CHAPTER - 1

INTRODUCTION

1.1 Hardfacing - Introduction

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INTRODUCTION

1.1 HARDFACING - INTRODUCTION

“Hardfacing” or “Hardsurfacing”, is the application of depositing specialized alloys by means of a welding process to resist wear due to abrasion, impact, corrosion, high temperature etc. These alloys can be deposited on the component surface, especially at the areas which are subjected to wear through different welding processes such as Arc Welding, Oxy-Acetylene Welding (commonly called Gas Welding), TIG Welding etc. In a hard-faced part, the base material is selected to impart strength and economy, and the hard-facing material is selected for the specific wearing conditions to which the areas of the part will be subjected in service. Hardfacing can also be applied to a new component during its manufacture, or it can be used to re-establish a worn out surface [1]. Welding deposits can help to regain the components by enhancing their service life [2]. Welding plays a major role in fulfilling such requirements and also to efficiently deposit hardfacing alloys [3, 4].

Hard-facing extends the life of parts used in machinery or equipment very efficiently [3, 4]. Hardsurfacing of engineering components by welding processes is widely adopted among different surface treatment techniques available, as they require less time, help in effective deposition of extra material only in the worn out area, impart better strength and wear properties, equipment portability, cost effectiveness etc. Weld hard facing techniques are mainly used to improve the service life of engineering parts either by rebuilding in such a way that it produces a metallic/alloy wall section to resist wear, corrosion, etc. Hard surfacing products are
used in industries to reduce cost, extend equipment service life, reduce machine
downtime, reduce spare parts inventories etc.

Hard-facing can increase the service life of a component even more than ten times
[5]. In some cases, the cost of hard-facing may appear very expensive due to the cost
of hardfacing alloys used, but, if the costs involved in regular breakdowns to replace
worn out parts are also considered then cost is not only compensated but also is less
[5]. For instance, during Second World War, Gasoline engines were operated 24
hours a day to supply power to mobile oxygen plants. The unhardfaced exhaust valves
gave a life of 7 days where as the hard-faced valves gave a life of 14 days. The cost of
hard-faced valves was very high compared to unhardfaced valves. But replacing the
valves resulted in loss of oxygen production up to eight hours. Hard-faced valves are
definitely economical in such case. Due to result of such considerable savings in
machine down time and production costs this process has been adopted across many
industries [5]. Numerous electrodes for weld Hardfacing have been developed during
recent times [6]. Hardfacing also enhances the wear resistance [7, 8, 9], improves
even the ballistic capabilities [10], reduces wear in ploughshare [11, 12] etc.

Carbon Steels are widely used for producing enormous quantities of components /
parts of the machinery and equipments used in various industries such as Sugar Mills,
Earth Moving, Agriculture, Cement, Dredging, Construction, Rock Quarry / Mining,
Oil Drilling Service, Power Generation / Utilities, etc. These components / parts are
often subjected to wear and tear, cost of operation and maintenance, breakage leading
to increased down times for repair / replacement, wastage of money, material,
manpower, machine utilization etc.

Carbon steels are available in different rolled forms, and also in normalised or
hardened and tempered conditions, with the best properties developed by proper heat
treatment. Carbon is the main alloying constituent in Carbon steels. As the carbon content increases, the hardness and strength of the metal increases, but on the other hand it becomes less ductile and more difficult to weld. The table below enumerates some of the properties and applications of certain carbon steels.

**TABLE: 1.1 PROPERTIES OF CARBON STEELS**

<table>
<thead>
<tr>
<th>Carbon Steel type</th>
<th>Percentage of Carbon</th>
<th>Properties</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low carbon steels</td>
<td>&lt; 0.25%</td>
<td>Good formability, weldability, low cost, low strength</td>
<td>Machine parts, deep drawing parts, chain, pipe, wire, nails,</td>
</tr>
<tr>
<td>Medium carbon steels</td>
<td>0.25 to 0.55%</td>
<td>Good toughness, ductility, relatively good strength</td>
<td>Machine parts, rolls, axles, screws, cylinders, crankshafts,</td>
</tr>
<tr>
<td>High carbon steels</td>
<td>&gt; 0.55%</td>
<td>High strength, hardness, wear resistance, moderate ductility</td>
<td>Rolling mills, rope wire, screw drivers, hammers, band saws</td>
</tr>
<tr>
<td>Tool steels– sub group of high carbon steels</td>
<td>&gt; 0.8%</td>
<td>Very high strength, wear resistance, hardness, poor weldability, low ductility</td>
<td>Punches, shear blades, springs, milling cutters, knives, razors</td>
</tr>
</tbody>
</table>

Hence to improve the strength, wear characteristics, life etc these components / parts are subjected to various treatments such as:

- Organic and inorganic coatings like paints, laminates, cements, floor toppings, hot dippings, autocatalytic platings, furnace fusings, hardfacings, thermal sprayings, electroplatings etc.
- Heat treatments done by flame heating, induction heating etc to improve hardnesss.
• High energy treatments like laser glazing, ion implantation, and electron beam treatment.
• Diffusion processes like boronizing, Ferritic-nitrocarb, carburizing, nitriding, carbonitriding etc.
• Special treatments, like magnetic, sonic, cryo treatments, which not only affect the surfaces but also the bulk materials.

1.2 HARDFACING - ADVANTAGES

Hard surfacing products are widely used in engineering applications due to:

1. Reduced costs (25-75% of the cost of a replacement part).
2. Prolonged equipment life (30-300 times, depending upon application).
3. Reduced downtimes since the parts give more life and hence the number of shutdowns required to replace the parts are less.
4. Reduced inventory of spare parts since worn parts can be rebuilt.

Steel mill roll rebuilt  Worn rail end rebuilt  Bucket lip hard surfaced

PLATE: 1.1 EXAMPLES OF HARDFACED PARTS

1.3 HARDFACING - USES

The two basic areas where hard surfacing is used are:

1.3.1. To Retrieve Worn out Components

A total solution to metal wear never exists. Hence when components reach their limits of useful life, two options are possible - to replace the part or to retrieve the life.
To replace the part it should be available in stock or a new one has to be purchased. Expensive parts that require frequent replacement must always be kept in the stock. This increases the inventory costs and also increases administrative expenditure of the firm, apart from the actual cost of replacement.

Sometimes due to the unavailability of components, longer delays may take place thus increasing the downtime of equipment and also incur further loss of production time. On the other hand retrieving the part by Hard-facing techniques can be done at a lesser cost than that of replacement by a new part. This reduces the loss due to shortage of spares which further reduce inventory costs and administration costs there by eliminating the waiting time for replacement of components.

Parts retrieved by hardfacing are often better than new parts. Hardfaced components give longer life than those that are not hardfaced. Also retrieving the life by hardfacing in many cases can be done on site itself without the need for complete or even partial dismantling of the machine. Hardfacing worn out components can save lot of maintenance expenditure.

1.3.2 To Protect new parts from loss of metal

Hard surfacing can be used on new part also on the areas where it is most subjected to wear. Depositing a high alloy element offers much better wear resistance than that of the original base material. Such deposition also increases the working life of the part up to two or more times than that of a part which is not hard surfaced. The extra expense involved in Hardfacing can be compensated by using less expensive base material.
BIBLIOGRAPHY


