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Wear Analysis on 410 Stainless Steel Material by Hardening Process

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Abstract— *The wear conduct of 410 stainless steel has been examined under a dry sliding contact at consistent load. It was found that hardening procedure was successful in enhancing the wear conduct of stainless steel material, advancing the property of pliability. A low temperature hardening has been completed for three distinct examples at a hour, a hour and a half, 120 minutes. Untreated stainless steel was utilized as a kind of perspective material and experienced wear test for comparison with different hardening samples. The hardening samples uncover that hard layers that are shaped which enhances the surface hardness. Small scale hardness estimations uncovered a critical increment in hardness after treatment. The layers were portrayed by optical magnifying lens and checking electron magnifying lens investigation.*

Keywords— Hardening, stainless steel, wear, hardness.

I. INTRODUCTION

Hardening is done to get high surface hardness, increment wear resistance, enhance exhaustion life, and enhance consumption resistance, high dimensional solidness. Stainless steel is utilized in view of their high imperviousness to oxidation and consumption resistance. They discover applications broadly utilized as a part of atomic reactors, car parts like cam shafts, cam adherents, injectors, bio restorative inserts, synthetic and nourishment ventures. Of the different warmth treatment methods accessible, hardening offers the advantages of high dimensional strength. The elevated amounts of substrate add to incredible consumption resistance in stainless steel materials.

Decided for this exploration work, on the premise of their application and business accessibility, hardening produces more uniform metallurgical framed case profundity. The profundity and nature of case would be controlled by the synthetic arrangement under which extinguishing is finished. Solidifying is completed by taking steel to austenizing temperature and extinguishing it all of a sudden. The case solidifying medium utilized as a part of this strategy is oil extinguishing.

II. MATERIALS USED

The material used in the present work was 410 stainless steel material. The specimens were prepared in following forms. (i) Polished cylindrical disc specimen measuring 50 mm diameter and 10 mm height were used. (ii) Pin specimen with diameter 8 mm and height 30 mm were used with taper edged surface.

III. TREATMENTS

Prior to all treatments, the specimens were cleaned ultrasonically, rinsed and dried, with care taken to avoid finger contact. Before hardening, the specimens were sand blasted, pickled in 15% sulphuric acid for 20 minutes. The samples were degreased using acetone and preheated in an air circulated furnace for 15 minutes. The samples were hardened for three different temperatures at 60 minutes, 90 minutes, 120 minutes respectively.

IV. WEAR MEASUREMENTS

Wear tests were carried out on a pin on disc machine. A stationery pin was mounted horizontally against a vertically rotating disc. The disc is rotated at a constant speed of 1000 rpm at a constant load of 2 Kg, which was applied continuously for a fixed period of 2 minutes under dry conditions. Wear test were conducted and the samples were replaced one by one. The weights of the specimens were measured using a standard caliberometer. The difference between the specimen before and after testing gives the wear loss.

V. RESULTS AND DISCUSSIONS

The hardened specimen results were compared with the untreated specimen and it was found that, in hardened specimen, the mixture of cementite and ferrite were precipitated on the surface, to improve the hardness of material. The wear rate of untreated specimen is specified to

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be lower that of hardened material. Hence good surface hardness is obtained. Low temperature hardening results in good wear performance to relative case depth, which improves wear resistance. The ductility of material is promoted in 410 stainless steel material. So by the process of re - heat treatment of 410 stainless steel material, this material can also be used for higher applications like power plant turbine blades, nuclear reactors, marine applications where components are subjected to sea water, automobile applications.

5.1 Optical Microscope Results

Fig.1: Untreated Specimen

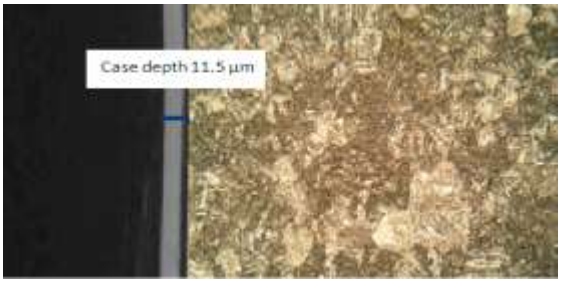

Fig.2: Hardening for 1 hour 11.5 microns

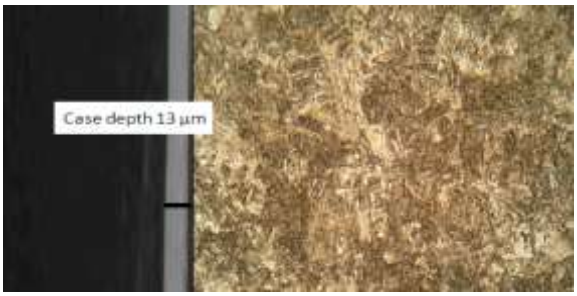

Fig.3: Hardening for 1.5 hour 13 microns

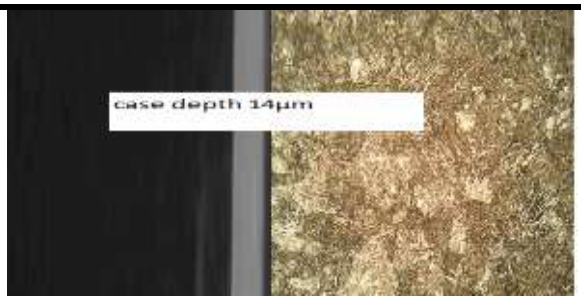

Fig.4: Hardening for 2 hour 14 microns

From the figure 1,2,3,4 it is seen that, as the time of hardening increases, case depth also increases. Therefore the case depth is increased from 11.5 to 14 microns specimens respectively. The results are compared with untreated specimen. Hence hardened specimen done for 120 minutes improves its wear resistance causing low wear loss and wear rate.

5.2 Scanning Electron Microscope Results

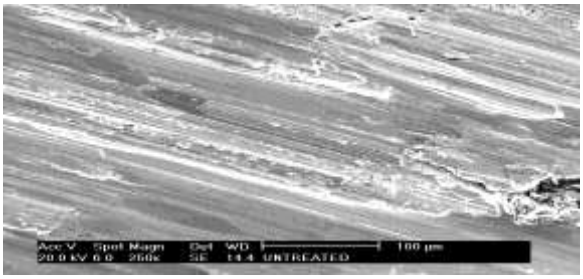

Fig.5: Untreated Specimen SEM Image

Fig.6: SEM Image for 1 hour hardened specimen

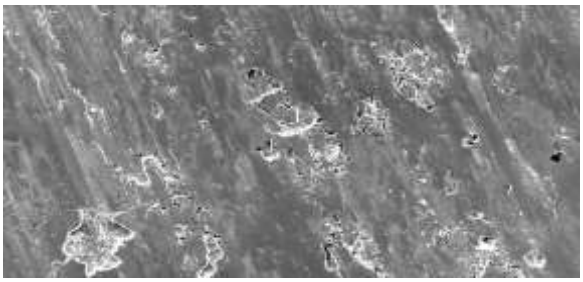

Fig.7: SEM Image for 1.5 hour hardened specimen

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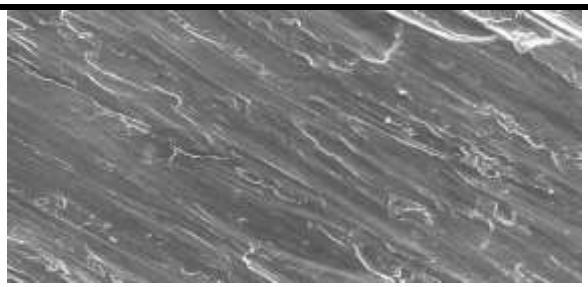

Fig.8: SEM Image for 2 hour hardened specimen

From the figure 5,6,7,8 the specimens were compared with untreated specimen. The peel of material is very high in untreated specimen. The wear of material is high. As the case depth increases, wear loss of the material decreases. In hardened specimen for 120 minutes, the wear loss of material is less when compared to other hardened specimens, which improves its wear resistance.

VI. CONCLUSION

The result of this work confirms that, hardening process has effectively improved its wear resistance. As the time for treatment increases, the case depth also increases. From the wear studies, it is observed that hardened specimen for 120 minutes has a very good wear resistance. It is showed that, as the time of treatment increases, weight loss decreases, hence the life of the material is increased.

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