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EFFECT OF HARDENING ON IMPACT STRENGTH FOR THE KNIFE COMBINATION HARVESTER

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Abstract - Heat treatment is the process of heating and cooling metals to change the physical, and sometimes chemical, properties of steel. In the fastening industry, steel is subjected to heat treatment to improve its hardness, strength, toughness, ductility and corrosion resistance, which improves performance when forming, welding or conducting. In this research, the harvester knifes was hardened in different solutions in order to increase the resistance to the impact loads that affect these knifes during the harvesting process.

The results of the hardening and comparison with the model before hardening indicate that the highest increase in the hardness value is at the point near the teeth and the highest percentage was in the case of hardening with water, and the highest percentage increase in hardness in the center of the knife was when hardening with oil, but the highest percentage increase in hardness at the end of the knife It was when hardening with water, which is a very small increase. In general, the results indicate that the hardness increases near the teeth and decreases significantly when moving away from the teeth.

Index Terms - hardness; fatigue; heat treatment; grain structure; quenching; carbonization.

I. INTRODUCTION

There are many kinds of cutting devices in machinery and food processing equipment. The quality of the cutting component depends on the material characteristics and its production method [1]. Tempering is a group of different technologies and methods that are used to increase the hardness of a metal or alloy. Toughness is the material's resistance to being scratched, torn or penetrated by the harder material. The concept of hardness is a relative one, as there are no natural or synthetic materials having absolute hardness.

The hardness of non-metallic materials is estimated by comparing it with the hardness of some well-known natural stones or crystals such as steatite, feldspar, topaz, quartz, diamonds, etc., and it is classified in ten degrees, the lowest of which is statute (1) and the highest is diamond (10), which is the hardest material known in nature [2].

As for the hardness of the mineral and mineral alloys, it is measured by many means and methods, which are different in principle, the most important and most used methods are: Brunel, Vickers and Rockwell.

These include those technologies that increase the hardness of the entire section of the metal piece, and it is one of the most important comprehensive methods of hardening that is performed on iron alloys containing a percentage of coal not exceeding 2%, which is called steel. Steel is called coal steel when it is not exposed to metallic additives, as it contains small percentages of some elements such as manganese and silicon (silicon) and other impurities, which are often associated with the metals from which iron is extracted. It is called alloy steel when a metallic element or other metallic elements are intentionally added to it in order to give it a certain special, or a group of mechanical, physical or chemical properties [3-4].

The results of much research in this area have been that the effects of mechanical treatment on the microstructure consist of residual stress structures with a small amount of austenite trapped [5-11].

The aim of this study is to know the increase in hardness when hardening with different solutions.

II. SPECIFICATIONS OF HARVESTER SCYTHE KNIFE

Figure 1 Show the dimensions of a standard harvester sickle knife and figure 2. Appearance shapes of harvester sickle knife teeth: A- Soft tooth; B- Medium rough tooth; C- Rough tooth.

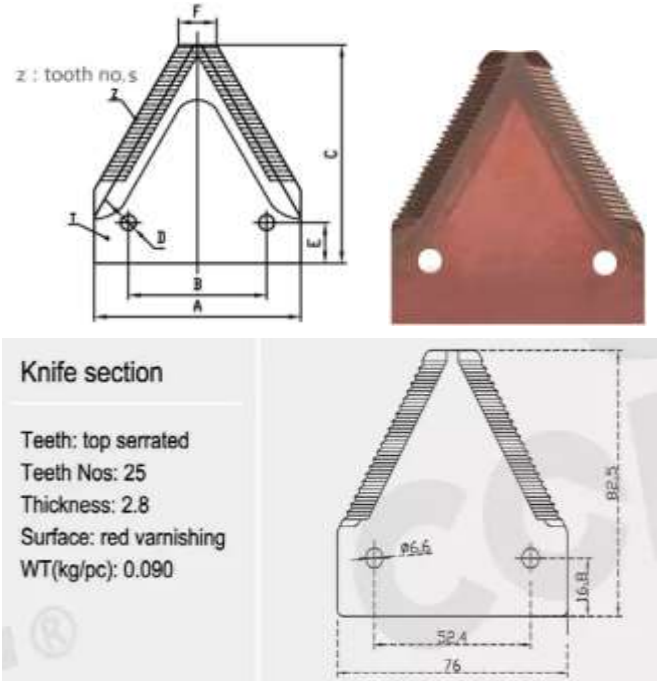

Figure 1 Dimensions of a standard harvester sickle knife.

A. B. C.

Figure 2 Shapes of harvester sickle knife teeth: A- Soft tooth; B- Medium rough tooth; C- Rough tooth.

III. HEAT TREATMENT FOR SICKLE CUTTING SHAFTS IN HARVESTER

After confirming the chemical composition of the test samples and ensuring that they comply with the semi-metal fabrication standard specifications. Before the heat treatment, microscopic detection, hardness and shock tests were performed with pre-calibrated equipment, after which the samples were subjected to heat treatment, by exposing the samples to different temperatures and time depending on the type of heat treatment (hardening and revision). Then the samples were cooled using six different media (air - water - oil - water for a period of time, then oil - milk - animal blood) in order to monitor the effect of these media on the microstructure as well as the mechanical properties (hardness and impact).

Initially, before processing, we put the cap in a hot water bath with a detergent to remove the grease and dirt stuck to the cover, to prevent the sleeve surfaces from peeling off when performing the heat treatment process.

The heat treatment process is known as the processes of heating the metal to a certain temperature and fixing it at this temperature for a certain period, then cooling it at a special cooling rate, and it is noticed that the degree of heating takes place without reaching a certain temperature. The melting point of the metal. Various heat treatment processes play an important role in improving the microstructure of engineering materials, including steel.

IV. EXPERMINTAL WORK

A. Tempering Process

The samples were placed inside the oven and turned on to the required temperature for the heat treatment and the appropriate time and temperature were fixed for this process.

Where the appropriate time for the hardening process for all test samples is the thickness of the eye in millimeters multiplied by (2) minutes, that is, approximately ten minutes. The samples are placed inside the oven with a temperature of (850) degrees Celsius, at the end of the heating period and placed as follows: -

1. The first sample was placed outside the oven to cool in the air.
2. The second sample was placed in water and thrown directly into the basin of cold water at room temperature in less time
3. From five seconds, stirring by a rotating stir for a minute and left to cool in the water tank.
4. The third sample was placed in the oil and thrown directly into the oil sump in less than five seconds with
5. Stirring the oil pan, rotating it for a minute, then leaving it to cool in the oil.
6. The fourth eye was placed in (water, then oil) and thrown directly into the water basin in a time of less than five seconds with flipping in the water basin, rotating for a minute and for a period of four seconds according to the thickness of the cutting knife (fish in mm multiplied by one second) and then taking it out from the water basin directly Throwing it into the oil basin with stirring and turning it over for a minute and then left to cool in the oil pan.
7. The fifth sample was placed in the milk and thrown directly into the milk tank in a time of less than five seconds, with stirring in the milk tank, rotating for a minute and then left to cool in the milk.
8. The sixth sample was placed in the blood and thrown directly into the blood pool in a time of less than five seconds, with stirring in the blood pool, rotating for a minute and then left to cool in the blood.

After the curing process, the operations required to prepare the samples for testing were carried out including grinding, polishing, finishing and cleaning of the surfaces from impurities to ensure accurate reading.

Where the hardness was then tested using a Rockwell hardness tester and according to the load installed in the table below, and the readings for that were taken from three different areas of one sample, as shown in Table (1) for hardening.

B. Review Process (Normalization)

The need for heat treatment and heat treatment, to be processed in a timely manner. During the review period, there are samples from the test samples. The temperature of the oven is tested in ten minutes. The temperature of the oven is placed inside the oven at a temperature of (200) degrees Celsius. At the end of the heating period, the air inside the oven is divided.

After completing the election Table (1) for the review.

C. Areas Where Hardness Was Measured

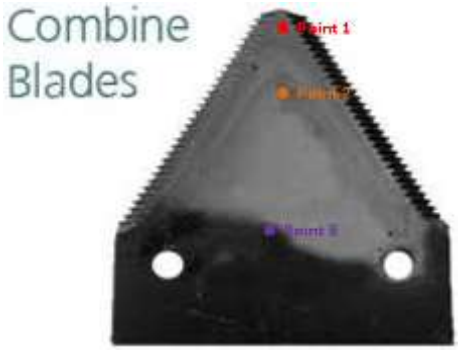

Figure (4) shows the areas in which the hardness was measured.

Figure **4** Hardness measurement points**.**

TABLE 1

SHOWN PERCENTAGES OF THE CORE (HRC) AFTER TEMPERING.

NO.	Reading number	Specimens without processing	Water treatment	Increase in hardness %	treatment oil	Increase in hardness %	Treating water with oil	Increase in hardness %	Blood treatment	Increase in hardness %	Milk treatment	Increase in hardness %	Air treatment	Increase in hardness %
1	1	54	71	**31.48**	68	**25.93**	69	**27.78**	63	**16.67**	67	**24.07**	66	**22.22**
	2	53	60	**13.21**	59	**11.32**	60	**13.21**	55	**3.77**	56	**5.66**	55	**3.77**
	3	53	56	**5.66**	54	**1.89**	56	**5.66**	54	**1.89**	53	**0.00**	53	**0.00**
2	1	53	70	**32.08**	69	**30.19**	65	**22.64**	64	**20.75**	66	**24.53**	65	**22.64**
	2	53	56	**5.66**	58	**9.43**	54	**1.89**	54	**1.89**	56	**5.66**	56	**5.66**
	3	53	55	**3.77**	54	**1.89**	52	**1.89**	54	**1.89**	54	**1.89**	54	**1.89**

TABLE 2

TABLE OF HRC RATIOS AFTER TEMPERING.

Reading number	Specimens without processing	Increase in hardness when hardening with air 100%		Increase in hardness %	Increase in hardness when hardening with water 100%		Increase in hardness %	Increase in hardness when hardening with oil 100%		Increase in hardness %	Increase in hardness when hardening with oil and water 100%		Increase in hardness %	Increase in hardness when hardening with blood 100%		Increase in hardness %	Increase in hardness when hardening with milk 100%		Increase in hardness %
		Model-1	Model-2		Model-1	Model-2		Model-1	Model-2		Model-1	Model-2		Model-1	Model-2		Model-1	Model-2	
1	54	22.64	22.22	**22.43**	32.08	31.48	**31.78**	30.19	25.93	**28.06**	22.64	27.78	**25.21**	20.75	16.67	**18.71**	24.53	24.07	**24.30**
2	53	5.66	3.77	**4.715**	5.66	13.21	**9.435**	9.43	11.32	**10.375**	1.89	13.21	**7.55**	1.89	3.77	**2.83**	5.66	5.66	**5.66**
2	53	1.89	0	**0.945**	3.77	5.66	**4.715**	1.89	1.89	**1.89**	1.89-	5.66	**1.885**	1.89	1.89	**1.89**	1.89	0	**0.95**

Table No. (2) And from the graph in the graph before the previous graph, as for the percentage increase in the second degree at the second point and its value (10.38%), the highest percentage increase in the corner in the third corner was when hardening with water and its value (4.22%).

Schedule (2), appearing significantly when moving away from the teeth. Line drawing from the starting point of the graph.

V. CONCLUSIONS

Tempering is a group of different technologies and methods that are used to increase the hardness of a metal or alloy. Toughness is the material's resistance to being scratched, torn or penetrated by the harder materials. The concept of hardness is a relative one, as there are no natural or synthetic materials having absolute hardness.

The results shown the following

1. The percentage increase in the percentage at the hardening point (31.78%), the percentage in the percentage when hardening with oil and its value (10.38%) The third angle at the rainbow at the rainbow (4.22%).

2. 2 - The floral decor of the teeth is significantly reduced when moving away from the teeth. Line drawing from the starting point of the graph.

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