Evaluation of EN8 Steel in Different Quenching Medium

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ABSTRACT

Specimens of EN8 medium carbon steel were examined after heating between 900°C-930°C in the Gas Carburizing Furnace and quenched in different quenching medium. We have been used quenching mediums are Oil, Water, and Air. The mechanical properties such as hardness are determined using the Rockwell hardness equipment and the hardness of the quenched material is higher than the parent material. The hardness of the water quenched material is higher than the other quenched materials. The wear behaviors of the samples were investigated using pin on disc equipment. And the microstructure of the quenched samples was taken using optical microscope. The Wear of the quenched samples was relatively less than those of the parent material samples. The water quenched material had more wear resistance, to suggest in improved mechanical properties. Keywords: Heat treatment; Quenching; Hardness; Wear; Microstructure.

1. INTRODUCTION

Today, steel is one of the most common materials in the world, with more than 1.3 billion tons produced annually. It is a major component in buildings, infrastructure, tools, ships, automobiles, machines, appliances and weapons. Modern steel is generally identified by various grades defined by assorted standards organizations. The EN8 grade steel is chosen for heat treatment to increase the hardness and wear resistance of the steel. In heat treatment we are applying different types quenching medium and compare which quenching medium is best for EN8 steel to improve the hardness and wear resistance. Also we are compare microstructure of different quenched materials. The objective of this study is to improve the hardness and wear resistance of EN8 steel by using heat treatment.

2. METHODOLOGY

EN8 steel is heat treated up to 930°C in two different type furnaces. One is Gas Carburizing Furnace. In Gas Carburizing Furnace the samples are quenched in outside of furnace. Another one is Seal Quenching Furnace. In Seal Quenching Furnace the samples are quenched in inside the furnace. Heating the samples of 3 quantities up to 930°C for 3 hours in the Gas Carburizing Furnace (GCF). Temperature drop at 840°C for 30 min is done in the furnace. One quantity is heated up to 930°C for 3 hours in Seal Quenching Furnace (SQF) and quenched within the furnace itself. Four different types of quenching is used in heat treatment namely as oil (open), oil (close), air and water.

The indentation is done in Rockwell hardness tester for determining the hardness of the quenched materials. The “C scale” is taken to find hardness. The 120\degree diamond cone was used an indenter. The load of 150Kg is applied for the penetration. The required shape for wear testing is obtained by cutting the materials using the wire cutting machine. We have selected wire cutting because it gives the perfect finishing of the surface without any changes in the mechanical properties.

3. RESULTS AND DISCUSSION

As described the EN8 steel samples were subjected to heat treatment up to 930°C and subjected to the four types of quenching process: air quench, water quench, oil quench (open), oil quench (closed). Variation of mechanical properties of EN8 steel after the heat treatment and these quenching sequences is shown in a graphical format. All mechanical testing was performed at room temperature.

3.1 Effect of Heat Treatment on Hardness

After heat treatment hardness test was taken to determine the hardness of quenched samples as well as received sample and compared.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>TYPE OF QUENCHANT</th>
<th>HARDNESS (HR\textsubscript{C})</th>
<th>MEAN VALUE (HR\textsubscript{C})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>As received</td>
<td>12,13,12,14,13,14,12,12,13,14,12,14</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Air</td>
<td>19,20,20,22,19,20,21,22,21,20,19,22</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>Oil (Open)</td>
<td>34,33,30,33,35,32,34,32,30,32,33,30</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>Oil (Closed)</td>
<td>42,40,40,41,39,41,41,42,40,39,40,42</td>
<td>42</td>
</tr>
<tr>
<td>5</td>
<td>Water</td>
<td>42,45,42,44,43,45,42,43,42,44,43,42,44</td>
<td>46</td>
</tr>
</tbody>
</table>
From this table we can see, all heat treated samples hardness is higher than the raw samples (as received). Here, the hardness of the water quenched sample is higher than the other quenched materials. Variation of hardness against hardening temperature for each quenching medium is shown in Figure 1. As hardening temperature increases, the stresses in the steel get relieved and the material becomes soft and the phase changes to martensite. Hardness of the material gradually decreases. The different quenching made for the EN8 steels shows the hardness increased in each materials than the raw material as received.

The below graph represents the comparison of wear occurred in each quenched material specimens with an track rack radius of 30mm with the velocity of 2 m/s, load of 1Kg, speed of the disc is 637 rpm, the wear time carried out for a time period of 17 min for a sliding distance of 2000 m.

Red - Oil (open) quench
Blue - Water quench
Green - Oil (closed) quench
Black - Air quench

Figure 2 (a) Wear comparison at load 1Kg with velocity 2 m/s

The below graph represents the comparison of wear occurred in each quenched material specimens with an track rack radius of 30mm with the velocity of 2 m/s, load of 2 Kg, speed of the disc is 637 rpm, the wear time carried out for a time period of 17 min for a sliding distance of 2000 m.

Red - Oil (open) quench
Blue - Water quench
Green - Oil (closed) quench
Black - Air quench

Figure 2 (b) Wear comparison at load 2Kg with velocity 2 m/s
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Figure 2 (b) Wear comparison at load 2 Kg with velocity 2 m/s
Also the below graph represents the comparison of wear occurred in each quenched material specimens with an track rack radius of 30mm with the velocity of 2 m/s, load of 1 Kg, speed of the disc is 796 rpm, the wear time carried out for a time period of 17 min for a sliding distance of 2000 m.

Figure 2 (c) Wear comparison at load 1Kg with velocity 2.5 m/s
Also this graph represents the comparison of wear occurred in each quenched material specimens with an track rack radius of 30mm with the velocity of 2 m/s, load of 2 Kg, speed of the disc is 796 rpm, the wear time carried out for a time period of 17 min for a sliding distance of 2000 m.

Figure 2 (d) Wear comparison at load 2 Kg with velocity 2.5 m/s
From these graphs we have taken the maximum wear value of each quenched specimens in each and every load and velocity conditions and are shown in below graph.

Series1: load 1kg with velocity 2m/s
Series2: load 2kg with velocity 2m/s
Series3: load 1kg with velocity 2.5m/s
Series4: load 2kg with velocity 2.5m/s
3.3 Effect of Heat Treatment On Microstructure

The microstructures of different quenched samples as well as received sample were taken using optical microscope.

![Figure 3(a) microstructure of Received material](image)

![Figure 3(b) microstructure of Air quenched material](image)

![Figure 3(c) microstructure of Oil (open) quenched](image)

![Figure 3(d) microstructure of Oil (closed) quenched](image)

![Figure 3(e) microstructure of Water quenched material](image)

The microstructure of ‘as received material’ is shown in figure 3(a), the pearlite and ferrite have been seen clearly in the image. The microstructure of ‘air quenched material’ is shown in figure 3(b), It shown that ferrite and cementite. The microstructure of ‘oil (open) quenched material’ is shown in figure 3(c). The microstructure of ‘oil (closed) quenched material’ is shown in figure 3(d), it showed that needle like structure. The microstructure of ‘water quenched material’ is shown in figure 3(e). The structure clearly showed needle like structures. From the microstructure of the materials the effect of heat treatment is involved in the changes of the mechanical properties and the structure.

CONCLUSIONS

The heat treatment and different quenching medium on EN8 steel was investigated. Based on the results obtained, the findings are concluded as follows:

- The Hardness of the quenched materials was increased over the raw material.
- The Wear resistance of the quenched material was increased over the raw material.
- The water quenched material has the best mechanical properties in Hardness and Wear resistance when compared to the other quenched materials.
This improved EN8 steel can be used in the automobile brake drums due to its high hardness and wear resistance.

REFERENCES

AUTHOR BIOGRAPHY
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