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Study of Abrasive Wear on Hard facing Alloy

P. B. Dhotrad[1*], D. G. Sondur[2] , M. D. Harlapur[3]
[1]*Department of Mechanical Engineering, Rural Engineering College, Hulkoti, 582205, Karnataka, India,
[2]Reaserch centre, Department Mechanical Engineering, Rural Engineering College, Hulkoti, 582205, Karnataka, India,
[3]Reaserch centre, Department Mechanical Engineering, Rural Engineering College, Hulkoti, 582205, Karnataka, India,
email:pbdhotrad1970@gmail.com, email: dgsondur_tce@yahoo.co.in, email: mdhrechulkoti@gmail.com

Abstract Hardfacing is one of the versatile techniques that can produce the hard and wear resistant surface layer of various metals and alloys on metallic substrate. It not only helps them withstand wear, but also helps to prevent corrosion and high temperature oxidation Hardfacing is particularly associated with the earth moving equipment, cement ovens and rock crushing and processing industries. In the present study, sample of 75x26x12 mm size were used for testing as per ASTMG65 standards. Specimens were ground using surface grinder to make the surface flat. Before the abrasive wear test all the specimens were cleaned with acetone and then weighed on an electronic balance with an accuracy of ± 0.001 gm. The three-body abrasive wear test were conducted using a dry sand/rubber wheel abrasion tester as per ASTM G65. The experiments were carried out for different loads 1, 2, 3 & 4 kgf on the load hanger. Carbon and chromium are the major elements which are used in hardfacing alloys. It is found that low percentage of carbon and high percentage of chromium will enhance wear resistance. Volumetric wear loss is maximum at higher load and at higher speed.

Keywords: Abrasive wear, Hardfacing, Volumetric wear loss

1. Introduction Surface modification techniques are used to enhance the service life of several engineering components. Surfacing is one of such techniques; where in a superior material is deposited over industrial components, by welding, to enhance surface characteristics. Material loss due to wear in various industries is significantly high. All these components face the problem of wear, before put into services, are given a surface hardening treatment or a protective coating with wear resistance materials of various types, depending upon its service conditions. After a period of service these components will get reduced in size because of wear and can no longer be used. So these components either have to be rebuilt or rejected. Rebuilding of these components to the required size by the welding can save the cost tremendously. Surfacing is a cost effective and proven method of depositing protective coating. The effect of surfacing on component life and performance will depend upon the surfacing material and the application process.

Hardfacing is one of the versatile techniques that can produce the hard and wear resistant surface layer of various metals and alloys on metallic substrate. It not only helps them withstand wear, but also helps to prevent corrosion and high temperature oxidation. Hardfacing is commonly employed method to improves surface properties of agricultural tools, components for mining operations, soil preparation equipments and others. An alloy is homogeneously deposited on the surface of a soft material (usually low or medium carbon steels) by welding with the purpose of increasing the hardness and wear resistance without significant loss in ductility and toughness of the substrate. The hardfacing technique as in the mean time grown into a well-accepted industrial technology. Due to continuous rise in the coat of materials has well as increased material requirements, the hardfacing has been into prominence in the last few decades.

1.1 Hardfacing Deposition Techniques

Welding is preferred for applications requiring dense relatively thick coatings (due to extremely deposition rates) with high bond strength. Welding coatings can be applied to substrate which can withstand high temperatures. Welding processes most commonly use the coating material in the rod or wire form. Thus materials that can be easily cast in rods or drawn into wire are commonly deposited. In Arc Welding the substrate and the coating material must be electrically conductive. Welding processes are most commonly used to deposit primarily various metals and alloys on metallic substrates. Hardfacing by arc welding is performed using all of the common processes and equipment. From the arc welding group, Manual Metal Arc Welding (MMAW), or stick welding, is the most common and versatile process.

2. Experimental Description Dry abrasion tester measures index of abrasive resistance to dry sand. The Dry Sand / Rubber Wheel Abrasion test involves abrading of test specimen with a grit of controlled size and composition. The test specimen is pressed against a rotating wheel, while a controlled flow of grit abrades test surface. The rotation of the wheel is along the sand flow. The duration of test and force applied is varied. Specimens are weighed before and after the test. Loss in mass is recorded. It is necessary to convert mass loss to volume loss. due to differences in density of materials. Index of abrasion is reported as loss of volume. Wheel rim is of chlorobutyle rubber with shore hardness of A60±2.

Specifications**:** Speed : 200 RPM , Wheel diameter :228.6 mm.

Test Load: 4.5 to 13.25 kgf, Instrumentation: 4 digit preset counter to stop test after preset revolution count. Power: 230V / 50Hz/ Single phase / 1.5 KVA

3. Methodology In the present study, sample of 75x26x12 mm size were used for testing as per ASTMG65 standards. Specimens were ground using surface grinder to make the surface flat. Before the abrasive wear test all the specimens were cleaned with acetone and then weighed on an electronic balance with an accuracy of ± 0.001 gm. The three-body abrasive wear test were conducted using a dry sand/rubber wheel abrasion tester as per ASTM G65.The sand particles of mesh size 50 to 80 are used as abrasives and they were angular in

Shape with sharp edges. The sand particles were sieved (size200–250 µm), cleaned and dried.

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Fig.1 test specimen

In this test, samples were held against a rotating rubber wheel under the constant flow of abrasives in between the sample and the rubber wheel under predetermined load. In the present study, silica sand was used as the abrasive. The abrasive particles of grade silica sand were angular in shape with sharp edges. The abrasive was fed at the contacting face between the rotating rubber wheel and the test sample. The tests were conducted at a rotational speed of 50 to 200 rpm. The flow rate of the abrasive was 370 g/min. The sample was cleaned with acetone and then dried. Its initial weight was determined in a high precision digital balance (0.001gm accuracy) before it was mounted in the sample holder. The abrasives were introduced between the test specimens and rotating abrasive wheel composed of chlorobutyl rubber tyre. The diameter of the rubber wheel used was228 mm. The test specimen was pressed against the rotating wheel at a specified force by means of lever arm while a controlled flow of abrasives abrades the test surface. The rotation of the abrasive wheel was such that its contacting face moves in the direction of sand flow. The pivot axis of the lever arm lies within a plane, which was approximately tangent to the rubber wheel surface and normal to the horizontal diameter along which the load was applied. At the end of a set test duration, the specimen was removed, thoroughly cleaned and again weighed (final weight). The difference in weight before and after abrasion was determined. Four tests were performed and the average values so obtained were used in this study. The experiments were carried out for different loads 1, 2, 3 & 4 kgf on the load hanger

4. Results and discussion The chemical composition of the hardfacing alloy is given in Table.1

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Table 1.Chemical composition for hardfacing alloy

Element	Carbon	Silicon	Manganese	Phosphorous	Sulphur	Chromium	Nickel	Molybdenum
%	0.0610	0.364	0.265	0.022	0.014	6.630	0.078	0.510

The following observations provided in Table-2 were made during the conduct of test on dry abrasion tester using specimen of Hardfacing material. The tests were conducted at constant speed and varying the loads.

Table-2

Sample No.	Speed RPM	Load in N	Time Minutes	Initial weight (gms)	Final weight (gms)	Weight Loss (gms)	Volumetric loss(mm^3) X 10^{-7}	Volumetric loss (mm^3) per unit
1-1	200	9.81	5	164.64	164.52	0.12	15.846	3.0769
1-2	200	19.62	5	179.087	178.927	0.16	20.5128	4.1025
1-3	200	29.43	5	179.499	179.319	0.18	23.0769	4.6153
1-4	200	39.24	5	169.942	169.732	0.21	26.923	5.3846
2-1	150	9.81	6.67	182.515	182.443	0.072	9.2307	1.3839
2-2	150	19.62	6.67	178.246	178.116	0.08	10.2564	1.5376
2-3	150	29.43	6.67	178.447	178.347	0.1	12.8205	1.9221
2-4	150	39.24	6.67	180.029	179.919	0.11	14.102	2.1143
3-1	100	9.81	10	171.741	171.683	0.058	7.4358	0.7453
3-2	100	19.62	10	179.541	179.919	0.062	7.948	0.7948
3-3	100	29.43	10	173.624	173.559	0.065	8.333	0.8333
3-4	100	39.24	10	180.571	180.501	0.07	8.9743	0.8974
4-1	50	9.81	20	180.973	180.925	0.048	6.1538	0.3076
4-2	50	19.62	20	176.094	176.043	0.051	6.5384	0.3269
4-3	50	29.43	20	175.556	175.5	0.056	7.1794	0.3589
4-4	50	39.24	20	175.78	175.72	0.061	7.5621	0.3872

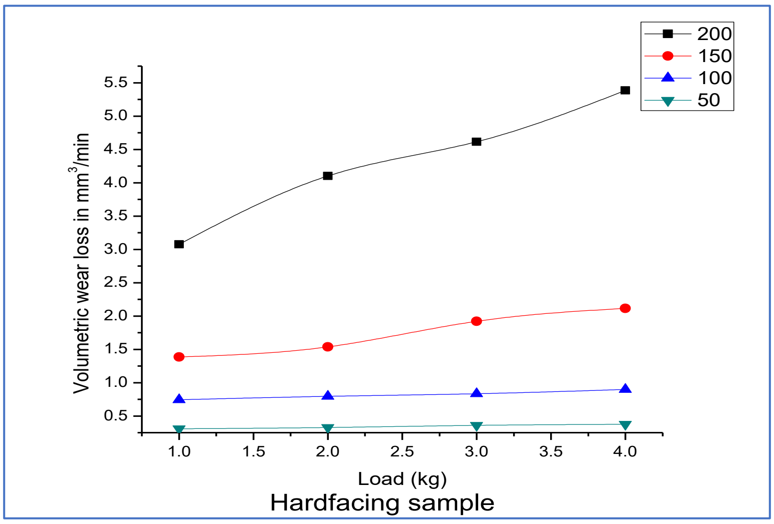

Fig.2 Load v/s volumetric wear loss

The graph shown in fig.-2 indicates the effect of speed on the volumetric wear loss of at constant load of 1,2,3 & 4 kgf on the load hanger .It is clear from the graph that as load increase volumetric wear loss also has increased. At 1kgf and 2kgf of load on the load hanger the change in volumetric wear loss is not that more even though the speed changes from 50 to 200 rpm but for 3kgf and 4kgf load there is greater change in volumetric wear loss when speed change from 50 to 200 rpm. Volumetric wear loss is maximum at 200 rpm for all loads.

5. Conclusion Carbon and chromium are the major elements which are used in hardfacing alloys. It is found that less percentage of carbon and high percentage of chromium will enhance wear resistance. volumetric wear loss is maximum at higher load and at higher speed..

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7. Referrences

1) R. Chotěborský1, P. Hrabě1, M. Müller1, J. Savková2, M. Jirka1
2) L.Xu and N.Kennon , “A Study of the Abrasive Wear of Carbon Steels”, Wear, Vol 148, pp 101-112, 1991.
3) Buchely, M. F., Gutierrez, J. C.,“The Effect of Microstructureon Abrasive Wear of Hardfacing Alloys”, Wear, Vol. 259, 2005, pp. 52–61.
4) T.K.Pal Study on wear behavior of Fe-Cr-Chardfacing Deposits, Metallurgical engg. Department, Jodhpur University, Calcutta-700032. Domian Kotech,

Hardfacing benefits maintenance and Repair welding, welding Journal, p.51-53, Nov 1992.
5) D.J. Kotecki, J.S. Ogborn, “Abrasion resistance of iron-based hardfacing alloys”, Weld, vol. 74 (8),pp 269–278. 1995.
6) D.K. Dwivedi, “Microstructure and abrasive wear behaviour of iron base hardfacing”, Mater. Sci. Technol, vol. 10, pp 1326–1330, 2004.
7) H.S. Avery, H.J. Chapin, “Hard-facing alloys of the chromium carbide type, Weld, 31 (10) (1952) 917–930.G.L.F. Powell, The microstructure of hypereutectic Cr-C hard surfacing deposits and its dependence on welding variables”, Aust.Weld. Res. 6, pp. 16–23, 1979.
8) R.C.D. Richardson, ‘The wear of metals by hard abrasives’, Wear, 1967. 10, pp. 291-309.