Improvement in Hardness of Mild Steel by Carburizing Heat Treatment Process

Arifur Rahman, Shakhawat Hossain, Pabitra Kumar Kabiraj

Abstract— **Mild steel containing 0.15% to 0.45% of Carbon is naturally available material for industrial spare parts manufacturing process. For the reason of low carbon steel it is very soft materials, it is necessary to harden the mild steel for manufacturing purposes. Without hardening & tempering any industrial spare parts which surface is direct contact to any other surface of a part of a machine is broken rapidly in the industry. For this reasons to improve the surface hardness of mild steel is done in which the surface harness of the low carbon steel changes by hardening heat treatment process and results in to hard outer case with good wear resistance. The mild steel was harden a temperature of 900˚C for 8 hours. In this investigation, after hardening and tempering heat treatment process the resultant hardness has been measured.**

Keywords: Hardening, mild steel, tempering, heat treatment.

I. INTRODUCTION

Heat treatment is a combination of heating & cooling operation of metals to change their physical and mechanical properties, without distorting its shape. For manufacturing purpose the property of materials need soft. But for machining purpose it is not easy for cutting harden material. But for the industrial application need harden metal for spare parts. So for improve machining & formability, restore ductility, recover grain size we have to do heat treatment of metal. In hardening, the steel is heated at an appropriate temperature and keeping it until all pearlite is transformed into austenite, and then quenching it rapidly in water or oil. The temperature at which austentizing rapidly takes place depends upon the carbon content in the steel used. The heating time should be increased ensuring that the core will also be fully transformed into austenite. Hardening of mild steels is done to increase the strength, mechanical and wear properties. Tempering means subsequent heating of harden mild steel leads to the decomposition of martensite into ferrite-cementite mixture. Tempering temperature is up to 200°C or 250°C. By tempering, the properties of quenched steel could be modified to decrease hardness and increase ductility and impact strength gradually.

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II. METHODOLOGY

A. *Selection of Material*

Steel of grade AISI1040 is being chosen for investigation. It is one of the American standard specifications of the plain carbon steel having 0.40% carbon in its composition, so it is called medium carbon steel. The chemical composition of AISI1040 is given in the table-I below:

Steel designation	C ≤	Si ≤	Mn ≤	P ≤	S ≤	Cr
Mild steal SAE 1015	0.13-0.18	0.07-0.6(a,b)	0.3-0.6	.03	.05	.13 -.18

Table I

B. *Sample preparation*

In this research we take the following two sample of Mild steal SAE 1015 for our investigation.

Sample 1

Length L = 55mm, Outside Diameter = 80 mm, Hardness HRC= 22

Fig. 1

Sample 2

Length L = 70 mm, Outside Diameter = 80 mm, Hardness HRC= 5

Fig. 2

C. *Experimental setup*

The Rockwell scale is a hardness scale based on

indentation hardness of a material. The Rockwell test measuring the depth of penetration of an indenter under a large load (major load) compared to the penetration made by a preload (minor load). [7] There are different scales, denoted by a single letter, that use different loads or indenters. The result is a dimensionless number noted as HRA, HRB, HRC, etc. In this research we used HRC.

The equation for Rockwell Hardness is H R = N − d s {\displaystyle HR=N-{\frac {d}{s}}} {\displaystyle HR=N-{\frac {d}{s}}}, where d is the depth (from the zero load point), and N and s are scale factors that depend on the scale of the test being used.

There are several alternative scales, the most commonly used being the "B" and "C" scales. Both express hardness as an arbitrary dimensionless number

Scale	**Abbreviation**	**Load**	**Indenter**	**N**	**s**
A	HRA	60 kgf	120° diamond sphero conical		
B	HRB	100 kgf	1/16-inch-diameter (1.588 mm) steel sphere	130	.002 mm
C	HRC	150 kgf	120° diamond spheroconical	100	.002 mm

Table II

Fig. 3

III. RESULTS AND DISCUSSION

The variation between hardness before carburizing and after carburizing is represented in the table III and the figure (4).

SN.	Sample Type	Hardness Before HRC	Hardness After HRC
1	Sample 1	22	65
2	Sample 2	5	35

Table III

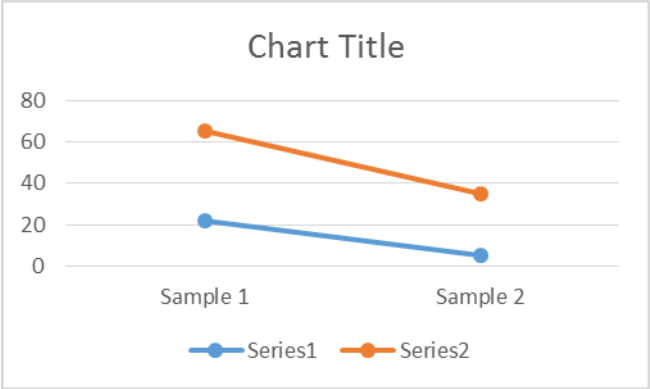

Fig. 4

The hardness is highly affected by the carburizing heat treatment process.

IV. CONCLUSION

From the present studies on “Hardness of carburized mild steels samples” the following conclusion have been drawn:

1. The carburization treatment process appreciably improved the hardness of mild steels.

are placed in the unnumbered footnote on the first page.

REFERENCES

References that are cited in the literature should be identified in the text in square brackets and grouped at the end of the paper in numerical order of appearance. References should be styled and punctuated according to the following examples: journal article [1], book [2], thesis [3], proceedings [4], technical paper/report [5] and website [6].

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