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Effect of Flame Hardening and Various Quenching Medium on the Mechanical and Metallurgical Properties of Grey Cast Iron Lathe Bed

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ABSTRACT

Grey Cast iron is the most commonly used material in lathe bed. The properties of grey cast iron before and after the flame hardening process for different quenching medium is studied and analysed. The three quenching medium used are water, polymer and Sherol. The mechanical and micro structural behaviour of the material are determined and evaluated for the raw and treated specimens. The following properties are tested; hardness, wear and corrosion resistance. The hardness is tested using Rockwell hardness testing machine, the wear and corrosion resistance are tested using Pin on disc apparatus and Neutral salt spray test apparatus respectively. The micro structures are determined using metallurgical microscope.

KEYWORDS: *Flame hardening, Quenching medium, Water, Polymer and Sherol.*

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1. INTRODUCTION

1.1 Flame hardening

Flame hardening is a process which is used for surface hardening of components, generally in selected areas by using high intensity flame for a short period immediately followed by quenching. Water is used as the quenching media. Usually oxygen-acetylene gas is used as fuel. The effects of hardening and heating can be localized and the depth up to which the hardening is required is controlled. It improves the mechanical properties of the material such as wear resistance, hardness, fatigue strength etc. The important parameters which affect flame hardening process are flame head design, standoff distance between the component and flame head, composition of the material being heat treated, temperature at which the process is being carried out, time duration or traverse speed of the burner head. The movement of burner head over the component can be single shot or multiple movements depending on the hardness to be imparted on the components.

1.2 Quenching

Quenching is defined as the rapid cooling of the work material in order to acquire certain mechanical properties. This is followed by any heat treatment process. The high temperature material is soaked in any quenching medium like air, water, oil or polymer where there is a instant change in state from austenite to martensite. It is related to the change in crystalline structure or phase transformation of the material which affects its hardness and other properties.

1.3 Problem Definition

Studying and analysing the properties of grey cast iron before and after the flame hardening process for various quenching medium. Finding out the changes that occurred in the material properties (characteristics) and microstructure.

1.4 Objectives

- Observe the behaviour of materials (properties) before and after flame hardening.
- To study the effect of various quenching media on the mechanical properties of grey cast iron.
- To study and analyse their microstructure.

2. EXPERIMENTATION

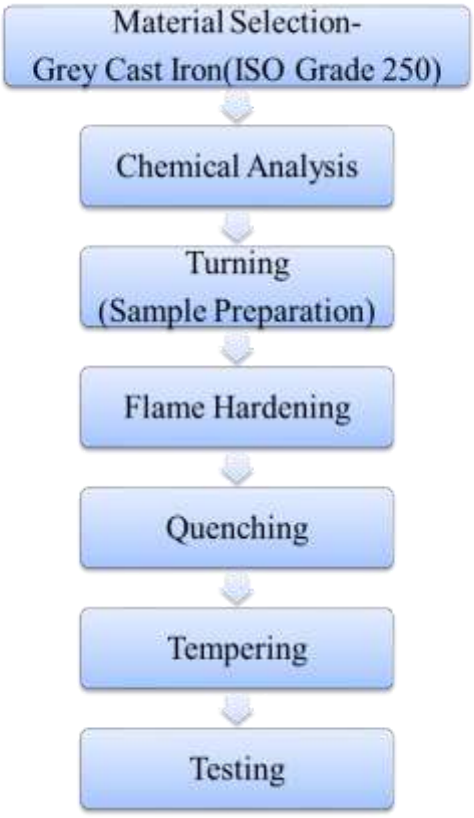


Figure 2.1: Methodology

- The grey cast iron (ISO Grade 250) bar is turned to a diameter of 8mm using a lathe and cut into a length of 30 mm. Totally 10 numbers of such samples are prepared. These samples are subjected to the heat treatment process and mechanical tests.
- An Oxy-Acetylene flame is used for the flame hardening process. This process is done manually. The temperature obtained is around 1000 degrees. The standoff distance is about 8-10 mm.
- Flame hardening is immediately followed by the quenching process. The treated samples are quenched in the following mediums at room temperature separately.

  1. Water

  2. Polymer (Servo quench 11**)**

  3. Sherol (MAK sherol B)
- The final heat treatment process is tempering, the treated samples are heated in an induction furnace for a period of two hours and maintained at a temperature of 2000^0C. Then they are allowed to cool at room temperature gradually.
- After tempering the samples are tested for hardness, wear and corrosion resistance. Also the microstructures of the various quenched samples are observed.

3. RESULTS AND COMPARISON

3.1 Rockwell Hardness Test

Material used: Grey cast iron GD 250

Indenter type: Diamond penetrator having 120° angle and 0.2 mm radius

Load: 150 Kgf.

The hardness values of different samples are given below

Table 3.1 Rockwell hardness results

Type	Hardness(HRC)
Raw material	26
Water	43
Polymer	48
Sherol B	41

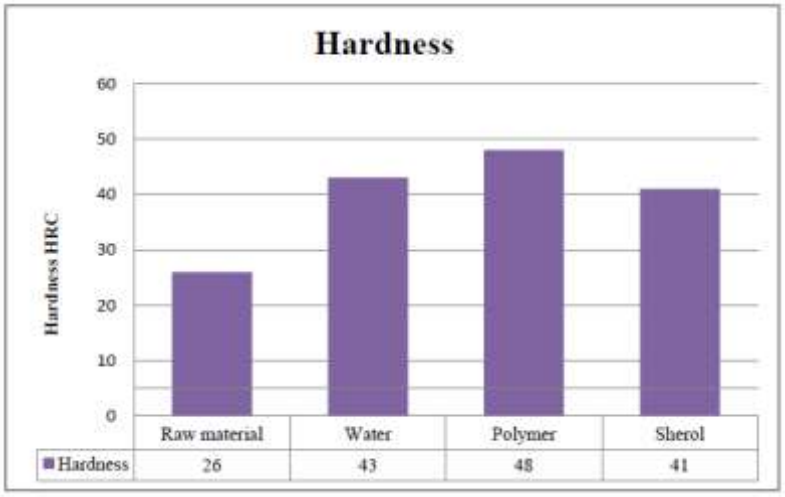


Figure 3.1 Hardness of various samples

3.2 Corrosion test

- All the samples tested showed signs of oxidation within 24 hrs when exposed to NaCl solution.
- A red corrosion was observed for all samples.

Table 3.2 Corrosion test specifications

Test solution	5 % NaCl solution in distilled water
Type of protection used	Nil
Test temperature	30-35^0 C
Method of cleaning after test	Cleaned with running water
Required exposure time	24 hours

Before test After test

Figure 3.2 Corrosion test results

3.3 Pin on Disc Wear test

Load: 20N

Testing time: 10 minutes

Speed: 300 RPM

Track diameter: 50mm = 0.05 m

Table 3.3 Pin on disc test results for 20N load

Type	Speed(RPM)	Time (min)	Sliding velocity (m/s)	Weight loss(g)	Wear rate(mm^{3}/Nm)
Raw material	300	10	0.786	0.057	$8.39x10^{-4}$
Water quneched	300	10	0.786	0.02	$2.94x10^{-4}$
Polymer quenched	300	10	0.786	0.027	$3.98x10^{-4}$
Sherol quenched	300	10	0.786	0.0298	$4.39x10^{-4}$

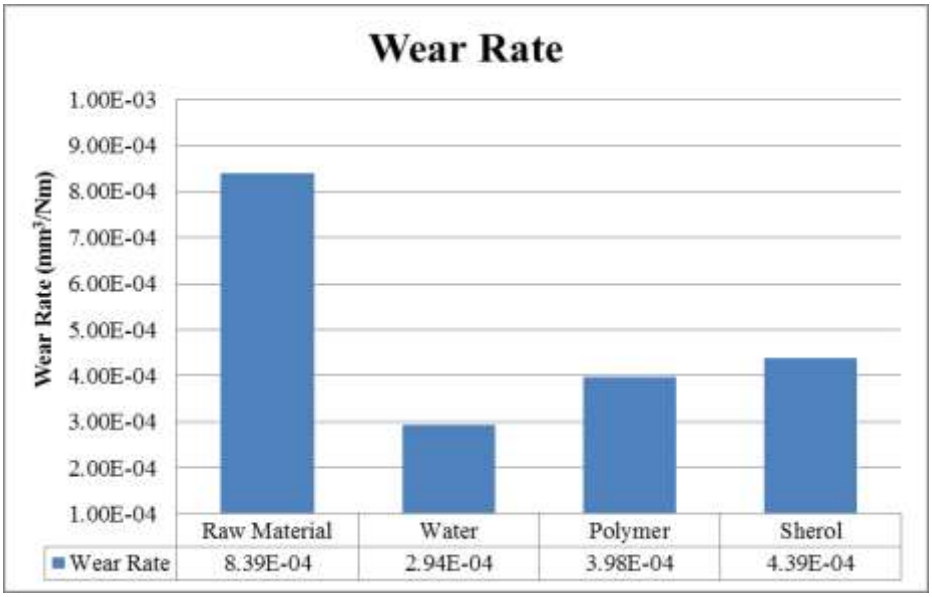
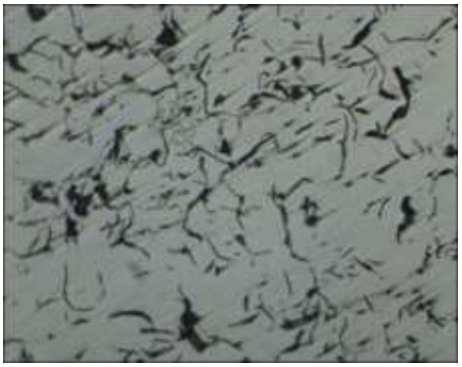


Figure 3.3 Wear rate of various samples for 20N load

3.4 Micro Analysis using Metallurgical Microscopes

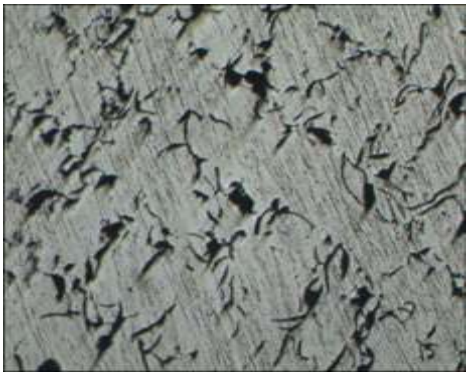
A magnification of 100X is used for analyzing the microstructure of grey cast iron specimen

1. Raw material sample



2. Water quenched sample

3. Polymer quenched sample



4. Sherol quenched sample

Figure 3.4 Microstructures of various samples

1. Raw material sample: Microstructure structure reveals needle shaped appearance of the bainite (light grey).Remaining structure is fine pearlite (dark grey) and graphite(black).

2. Water quenched sample: Microstructure structure reveals graphite flakes are present in a matrix containing 20% of free ferrite (light colour) and 8% of pearlite (dark coloured constituent)

3. Microstructure structure reveals flake graphite in a matrix of fine pearlite with less than10% free ferrite and less than 5% free cementite.

4. Sherol quenched sample: Microstructure structure reveals graphite in matrix of free ferrite and pearlite and dark bands of pearlite at cell boundaries.

4. CONCLUSIONS

- The mechanical properties such as hardness, wear resistance and corrosion resistance were tested for various quenching media.

- The microstructures for various quenching medium were observed.
- The hardness and wear resistance increased after the flame hardening process. A hardness value of 48, 43 and 41 HRC were obtained for polymer and water and sherol quenchant respectively. The polymer quenchant showed higher hardness value compared to other medium.
- Maximum wear resistance was obtained when water was used as quenching medium, followed by polymer and sherol.
- A red corrosion was found for all the treated specimens and raw material in a period of 24 hrs.
- From the above results it is seen that polymer quenching medium showed better results in terms of hardness compared to other medium but in terms of wear resistance water is the best quenching medium.

REFERENCES

[1]. Ahmed O.Jasim, *"Study the effect of polymer solution and oil quenchants on hardening automotive camshaft"*, Journal of Thi-Qar University,number2, Vol.6, March/2011.

[2]. M. Eshraghi-Kakhi, M.A. soltani, K. Amini, H.R. Mirjalili, *"Application of Polymeric Quenchants in Heat Treatment of Steels"*, International Journal of ISSI, Vol.6 , No. 1,pp.34-38 (2009).

[3]. S. Jeyaraj, K.P.Arulshri, K. P. Harshavardhan and P.S.Sivasakthivel, *"Optimization of Flame Hardening Process Parameters Using L9 Orthogonal Array of Taguchi Approach"*,International Journal of Engineering and Applied Sciences (IJEAS), ISSN: 2394-3661, Volume-2, Issue-3, March 2015.

[4]. George E. Totten, *"Quenching Technology: A Selected Overview of the Current State-of-the-art"*, Materials Research, Vol. 8, No. 4, 461-467, Sep 2005.

[5]. SaliuOjoSeidu and Bolarinwa Johnson Kutelu, *"Influence of Heat Treatment on the Microstructure and Hardness Property of Inoculated Grey Cast Iron"*, International Journal of Engineering and Technology, Volume 3, No. 9, September 2013.

[6]. *"Grey Cast Iron"* International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 Volume: 2 Issue: 8 2092 – 2093, Aug 2014

[7]. *"Grey Iron Castings – Specification"* Indian Standard *210*

[8]. *"Defects and Distortion in Heat-Treated Parts"*ASM Handbook, Volume 4: Heat Treatment.