

**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH
TECHNOLOGY****INVESTIGATION OF HARDNESS FOR AISI 1040 STEEL USING VARIOUS
COOLING METHODS****Ch. Tirumala Prasad¹, Gandi Umesh² & N. Surya³**¹Associate Professor, ^{2,3}Assistant Professor,^{1,2,3}Department of Mechanical Engineering, Teegala Krishna Reddy College of Engineering and
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ABSTRACT

The aim of this work is to investigate the hardness of 1040 steel using various cooling methods. Heat treatment is the technique to get the required mechanical properties using different heat treatment process. The samples were prepared and heat-treated at 750 °C and 850 °C subsequently was cooled by three different methods (Air, Water, and Furnace). The objective of present work is to carry out the Vickers hardness of 1040 steel material in such a way that to improve the toughness, ductility or to remove the residual stresses.

Keywords: Steel Material; Heat treatment; Vickers Hardness tester; Hardness.**I. INTRODUCTION**

Now a day's many industries are using heat treatment method to change or to get required mechanical properties of materials in various applications [1]. It is an operation means to control the mechanical properties such as hardness, toughness, yield strength, ultimate tensile strength, Young's modulus, the percentage of elongation and reduction [2]. Heat treatment classified as thermal treatment, thermochemical and thermomechanical processes are useful, especially where most of the products are from recycled scrap materials [3]. Mechanical properties of steels are strongly depending on the carbon content of steel, heating and cooling rate [4, 5]. As the tempering time increase than the ultimate tensile strength, yield strength, elongation and ductility increases. Oil quenching produces an essentially ferrite-martensite dual phase structure with about 4 volume pct of fine particle and thin film retained austenite. [6-10]. The annealed specimen with mainly ferrite structure gives the lowest hardness value but highest ductility and toughness value. However, after quenching, the microstructure shows the formation of martensite and this increases the hardness of materials [11]. In the present work, the AISI 1040 steel material hardness has been reported.

II. EXPERIMENTAL WORK

The AISI 1040 Steel material specimens were prepared to carry out this work. The prepared specimens were heated in muffle furnace shown in Fig.1 at a temperature of 750 °C and 850 °C and the specimens were cooled in three different methods i.e. air, water and furnace cooling. After cooling process is over then go for Vickers hardness test to carry out hardness test of all specimens were cooled by different methods. The hardness property of tempered specimens is measured as a function of temperature and time i.e. due to the decomposition of the martensite and coagulation of carbides of the cementite which precipitate from martensite. The water cooling has high hardness compared to air and furnace cooling.



Fig.1. Muffle Furnace



Fig.2. AISI 1040 Steel Specimens



Fig.3. Vickers Hardness Tester

III. RESULTS AND DISCUSSIONS

The specimens were heated 750 °C and 850 °C and cooled in three modes and the hardness values are tabulated below Table.1

S.No	Heating Temperatures(°C)	Mode of Cooling	Time of Cooling (Min)	Hardness (VHN)
1.	750	Air cooling	20	175
2.	750	Furnace cooling	385	170
3.	750	Water cooling	8	235
4.	850	Air cooling	22	189
5.	850	Furnace cooling	420	175
6.	850	Water cooling	10	308

From Table.1, it was observed that the hardness depends on the heating time, heating temperature and method of cooling. The results were shown that the hardness value of water cooling method > Air cooling method > furnace cooling method.

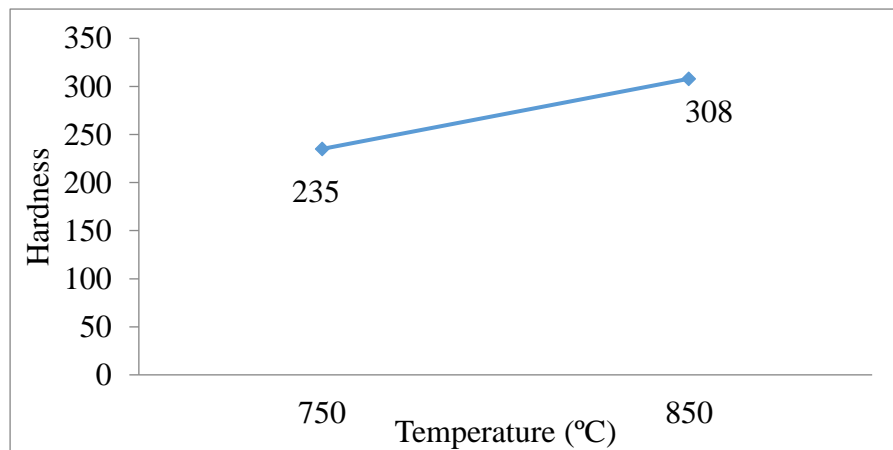


Fig.4. Temperature Vs Hardness for Water Cooling

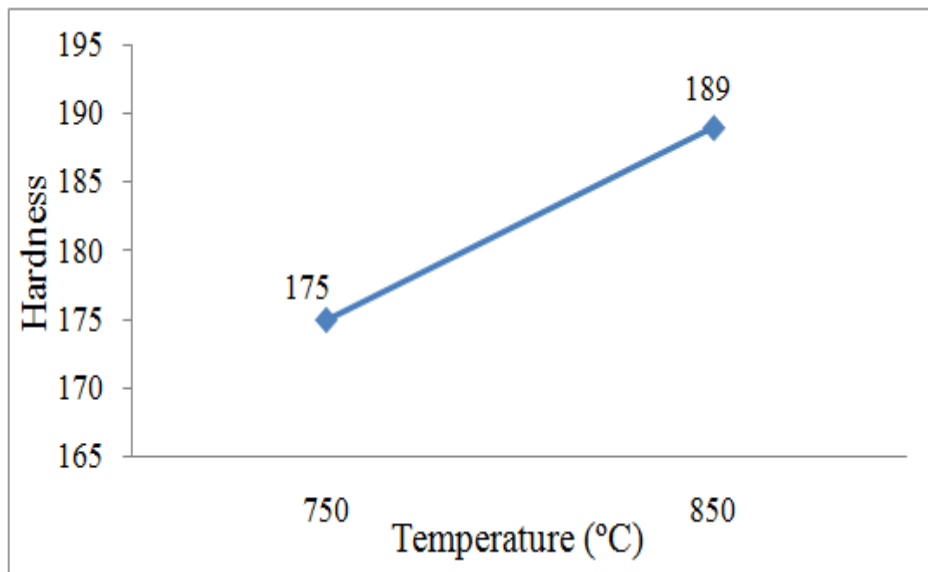


Fig.5. Temperature Vs Hardness for Air Cooling

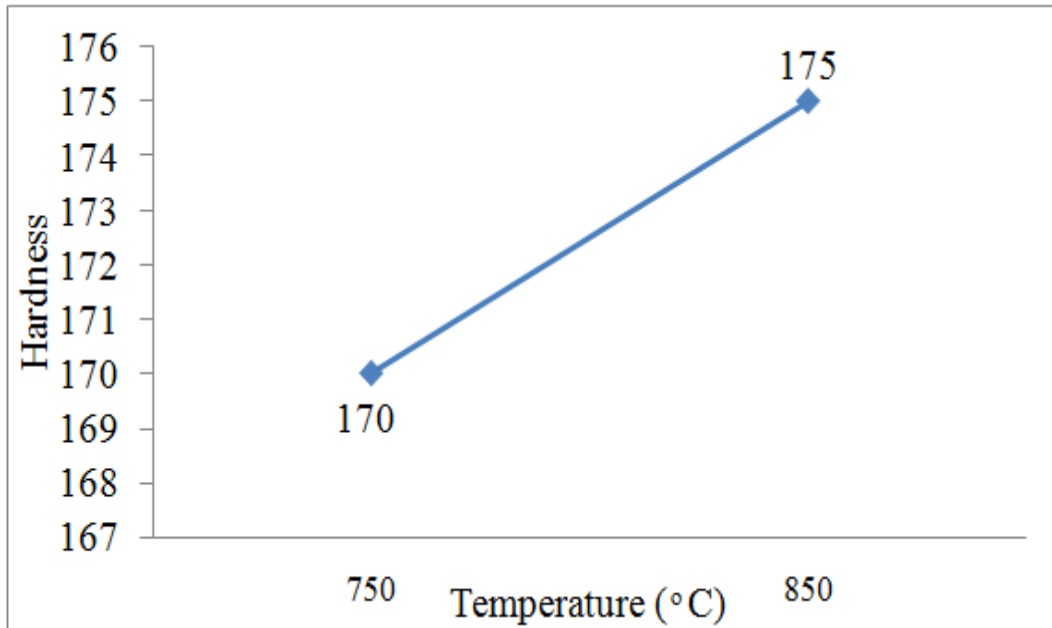


Fig.6. Temperature Vs Hardness for Furnace Cooling

From Fig.4-6 the value of Vickers hardness was higher for a temperature of 850 °C as compared to 750 °C

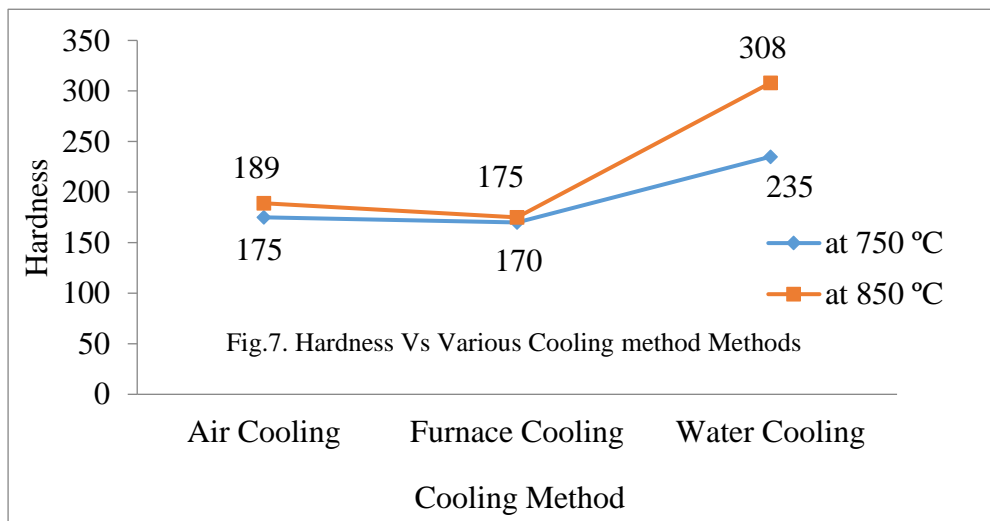


Fig.7. Hardness Vs Various Cooling method Methods

From the Fig.7, it was observed that the Vickers hardness number of water cooling > air cooling and least value of Vickers hardness was observed in the furnace cooling. The Vickers hardness value of water cooling has a maximum of 850 °C and least in furnace cooling at 750 °C.

IV. CONCLUSIONS

It was concluded that the hardness depends on the temperature and method of cooling; the hardness value is higher for water cooling method as compared to the air and furnace cooling methods. The value of hardness has a maximum for water cooling at 850 °C and minimum for furnace cooling at 750 °C.

V. REFERENCES

- [1] Pardeep Singh Bains, Raman Kumar, Analysis of hardness on SAE 1040 using different heat treatment process”, *Int. J. Advan. Technol. Eng. Sci.*, 2014, Vol.2, pp. 793-796.
- [2] Hasan MF, “Analysis of Mechanical Behavior and Microstructural Characteristics Change of ASTM A-36 Steel Applying Various Heat Treatment”, *J. Mater. Sci. Eng.* 2014, Vol. 5, pp. 01-06. doi.org/10.4172/2169-0022.1000227.
- [3] T. Senthikumar, T.K. Ajiboye, “Effect of Heat Treatment Processes on the Mechanical properties of Medium Carbon Steel”, *J. Mine. Mater. Char. Eng.*, 2012, Vol. 11, pp. 143-152.
- [4] Adnan Calik, “Effect of cooling rate on hardness and microstructure of AISI 1020, AISI 1040 and AISI 1060 Steels”, *Int. J. Phys. Sci.*, 2009, Vol. 4(9), pp. 514-518.
- [5] Dr. Amit Kohli, Dr. Gurudutt Sahni, Balpreet, “Induction Hardening Process Using AISI 1040 Steel Material on Samples of ASTM a 370-97 (E18) and E70-97 (E10) Standard its Benefits”, *Int. J. Eng. Innovate. Technol.*, 2014, Vol. 4(2), pp. 128-131.
- [6] Ashish Verma, Pravin Kumar Singh, “Influence of Heat Treatment on Mechanical Properties of AiSI 1040 Steel”, 2013, Vol. 10, pp.32-38.
- [7] Zavodinsky V, and Kabaldin Y, Influence of Dopants on Mechanical Properties of Steel: A Spin-Polarized Pseudopotential Study”, *J. Mater. Sci. Eng.*, 2017, Vol. 6, pp. 01-03. DOI: 10.4172/2169-0022.1000354.
- [8] Richetta M, Medaglia PG, Mattocchia A, Varone A and Pizzoferrato R, “Layered Double Hydroxides: Tailoring Interlamellar Nanospace for a Vast Field of Applications”, *J. Mater. Sci. Eng.*, 2017, Vol. 6, pp. 01-09. DOI: 10.4172/2169-0022.1000360.
- [9] Ali Kalkanlı, Tayfun Durmaz, Ayşe Kalemtaş and Gursoy Arslan, “Melt Infiltration Casting of Alumina Silicon Carbide and Boron Carbide Reinforced Aluminum Matrix Composites”, *J. Mater. Sci. Eng.*, 2017, Vol. 6, pp. 01-05. DOI: 10.4172/2169-0022.1000357.
- [10] Roberts Jo, “Proposed Link between the Periodic Table and the Standard Model”, *J. Mater. Sci. Eng.*, 2017, Vol. 6, pp. 01-02. DOI: 10.4172/2169-0022.1000356.
- [11] Noor Mazni Ismail, Nurul Aida Amir Khatif, Mohmad Aliff Kamil Awang Kecik, Mohd Ali Hanafiah Shaharudin, “The effect of heat treatment on the hardness and impact properties of medium carbon steel”, *IOP Conf. Series: Mater. Sci. Eng.*, 2016, Vol. 114, pp.01-09. Doi: 10.1088/1757-899X/114/1/012108.

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