material while using in industry and agricultural work by the mean of hardfacing. Hardfacing is a method in which a 3 LH hard electrode is deposite on surface of material by method of arc welding. In fields while ploughing the tiller blade are faced very high resistance from soil due to which there is wear on the surface of tiller blade. Due to abrasive wear of the surface of material, these steels require frequent repair, resulting in economic loss. The material tiller blade is EN-31.In this EN-31 is base material of substrate. It is found that with the help of hardfacing the wear resistance property of EN-31 is increase.

Keywords: *Wearresistance, Hardfacing, Hard Electrode, En31, SEM, EDS.*

* RIET, Phagwara, Punjab, India.

INTRODUCTION

Surface hardening is In this technique the coating is deposited by melting of the coating material onto the substrate by a gas flame, plasma arc or electric arc welding process. A large variety of materials that can be melted and cast can be deposited by this technique. During the welding process a portion of the substrate surface is melted and mixed together with the coating material in the fusion zone resulting in good bonding of the coating to the substrate. Welding is used in a variety of industrial applications requiring relatively thick, wear resistant coatings rangingfrom about **750** [µm] to a few millimetres [1]. Welding processes can be easily automated and are capable of depositing coatings on both small components of intricate shape and large flat

Surfaces.[2]

Wear Problems persisting in Tiller Blades

A tiller blade is an attachment for tractor which is designed to be used in site excavation. They come in a range of sizes and shapes. This tiller blade is used to plough the fields. This tiller blade has both sides effective. These have cutting edges on both sides. These are made of solid steel. The size of the tiller blade is near about 1 foot. Typically a material such as steel is used to make an tiller blade, because the attachment needs to be durable and very strong. Classically, both side are toothed, with the teeth acting to break up ground surface of fields as the teeth of tiller blade are dragged through it, loosening clay so that it will be easy for plough.

Tractors working in the soil generate functional forces which ploughing due to the compression to the soil, the soil resistance caused by plowing, the adhesive forces of the soil, and abrasive forces with the soil. The rate of attrition of tiller blades is depended on the frequency of the tractors operated. For example, a 100 hp tractor that was attached to a set of 2.4 m large rotary tiller needs 74 pieces of tiller blades. For a 15 ha sandy loam soil, the blades should be replaced every 50hrs leaving the iron dust of the worn-out tiller blade into the soil, which is detrimental to the environment in the long run. In addition the replacement of blades not only affects the efficiency of the job but also increases the cost of operation.[3]

Procedure for Experimentation In this experiment En-31 was choosen as test materials. In actual En-31 is material of tiller blade which is used in ploughing in fields. The tiller blade teeth have to bear heavy loads of ploughing soil and also subjected to abrasion wear due to the abrasive nature of soil particles when teeth acting to break up soil as teeth o tiller blade are dragged through it. So the teeth of tiller blade got damaged and wear tear takes place

Compostion of En-31

C%	MN %	SI %	P%	S%	CR %	CU %
0.51	**0.47**	**0.17**	**0.022**	**0.013**	**0.14**	**0.16**

Composition of 3LH Electrode

The reason for these electrodes being chosen was that they provide high resistance to wear.

Manual metal arc welding is used for hardfacing on the surface of substrate. For hardfacing of substrate the 3LH hardfacing electrode is used. It is made from alloy steel in order to increase the wear resistance on tiller blade surface and comparative wear tests were conducted in the field and laboratory. The reason for these electrodes being chosen was that they provide high resistance to wear. The structural and the mechanical properties of the material are much more severely affected by carbon than by all of the other alloying elements, and carbon in creases the strength of the weld metal. Manganese also increases the strength properties of the weld metal and provides deoxidation in the weld bath. Chromium is the alloying element participating in the composition of a variety of weld metals to improve the mechanical properties and to increase the corrosion resistance.

C	Cr	Mn	V	Si	Mo
0.50	6.00	0.80	0.35	0.60	0.50

In Pin On Disc test a pin is made with 8mm diameter and 30 mm long. Wear tests were performed on the cylindrical pin specimens that had flat surfaces in the contact regions and the rounded corner. The pin was held stationery against the counter face of a rotating disc made of En-32 steel at 100 mm track diameter. The wear test for coated as well as uncoated specimens was conducted at constant velocity i.e at 1ms^{-1} and at different loads i.e 50N, 60 N and 70 N. The track radii for the pins were kept at 40 mm. The speed of the rotation (478 rpm) of the disc for all the cases was so adjusted to keep the linear sliding velocity at a constant value of 1 m/s. Weight losses of each sample were measured after 5,5,10,10,20,40 minutes to determine the wear loss.The weight was measured by a micro balance accuracy of 10^{-3} g.f.

Experiment-1

Wear test data for Uncoated EN31, Applied Normal Load = 70N,

$v = 1ms^{-1}$, N = 480± 5 rpm, D = 40 mm, ρ = 0.00781 g/mm^3

Uncoated EN-31 @70 N						
Time(Min.)	**sliding distance**	**Initial weight(gms.)**	**Final weight (gms.)**	**Weight loss**	**Commulative wear rate (Bowden)**	**Commulative wear volume (mm3)**
5	300	11.477	11.476	0.001	6.09718E-12	0.01305208
5	600	11.476	11.474	0.002	6.9718E-12	0.02610417
10	1200	11.474	11.471	0.003	4.57289E-12	0.03915626
10	1800	11.471	11.465	0.006	6.09718E-12	0.07831252
20	3000	11.465	11.454	0.011	6.7069E-12	0.1435725
40	5400	11.454	11.435	0.019	6.43592E-12	0.24798965

Experiment-2

Wear test data for Hardfaced EN31, Applied Normal Load = 70N,

v = 1ms^{-1}, N = 480± 5 rpm, D = 40 mm, ρ = 0.00785 g/mm^3

3LH Coated EN-31@70 N						
Time(Min.)	**sliding distance**	**Initial weight(gms.)**	**Final weight (gms.)**	**Weight loss**	**Commulative wear rate (Bowden)**	**Commulative wear volume (mm3)**
5	300	12.784	12.783	0.001	6.0589E-12	0.01296905
5	600	12.783	12.782	0.001	3.0292E-12	0.01296905
10	1200	12.782	12.78	0.002	3.29202E-12	0.02593811
10	1800	12.78	12.776	0.004	4.03894E-12	0.05187623
20	3000	12.776	12.768	0.008	4.84672E-12	0.10375246
40	5400	12.768	12.756	0.012	4.03894E-12	0.1556287

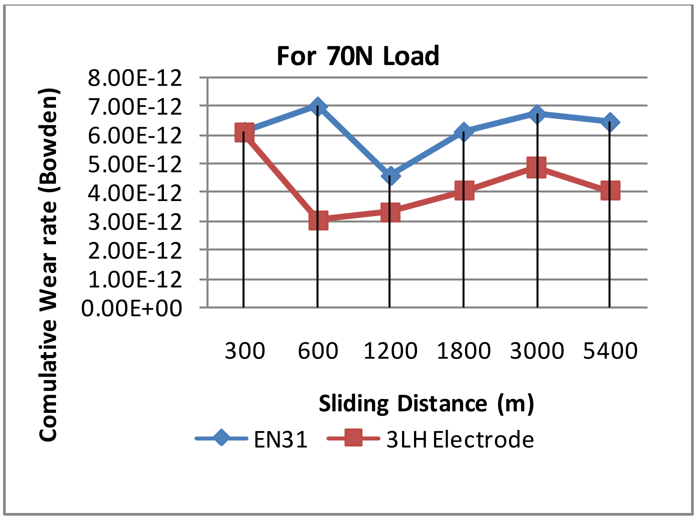
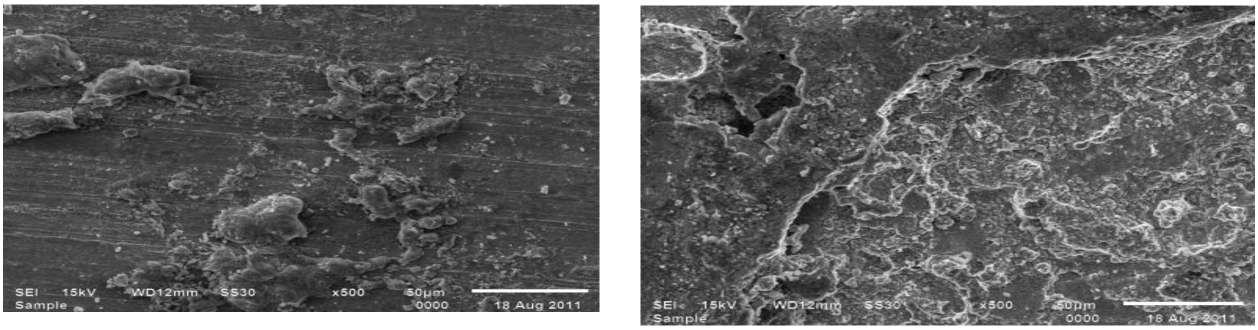


Fig.-Variation of cumulative wear rate for the uncoated EN31 the Hardfaced EN31 subjected to wear at normal load at 70N

Uncoated EN31



Hardfaced EN31

Fig.- SEM analysis of Un-Coated EN31 and Hardfaced EN31subjected to wear at a normal load of 70 N and sliding velocity of 1 m/sec. after a sliding distance of 5400 meters.

CONCLUSIONS

1 Increase in wear was observed with the increase in load.

2 The uncoated surfaces shows significant presence of wear scars along with peeling of its contact surfaces in the form of microchips. However, the coatings did not suffer any significant changes in their contact surfaces.

3. SEM analysis revealed splat morphology with distinct boundaries for hardfaced EN31, which is a characteristic feature of Hardfacing coating.
4. Hardfacing is the most versatile process to improve the life of the worn out component.
5. Hardfacing is the best chosen process these days for reducing the cost of replacement.
6. The hardfacing were found to be successful in keeping their surface contact with the substrate En-31 when subjected to wear tests.

REFERENCES

1. B. Bhushan and B.K. Gupta, Handbook of Tribology, Materials, Coatings and Surface Treatments, McGraw- Hill, Inc., 1991.
2. W.H. Roberts, Surface Engineering, Proc. Int. Tribology Conference, Melbourne, The Institution of Engineers, Australia, National Conference Publication No. 87/18.

3. Study on the characterstics of tiller blade shapes by spray welding hardening by jain song ju (Vol. 15, No. 3, pp. 219-231 (2007).