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IMPROVEMENT THE MECHANICAL WEAR RESISTANCE OF METAL KNIFE USED IN HARVESTER MACHINE

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ABSTRACT
The fast wearing components of agricultural machinery requires replacement which effect on the work as well as the quality of equipment. A special verification of possible heat treatment (H.T) carburizing and mechanical treatment (M.T) shoot peening of steel were Responded applied on carbon steel type (AISI 1030), have been done with view of conditions of real mechanical abrasive wear of harvester machine. These techniques are found promising to enhancement the quality of harvester knife, which is manufacturing in Iraq. Mechanical wear resistance is very important in many applications and in most cases it is directly correlated with metallurgical and hardness of materials surface. After both surface treatment (H.T and M.T) were applied the mechanical wear by using harvest process to determine the (actual wear rate) of the specimens depending on weight loss method. The results were found as; (1) the wear resistance Increases with increase hardness with varying surface treatment as follows; 35HRC, 47HRC, 55 HRC and 58 HRC for specimen's as-received, (2) increase wear resistance with increase shoot peening time at 30 min to 45 min respectively: (3) We found the fine of grain size structure in case of (M.T) shoot peening treatment. (4) The surface wear appearance were presented on the worn surfaces of the steels depended on type of treatment surface.

KEYWORDS: Microstructures, wear resistance, Harvester, carburizing and shoot peening.

INTRODUCTION
Abrasive wear has been emerged as a serious problem in the field of engineering particularly for the metallic surface of working components in machines. Important shortening of service life by abrasive wear appears on parts of machines working in soil. Alloy steel is mainly used to overcome abrasive wear-related problems due to their high strength and toughness. Various efforts are going on to reduce abrasive wear rate by changing the chemical composition, microstructure, and mechanical properties. Many researchers suggested heat treatment process as a suitable technique for obtaining combination of properties to resist the abrasive wear. The martensitic phase is usually considered for improved wear resistance of steel. Chahar, VK, Tiwari, GS [1], studies the abrasive wear of the soil-engineering components such as reversible shovel are usually fitted on cultivator as soil working tool for many purposes such as loosen the soil, destroy weeds and to mix soil particles. En 45 springs steel material is used in the manufacturing of reversible shovel was cause of concern as cause's damage to material and found increases the cost and time lost in replacing worn parts of agriculture machinery. Cryogenics is neither a substitute for heat treatment not a coating but an affecting factor of the entire volume of the material. Bressan et al [2], studies the several techniques developed over the year to increase the abrasive wear resistance of soil tools in order to improve the efficiency and agricultural equipments for the help of electro deposition, vapor deposition, thermal spraying surface, hard facing, cladding, ion implantation and heat treatment. They found the microstructure of high chro¬mium after weld depositing consists of hypoeutectic, eutectic or hypereutectic micro¬structure. Das et al [3], studies the effect of different heat treatment process on abrasive wear behavior of medium carbon alloy steel for enhancing the service life of soil working components of agricultural machineries. Finds out that increase of the wear resistance depends on the way in which the metal is being hardened (alloying, heat treatment or work-hardening) and that in some cases wear resistance decrease with increase of hardness.

The aim of the research is to study the effect of surface heat treatment techniques (carburizing) and shoot peening with different times on the microstructure, hardness and abrasive wear resistance of steel knife type (AISI 1030) compared with knife which is no heat treated. Also study the effect of surfacing treated on the wear appearance (worn surfaces) of the steels which were used in this work.

EXPERIMENTAL PROCEDURE

Materials

The chemical composition of specimen were preparation for abrasion wear, as show in table1.

Table 1. Chemical Composition of Steel Blade (AISI 1030)

Element	C%	Si%	Mn%	P%	S%	Cr%	Fe%
wt%	0.321	0.252	0.442	0.018	0.047	0.081	Rem

Carburizing Heat Treatments Process

Three specimens of materials which applied heat treatment processing were carried out in furnace model F62730, with different heat treatment. The spacemen (A) which applied Carburizing process was formation from carbon powder from wood with barium carbonate around the spacemen, 1cm depth of carbon powder. Heat socking was 900C^{O} in 60 min, and cooling in engine oil media.

Shot peening process

The shot peening processes by using ball steel with a hardness of 55 HRC and a nominal diameter of 2.75 mm to shot the specimens at different time 20 and 30 min. The angle of nozzle inclination was shifted by 10° with regard to the vertical axis [6]. A constant specimen distance from the nozzle of around 100 mm was maintained. The shot peening device used was shot tumbles control model STB – OB machine No. 03008 05 type. Fig. 1 shows the shot peening device with shot balls used.

Figure 1: Shows the shot peening device with shot balls used.

Specimen Preparation

The metallographic examination of the specimen's preparation involves the following steps:-

1. The specimens are cut to dimensions as, 10 mm lengths, 10mm widths, and 6mm thicknesses.
2. All specimens are ground with SiC emery grinding and polished by using emery paper of grit 80, 120, 600, 800, and 1000. Slurry of Al_2O_3 particles of size of 5μm and 0.5 μm were used for polishing process, with a special cloth.
3. Etching process was carried out using the solution consisting of 2% nitric acid (HNO_3) and 98% alcohol and followed by dried in air.
4. The optical microscopy type RGH, with digital camera connected to the computer is used optical microscope model (C 0.46X) TVLENS. All The etched specimens were studies using optical microscope. J-Image program was used to measurements of grain size.

Abrasive Wear Test

Actual abrasion wear test of steel knife materials were carried to study the effect of heat treatments technique on wear properties of alloy steel type (AISI 1030). Flat specimen with dimension 67mm length, 76mm width, and 2mm thickness was prepared for abrasion test as shown in Fig.2. The experimental wear resistance was carried out with harvest of wheat crop. The agriculture equipment carried out with tractate machine type (class - Germany). Fig3; has shown the arrangement of specimen knife with different surface treatment with used actual experimental process with the wheat crop harvest. Each specimen was weighed on a weighing machine (sensitive balance) with a least count 0.001gm before and after the wear test that were conducted for all the specimen of various types' treatment. Three times harvest as 40hr, 60hr and 80hr applied for all spacemen with different surface treated carburizing and and shoot peening compared with sample which no treated (as received). The mathematical model is weight losses calculated as eq. (1)

$\Delta W = W1 - W2$ (1) [4, 5]

Where:

ΔW: variation in mass losses (gm), W1: weight of the specimen before the test (gm), and W2: weight of the specimen after the test (gm)

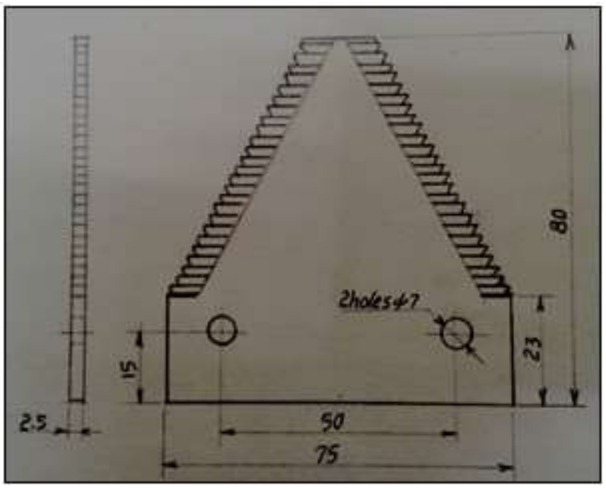

Figure 2: Design drawing of knife dimension was used in experimental.

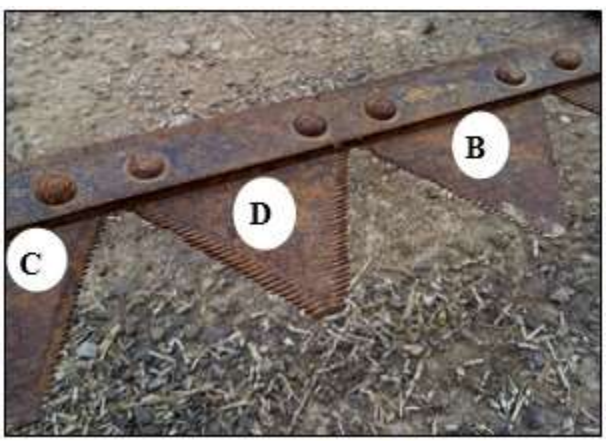

Figure 3: Shows the knifes assembly in harvest machine.

RESULTS AND DISCUSSIONS

Microstructure Evaluation

Fig. 4; show the structure was consists of martensitic, and retained austenite with large grain size (19, 11) µm. These results are good agreements with result of [6]. The carburizing surface heat treatment on the microstructure in

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specimen (B) was consisting of martensitic structures, and some carbide with grain size (15.34) µm, are smaller in size thane sample A. The results were good agreements with results of [7]. The shoot penning surface treatment in specimen (C) with different times, that effects of mechanical treatment on microstructure was consist of residual stress structures with small amount of retained austenite. The grains are smallest grain size (12.31) µm than sample B and A. the result was good agreements with results of [8].

A: As –received

B: Carburizing surface heat treatment

C: Shot penning at, 45min

Figure 4: Optical micrographs of specimens A (as received), B and C carburizing and shoot penning treated respectively.

Hardness Test

Table 2; Shows the relationship between hardness with different surface treatment. The hardness of the sample, due to transformation of austenite to martensite and also finer shape of the laths in the microstructure in case of H.T. The media quenching effects to change in Rockwell hardness number after most of the austenite is transformed. It is clear from the table that the effect of varies times in shoot penning treatment was lead to increase the hardness number from 55 HRC to 58HRC), result due to compression stress, carburizing, and shot peening at 30 and 45 min. Surface heat and mechanical treatment were effects to reduce the grain size of microstructure. That's effect to decreases in losses weights, because is owing to lath martensite forming with precipitate some carbides. The hardness was increase result from consist of fine grain size of martensite structure. These results are a good agreement with results of [9].

Table 2. Hardness of Samples at Different Surface Treatment

Specimens	S. treatment	Hardness (HRC)
A	As-received	35
B	Carburizing	47
C	Shoot penning 30min	55
D	Shoot penning 45min	58

Mass Loss

Fig. 3; Shows the typical variation of specific mass as function of the testing time (30hr) for knife of steel (AISI 1030) with different surface treatment. It's very clear when increase hardness that effect to decrease in mass losses, that's means increase wear resistance. Cooling media are effects on the hardness value and that's effects on wear resistance result from increase hardness due to refine the structure of grain size. The best specimen where have a good wear resistance low losses mass in materials as specimen (c) because of compression stress, that effect to increase in hardness , and the results was a good agreement with results of [10]. Fig. 4 shows the worn surfaces with quenching media decrease the pit and scratch with increase surface hardness.

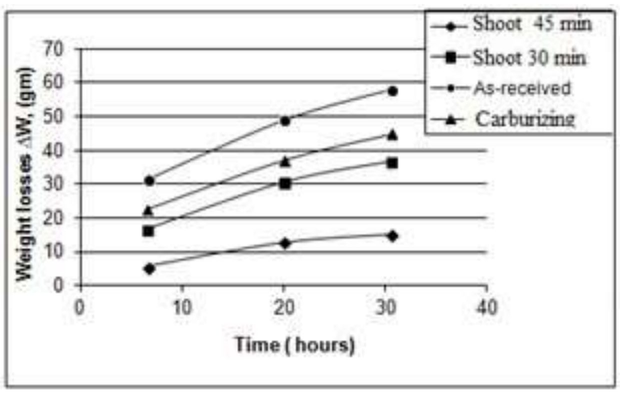

Figure 3: Variation of specific mass loss of specimens as function of heat treatment with testing time.

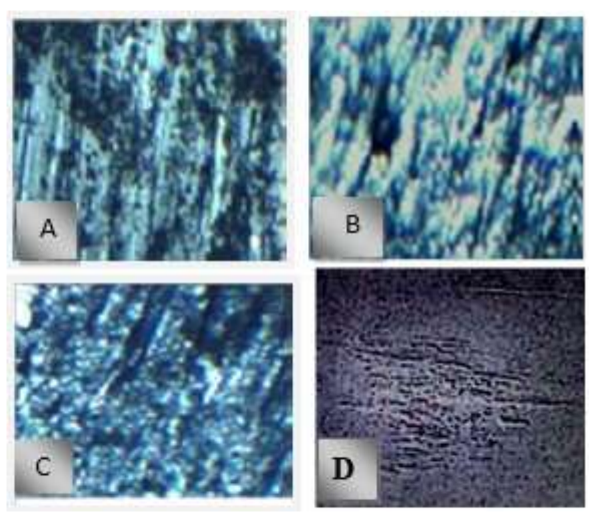

Figure 4: Topography of with different surface treated : A. carburizing heat treatment, B. Shoot penning, 30min , C. Shot penning 45min, and D, AS-received. (300X).

CONCLUSION

1. Surface heat treatment was effects to increase the hardness and lead to increase the abrasive wear resistance.
2. Increases wear resistance result from formed the Martensitic and retained austenite in microstructure steel as a function of phase transformation in H.T.
3. Fine grain size structure of shoot peening treatment lead to increase wear resistance compared with H.T.
4. Wear was presented on the worn surfaces as a function of hardness.

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