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Increasing The Wear Resistance Of EN 36 Feed Roller By Using Hard Facing Process

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Abstract:

One of the significant factors that control the life of the machine parts is the wear. Metal parts often fail to perform in the intended manner not only because of fracture, but also due to wear. In many cases, wear creates problem to the machine parts that result in loss of dimension and functionality of the machine. Reports on feed roller indicates that the life of the feed roller decrease to 3 to 4 months due to continuous working. This study aims to increase the life of the feed roller in drum chipper. This study also assumes that by improving the wear resistance property of the EN36 by means of hardfacing process the life of the feed roller may improve. Hardfacing is a method of increasing the hardness of the material by coating the hard electrode (MAGNA 402 and MAGNA 403) over the parent soft material by means of the shielded metal arc welding process. A weld coating is applied on the surface of the EN36 in order to increase the life of the feed roller. Results indicated that the life of the feed roller increased up to 5 to 6 months by implementing the hardfacing process. Thus, it is found that the life of the feed roller can be increased by improving the wear resistance property of the EN36 through hardfacing process.

Key words: *Hardfacing, Wear Resistance, EN 36; MAGNA 402; MAGNA 403*

1. Introduction

Weld hard facing techniques are employed mainly to extend or improve the service life of engineering components and to reduce their cost, either by rebuilding or by fabricating in such a way as to produce a composite wall section. Other desired properties obtained may include wear resistance, corrosion resistance, etc. In recent years, weld hardfacing processes have been developed rapidly and are now applied in numerous industries, e.g., chemical and fertilizer plants, nuclear and steam power plants, pressure vessels and agriculture machines, railways, and even in aircraft and missile components [1] .Hardfacing is primarily done to enhance the surface properties of the base metal (substrate) and hardfaced materials generally exhibit better wear, corrosion, and oxidation resistance than the base metal. Percentage dilution plays a major role in determining the properties of a hardfaced surface [2]. The weld deposition of hardfacing alloys is commonly employed in industry to increase the service life of components subjected to abrasive wear or to recover worn surfaces .In the hardfacing process an alloy is homogenously deposited onto the surface of a soft material (usually low or medium carbon steels) by welding. [3,4]

2. Wear problems occurring in feed roller

A feed roller is an attachment for drum chipper which is designed to feed the woods into the chipper unit. They come in a range of sizes and shapes. They are made up of medium carbon steel. The length of the feed roller is about 1045mm typically a material such as steel is used to make a feed roller, because the attachment needs to be durable and very strong. Basically, feed roller has number of teeth along its circumference radius, in order to feed the woods to the drum chipper with some grip.Function of the

drum chipper is to produce large number of chips which are relatively small in size. The production of the chips depends on the proper feeding of the woods in to the drum chipper unit. The proper feeding of the woods is usually done by the feed roller. The function of the feed roller is to feed the woods with proper gripping actions. Due to the continuous gripping action, the tooth on the surface of the feed roller starts to wear. The cause of the wear is categorized as environmental, mechanical, chemical and material. The major cause of wear is mechanical wear, due to the continuous vibration produced by the wooden logs while the feeding action takes place. Fig.1 shows the cause and effect diagram

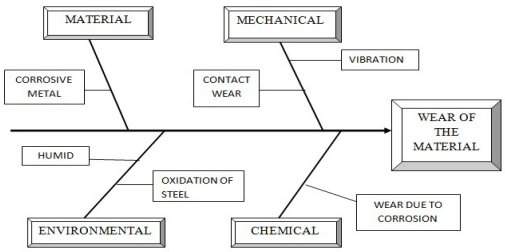

Fig. 1 Schematic representation of cause and effect diagram

3 Procedure for experimentation

In this experiment EN 36 was chosen as test material. The chemical composition and mechanical properties of the base material are presented in Table 1 and Table 2, respectively. In actual EN 36 is material of feed roller which is used in drum chipper unit. The feed roller teeth have to bear heavy vibration produced by the drum chipper unit while the feeding of wooden logs take place and also they are subjected to wear due to the chemical and environmental reactions takes place between them. So the teeth of feed roller got damaged and wear takes place.

Table 1 Chemical composition of EN 36 (mass fraction %)

C	Mn	Si	Ni	Fe
0.18	0.45	0.26	3.25	Balance

Table 2 Mechanical properties of EN 36

Tensile strength N/ mm^2	Elongation/%	Impact Izod J	Impact KCV J	Hardness HB
1100	15	40	35	341

3.1 Electrode used:

In this experiment MAGNA 402 and MAGNA 403 was chosen as electrode. Magna 403 resists the most extreme abrasion conceivable because of its super hard tough austenite matrix which contains finely dispersed carbides. Qualities of MAGNA 403, it is crack resistant and outer wears conventional hardfacing rods as much as 8 to1against abrasion and withstands high friction temperatures yet will not crack at low temperature of all types of high stress abrasion including erosion, scratching, grinding and gouging. Super high alloyed so that hardness is not dependent of cooling rate and easy to apply - has fast rate of deposition. The reason for these electrodes being chosen was that they provide high resistance to wear. For hardfacing of specimen the MAGNA 402 and MAGNA 403 hardfacing electrodes are used .It is made from alloy steel in order to increase the wear resistance on feed roller teeth surface and comparative hardness tests were conducted in the field and laboratory. After use of MAGNA 402 and MAGNA 403 hardfacing electrode, it was found that significantly different statistically and further suggested when the cost is taken into consideration. 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 increases 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. Fig.2 shows the new feed roller.

Fig. 2 New feed roller.

4 Hardfacing procedures

Metal arc welding is used for hardfacing on the surface of substrate. For hardfacing of substrate the MAGNA 402 and MAGNA 403 hardfacing electrodes are used. Fig. 3 shows the hardfacing procedure done on feed roller. Fig. 4 shows the hardfacing process carried out in worn out feed roller.

Fig.3 Hardfacing procedure.

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The feed roller consists of 21 set of teeth along its 1045mm length and 32 set of teeth along its 320 mm radius. The total number of teeth present in feed roller is 672 teeth. Due to the continuous working the teeth on the feed roller wear out, because of the mechanical, environmental, chemical and material factors. MAGNA 402 and MAGNA 403 electrodes are used to increase the wear resistance of the EN 36 feed roller. At first, MAGNA 402 electrode is used to build up the material in the worn out tooth, in order to achieve the standard dimension of the teeth. Secondly, MAGNA 403 electrode is coated over the surface of the MAGNA 402. Normally the hardness of the MAGNA 403 electrode is higher than the hardness of the MAGNA 402 electrode. These procedures are carried out in order increase the hardness at the edge of the teeth because only the edge of the teeth start to wear out first and at the same time cost is taken into consideration. Fig. 5 shows the welded feed roller.

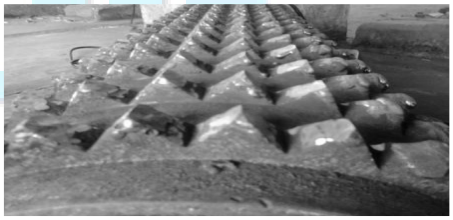

Fig. 5 shows the welded feed roller.

The following table 3 and 4 shows the height and width of the teeth for new feed roller, worn out feed roller and hardfaced feed roller.

Table 3 Height of teeth new, worn out and hard faced feed roller

s.no	Fresh teeth	Worn out teeth	Hard faced teeth
1	30.14	27.90	30.10
2	29.81	27.45	29.8
3	29.95	27.52	29.76
4	29.92	27.78	29.81

Table 4 Width of teeth new, worn out and hard faced feed roller

s.no	Fresh teeth	Worn out teeth	Hard faced teeth
1	20.18	18.09	20.10
2	20.19	18.39	20.14
3	20.20	18.21	20.10
4	20.20	18.11	20.40

After the successful completion of grinding operation, the edge of the hardfaced teeth of the feed roller is tested through Rockwell hardness tester in order to find out the hardness value between the feed rollers. Table 5 shows the hardness comparison between the feed rollers.

Table 4 Hardness comparison between the feed rollers

s.no	Item	Hardness value(HRC)
1	New feed roller	35
2	Worn-out feed roller	32
3	Hard faced feed roller	55

5 Conclusions

1) It has been proved that by increasing hardness valve, the wear resistant property of the feed roller can be improved by hardfacing process.

2) Thus, it is found that the life of the feed roller can be increased by improving the wear resistance property of the EN36 feed roller through hardfacing process.

3) Hardfacing is the most versatile process to improve the life of the worn out component.

4) Hardfacing is the best chosen process these days for reducing the cost of replacement.

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