iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** XI **Month of publication:** November 2018

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue XI, Nov 2018- Available at www.ijraset.com

Experimental Determination of Effect of Cooling Medium on Torsional Properties of MT40N

Adio M. A.[1], Babarinde F.[2]
[1, 2]Department of Mechanical Engineering, The Federal Polytechnic Ilaro, Ogun State.

Abstract: There is high demand for brass in industrial applications, the automotive industry, electrical and electronics industry and building industry is increasing; this necessitate the improvement of their mechanical properties by heat treatment process. Material properties largely determines its usage in any engineering application. There are several ways in which the integrity of materials can be tested to determine properties like strength, ductility, hardiness and elasticity tendencies inherent in the materials. This can be determined by subjecting the specimen to different load conditions.One underline method that differentiate heat processes from other is the rate of cooling or medium of cooling. In this research, two samples of MT40N were heated in a hearth forging furnace to austenitic temperature. The samples were heated for about 5 minutes simultaneously. The samples A and B were quenched in chilled water and in oil with equal volume being 500cl in each case. After cooling, the specimens were tested to determine their resistance to twisting or torsional load. A bench device SM1001 VersatileDevice AcquisitionSystem (VDAS) was used to measure its torsional properties. Specimen A was inserted and twisting force was applied until it reaches a break point. Specimen B was also was tested with same apparatus and twisting force is applied. The result shows that sample A was hardened and no appreciable necking was evidence before it snap off at peak torque of 9.5 Nm and maximum twist angle of 15.55 rad. While in sample B it shows substantial necking and withstand 32Nm torque and 210rad for angle of twist before it fractures, which depicts a ductile material. This findings suggests that heating and cooling, particularly in different medium has altered the behaviour of the materials. These specific findings can be applied by engineers and materials users as they respond to competitiveness demand in respect of quality assurance in materials usage.

Keywords: experimental, determination, cooling, torsional, properties..

I. INTRODUCTION.

Heat treatment is a technique that has been used for decades now to alter the microstructure of metals in other to suit a particular application. In other to meet specific properties, heating and cooling of alloys and metals under certain conditions are required (Chaturvedi, 2015). The effect of heat treatment on mechanical behaviour of untreated, as-hardened and hardened-tempered medium carbon steel reveals that hardened samples after heat treatment results into increased hardness and strength at a temperature of 250˚C (Tukur, Usman, Muhammad and Sulaiman, 2014). Altering physical, chemical and mechanical properties is primarily a function of various heat treatment processes such as Tempering, Annealing, and case hardening normalizing e.t.c. the results obtained from this processes are as a results of changing phases starting mainly from the austenitic phase. The important heat treatment commonly used to change the microstructure and mechanical characteristics of steels include annealing, normalizing, hardening and tempering (Motagi and Bhosle, 2012). Previous studies have shown that the effect of heat treatment on the mechanical properties of medium carbon steel with the aim of ensuring that steel is more suited for applications involving designing, fabrication, structures and maintenance (Senthikumar and Ajiboye, 2012). A research conducted by Babarinde and Adio (2017) reveals that, two heat treated samples of TR121 0.3% wt of carbon content were heated to the austenitic range and the samples were cooled in chilled water and the in air. These samples were investigated further by subjecting them to a twisting load. One of the samples showed ductility while the other showed brittleness. This contrast in behaviour exemplified by the samples was as a result of rapid rate of cooling in one of the samples. This research focus is to determine the effect of heating and cooling of two samples of MT40N brass which has 60% weight of copper and 40% weight of Zinc which are quenched in chilled water and in black oil respectively. Also, to determine the behaviour in torsion of the two samples subjected to heat hardening.

II. MATERIALS AND METHODS.

A. Materials.

1) *Hearth Forging Furnace:* The hearth forging furnace is connected to a three phase electricity AC power source. It has two control handles to regulate the air supply to the heating chamber. The chamber is made of 10 mm mild steel dimensioned as

80cm by 85cm by 42cm. it has an in-built refractory materials specifically designed to withstand heat produced during heating. It employs direct heating as sample will be in contact with source of heat. The specification includes:

Maximum voltage= 220-240V.

2) *SM1001 Versatile Data Acquisition System:* It is a laboratory scale machine that is mounted on a table to test specimens of any type of metal. It measures torque and twist angle as rotational load is applied from one end. As the rotational force is exerted, one end of the equipments rotates while the other end is fixed to produce the twisting effect in the specimen. The specimen is secured or tightened into a hexagonal socket at both ends. The equipment is connected to VDAS and the VDAS is linked to personal computer or laptop to record data and make a plot as the sample under the application of a twisting force.

Specification.

a) SM1001 Torsion testing machine (30NM).
b) Torsiometer (SM1001a).
c) Bench-mounted version of a Versatile Data Acquisition System (VDAS).

B. Methods.

This research considers two samples of half hard brass MT40N which have a composition of 60% Copper and 40% Zinc as stated in table 2.1a. Sample A and B were heat treated using hearth forging furnace powered by electricity. The blower of the furnace is controlled to provide a steady heat to the specimen during the heat treatment operation. The samples were heated for about 5 minutes simultaneously, after which they were quenched and retained for 10 minutes in chilled water. Used black oil having equal volume of 500cl as the chilled water was used as the cooling medium for the samples. The sample A and B were tested using SM1001 VDAS Torsion Testing Machine one after the other. The samples were secured into the hexagonal ends of the torsion testing machine as the twisting force is applied gradually. The torsion testing machine is synchronised with a laptop to obtain the reading and graphical representation of the specimens as the twisting force is progressively applied. The specimens were subjected to destructive testing to find out the maximum torque when the specimen fractures or reaches break point in each case.

Table 2.1a.
Chemical Composition of the sample used.

Test specimen	%Composition Copper	%Composition Zinc	Gauge length Mm	Initial diameter mm
MT40N	60.0	40	50.0	6.0

Table 2.1b.
Condition of heat treated sample.

Specimen Sample A and B	Retention time in furnace	Retention time in Cooling medium	Cooling medium
MT40N	5 minutes	10 minutes	Chilled water and black oil

III. DATA, RESULT AND DISCUSSION.

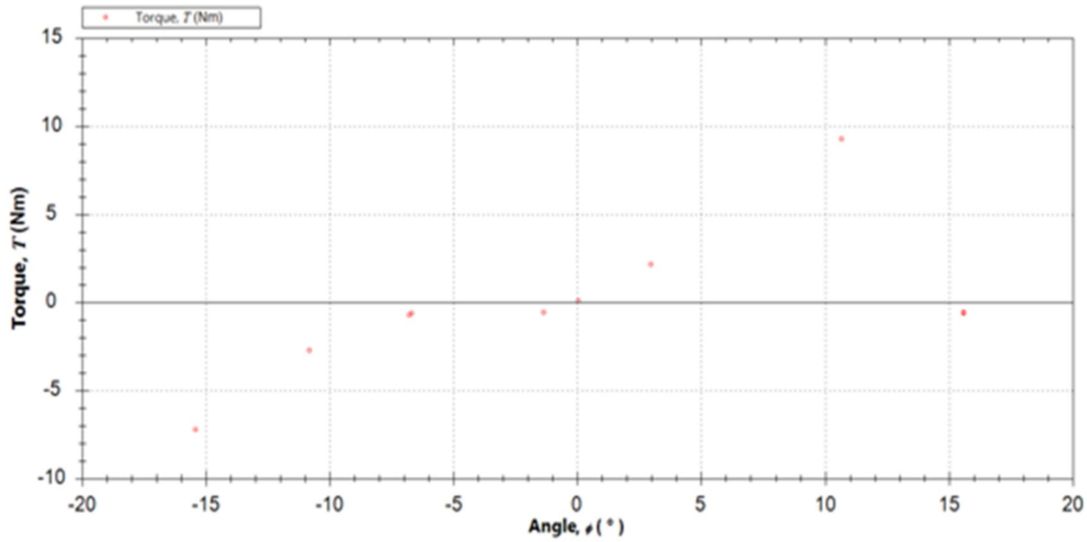
A. Data Analysis.

Torque (Nm)	-7.80	-2.50	-9.50	-0.20	0.10	2.50	9.50	1.0
Angle of twist	-14.80	-9.20	-3.80	-1.00	0.00	3.00	10.60	15.5

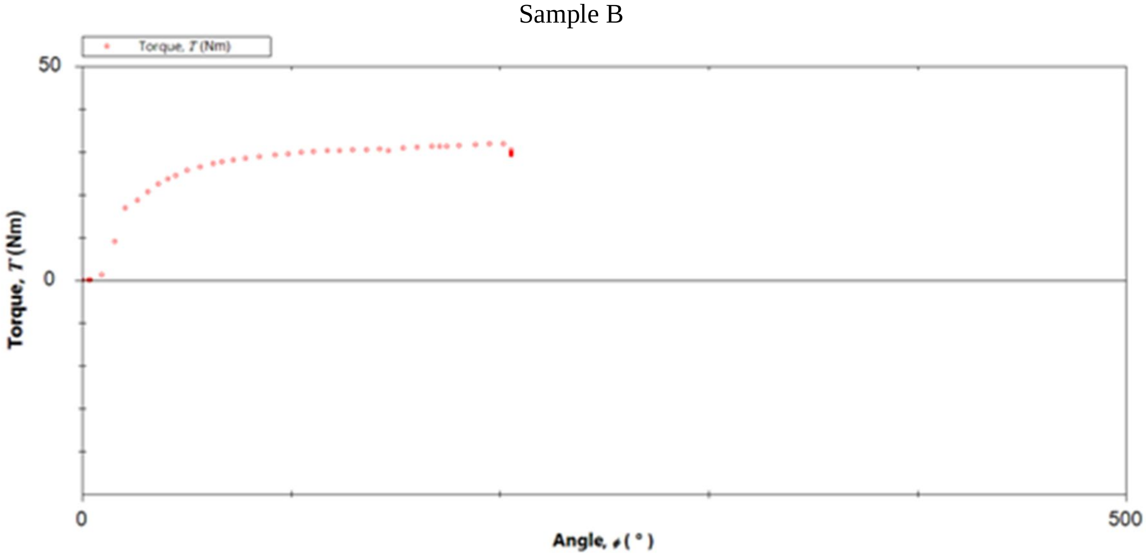
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue XI, Nov 2018- Available at www.ijraset.com

B. Results.

Sample A



Sample B



C. Discussion.

Table 3.1 represents the value of torque in Nm and angle of twist in rad of sample A which was quenched in chilled water. The peak torque and maximum twist angle attained for sample A were 9.5 Nm and 15.5 rad respectively. These values indicates that the material has become hardened upon heating and quenching which has made a MT40N -half hard brass significantly reduce its ductile properties. For this to happen, the sample structure has been altered by the heating and cooling operation carried out on the sample. The resistance to twisting load was small and it can be inferred that the material has transited from being ductile to brittle materials. Also from literature, when materials are subjected to rapid quenching, an unstable structure is birthed or produced which is described as martensite. However, to substantiate this claim, a further test is required to determine the microstructural examination of the fractured specimen. Specimen B was also heat treated and quenched in used black oil. The maximum peak and angle of twist reached in sample B were about 32N-m and 210 rad respectively. This shows an appreciable necking or reduction in area was observed in the second specimen. This also suggests that the material exhibit more ductile properties when compared with specimen A. This indicates that the cooling rate was not as fast as it was observed in specimen A and has significantly altered the behaviour of the samples under twisting condition. The value of maximum torque and maximum twist angle reached or attained in the hardened samples A and B can serve as a guide to Engineers or manufacturers of shaft, camshaft and other areas where the material composition in making an informed choice during selection.

IV. CONCLUSION AND RECOMMENDATION.

A. Conclusion

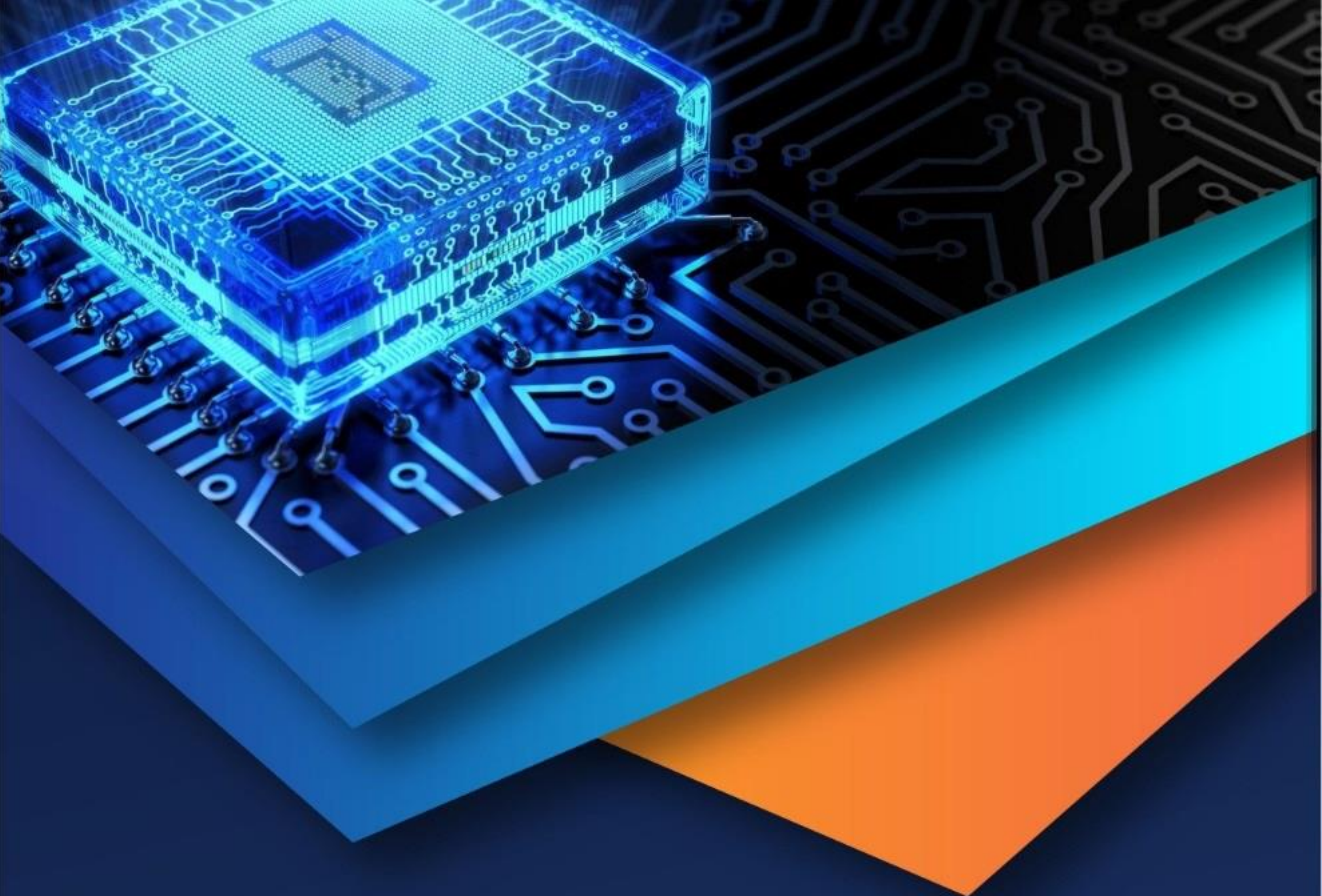
Heat treatment has served and is still serving the purpose of altering the behaviour of materials to suit different load applications or conditions. As demonstrated in the experiment carried out in this research, where two samples of MT40N were treated to same temperature and quenched in chilled water and used black oil. The effect of cooling in different medium has significantly impacted on the torsional behaviour of MT40N samples as one tends to show brittleness while the other shows less brittleness. These specific findings can be helpful to engineers and materials users as they respond to competitiveness demand in respect of quality assurance in materials usage.

B. Recommendation

Further work can be carried out to critically examine the fracture ends of the two samples A and B under microscope to determine the structure that exist in the samples after a careful control heating and cooling operations in different cooling media. Further analysis can also be done using a scanning electron microscope to get more information on topography, morphology and composition.

REFERENCE

[1] Babarinde, F and Adio, M.A (2017) The Effect of Heat Treatment on Torsional Properties of TR1021. A Paper presented at the School of Applied Science Federal polytechnic Ilaro Ogun State.
[2] Chaturvedi, S. (2015) Heat Treatment. Available at: https://www.researchgate.net/publication/281442356. Doi: 10.13140/RG.2.1.5096.8801.
[3] Senthikumar, T. and Ajiboye, K.T. (2012) Effect of Heat Treatment Process on the Mechanical Properties of Medium Carbon steel, Journals of Minerals and Materials Characterisation and Engineering 11(2). Available at: https://www.researchgate.net/publication/267426514
[4] Motagi, B.S. and Bhosle, R. (2012) Effect of Heat Treatment on the Mechanical Properties of Medium Carbon Steel, international Journal of Engineering Research and Development 2(1). Pp. 07-13. ISSN: 2278-067X
[5] Tukur, S.A., Usman, M.M., Muhammad, I. and Sulaiman, N.A. (2014). Effect of Tempering on Mechanical Properties of Medium Carbon Steel, International Journal of Engineering Trends and Technology 9(15). PP. 798-800



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY