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Impact of the Heat Treatment Processes on the Mechanical Properties of Low Carbon Steels

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Abstract: A careful consideration of facts, there is a segment of steel in the world at large. Steel has various realistic applications in each segment of life. Steel with unprecedented properties are the best among the things. Low carbon steel has carbon substance of 0.15% to 0.45%. Low carbon steel is the most appreciated kind of steel as its gives material properties that are praiseworthy for two or three usages. It is neither remotely sensitive nor bendable in light of its lower carbon content. The various heat treatment outlines are annealing, normalizing, hardening, austempering, hardening and surface hardening. The work is concerned it is basically centered on carburizing which is a case setting process. The cases were prepared for heat treatment process is finished. These cases are attempted under UTM machine. Then diverse mechanical properties are recorded
Keywords: Low carbon steel, Heat treatment, Mechanical properties, UTM, Carburizing

I. INTRODUCTION

Carbon steel or plain-carbon steel is a metal compound. It is a blend of two components, iron and carbon. Different components are available in amounts too little to influence its properties the principle distinctive segments allowed in plain-carbon steel are: 1.65% of manganese, silicon (0.60% max), and copper (0.60% max). Steel with low carbon content has an indistinguishable properties from press, delicate yet effectively shaped. With more carbon the metal increases hardness and quality yet turns out to be not so much bendable but rather more hard to weld. Higher carbon content cuts down steel's softening point and its temperature insurance when all is said in done.

Low crbon Steel (0.15%to0.45% carbon)
Medium carbon Steel (0.45%to0.8% carbon)
High carbon Steel (0.8%to1.5% carbon)

A. Low Carbon Steel

Ordinarily contain 0.04% to 0.30% carbon content. This is one of the biggest gatherings of Carbon Steel. It covers an extraordinary assorted variety of shapes; from Flat Sheet to Structural Beam. Contingent upon the coveted properties required, different components are included or expanded. For instance Drawing Quality, The level of carbon is kept low and Aluminum is incorporated, and the carbon level is high for Structural Steel and the manganese content is extended.

B. Heat Treatment

Heat treatment is the process of heating and cooling of metals in order to enhance their physical and mechanical properties, without sanctioning it to transmute its shape. Heat treatment could be verbally expressed to be a procedure for sustaining materials however could similarly be acclimated to transmute some mechanical properties, for instance, upgrading formability, machining, thus forth The different warmth treatment forms mundanely utilized in designing practice

C. Carburizing

As work is concerned warmth treatment of low carbon steel is an exploratory task which for the most part manages carburizing process. Carburizing, additionally alluded to as Case Hardening, is a warmth treatment process that delivers a surface which is impervious to wear, while keeping up durability and quality of the center. This treatment is connected to low carbon steel parts in the wake of machining, and in addition high combination steel course, gears, and different segment

D. Types of Carburizing Process

1) Gas carburizing
2) Liquid carburizing
3) Vacuum carburizing

4) Plasma (ion) carburizing
5) Salt bath carburizing
6) Pack carburizing

E. Pack Carburizing

Pack carburizing is a procedure in which carbon monoxide got from a strong compound decays at the metal surface into incipient carbon and carbon dioxide. The beginning carbon is assimilated into the metal, and the carbon dioxide instantly responds with carbonaceous material present in the strong carburizing compound to deliver new carbon monoxide. The arrangement of carbon monoxide is improved by energizers or impetuses, these energizers encourage the decrease of carbon dioxide with carbon to shape carbon monoxide. In this way, in a shut framework, the measure of energizer does not change. Carburizing proceeds as long as enough carbon is available to respond with the overabundance carbon dioxide. Pack carburizing is not any more a noteworthy business process. This has been for the most part because of substitution by more controllable and less work concentrated gas and fluid carburizing forms. Notwithstanding, any work cost advantage gas carburizing or fluid carburizing may have over pack carburizing can be refuted should work pieces require extra advances.

F. Sequence of Experiment Procedure

The experimental procedure can be followed as:
1) Specimen preparation
2) Harden measurement
3) Mechanical property study

Muffle Furnace

Inside Of Muffle Furnace

G. Specimen Preparation

Various specimens were prepared Normal bar, Annealed bar, Normalized bar, Hardened bar and Tempered bar using low carbon steels

H. Heat treatment

The various heat treatment process were conducted for the specimens at the temperature of 900 deg Celsius and the time period for 2 hrs in muffle furnac

I. Study of mechanical properties

As the objective of the project is to compare the mechanical properties of various heat treated cast iron specimens, now the specimens were sent to hardness testing and tensile testing.

J. Hardness Testing

The heat treated examples hardness were estimated by methods for Rockwell hardness analyzer. In the first place the ball indenter was embedded in the machine; the heap is balanced to100 kg. The dial contains 100 divisions. Every division compares to an infiltration of .002 mm. The dial is turned around with the goal that a high hardness, which brings about little entrance, brings about a high hardness number. The hardness esteem accordingly acquired was changed over into C scale by utilizing the standard converter graph

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Rockwell Hardness Tester

K. Ultimate Tensile Strength Testing

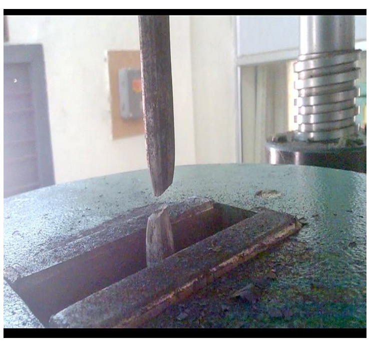
The heat treated examples were dealt with in UTS Machine for getting the % stretching, Ultimate Tensile Strength, yield Strength. The strategies for acquiring these qualities can be recorded as takes.

At first the cross segment zone of the example was estimated by methods for a vernier caliper and after that the measure length was figured. Now the separation between the jaws of the UTS was settled to the measure length of the example. The example was grasped by the jaws of the holder the most extreme load was set at 150 KN. The comparing Load versus Relocation graphs were plotted by utilizing the product. From the information got the % lengthening, yield strength and ultimate tensile strength were calculated by the following formulae: -

% elongation = change in length of specimen/initial length of the specimen *100

Yield strength = load at 0.2% offset yield/ initial cross section area

Ultimate tensile strength = maximum load/ initial cross section area



Universal Testing Machine

II. RESULTS AND DISCUSSION

SPECIMEN PREPARATATION	% OF ELAGATATION	% OF AREA OF REDUCTION
Normal bar	26.6	71.3
Annealed bar	29.16	64.26
Normalized bar	26.67	63.75
Hardened bar	10	62.44
Tempered bar	10	65.57

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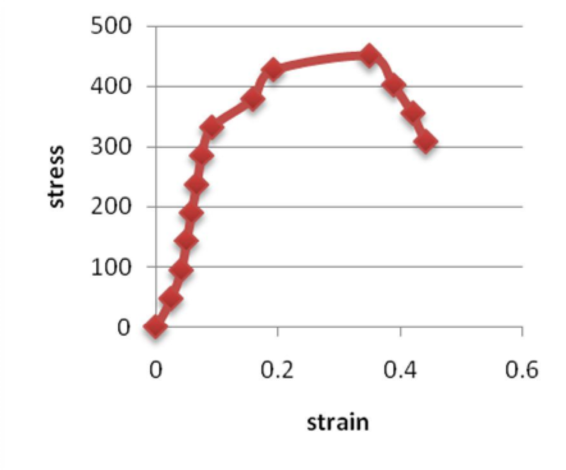
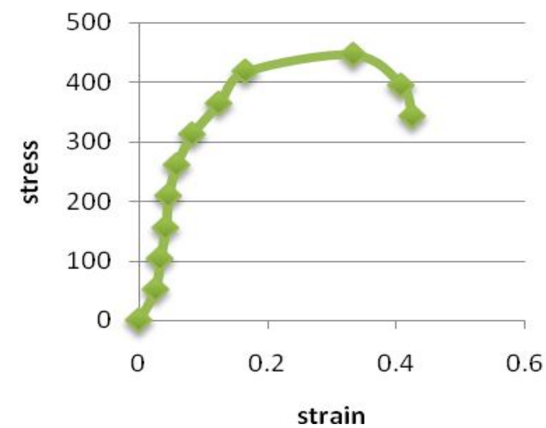
SPECIMEN PREPARATION	YIELD STRENGTH σ_y (MPa)	ULTINATE STRENGTH σ_u (MPa)	HARDNESS
Normal bar	332	451	64
Annealed bar	368	410	61.33
Normalized bar	298	467	70.33
Hardened bar	535	723	88.6
Tempered bar	440	637	92.67

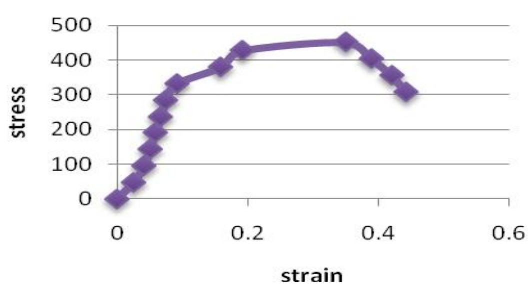
GRAPHS



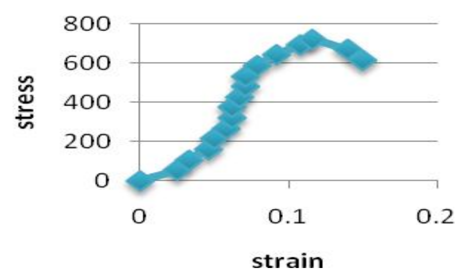
Stress – strain curve for a Normal bar



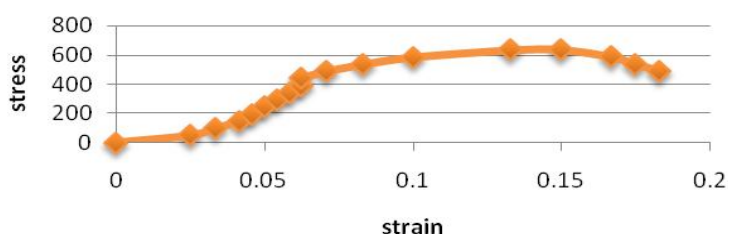
Stress – strain curve for an Annealed bar



Stress – strain curve for a Normalized bar



Stress – strain curve for a Hardened



Stress – strain curve for a Tempered bar

III. CONCLUSION

A. From the different outcomes got amid the venture work it can be inferred that the mechanical properties shift contingent on the different heat treatment forms.

B. Consequently relying on the properties and applications required we ought to go for a reasonable heat treatment forms. When malleability is the main criteria treating at high temperature gives the best outcome for hardening test

C. It is observed that tempered bar has more hardness than remaining specimens.

D. From the experiment it is observed from the specimens the percentage of reduction in area in hardening bar is efficient than remaining bars

E. It can be obviously observed contrasting all the heat treatment forms, ideal Combination of UTS, Yield Strength, % Elongation and hardness can be obtained through austempering as it were.

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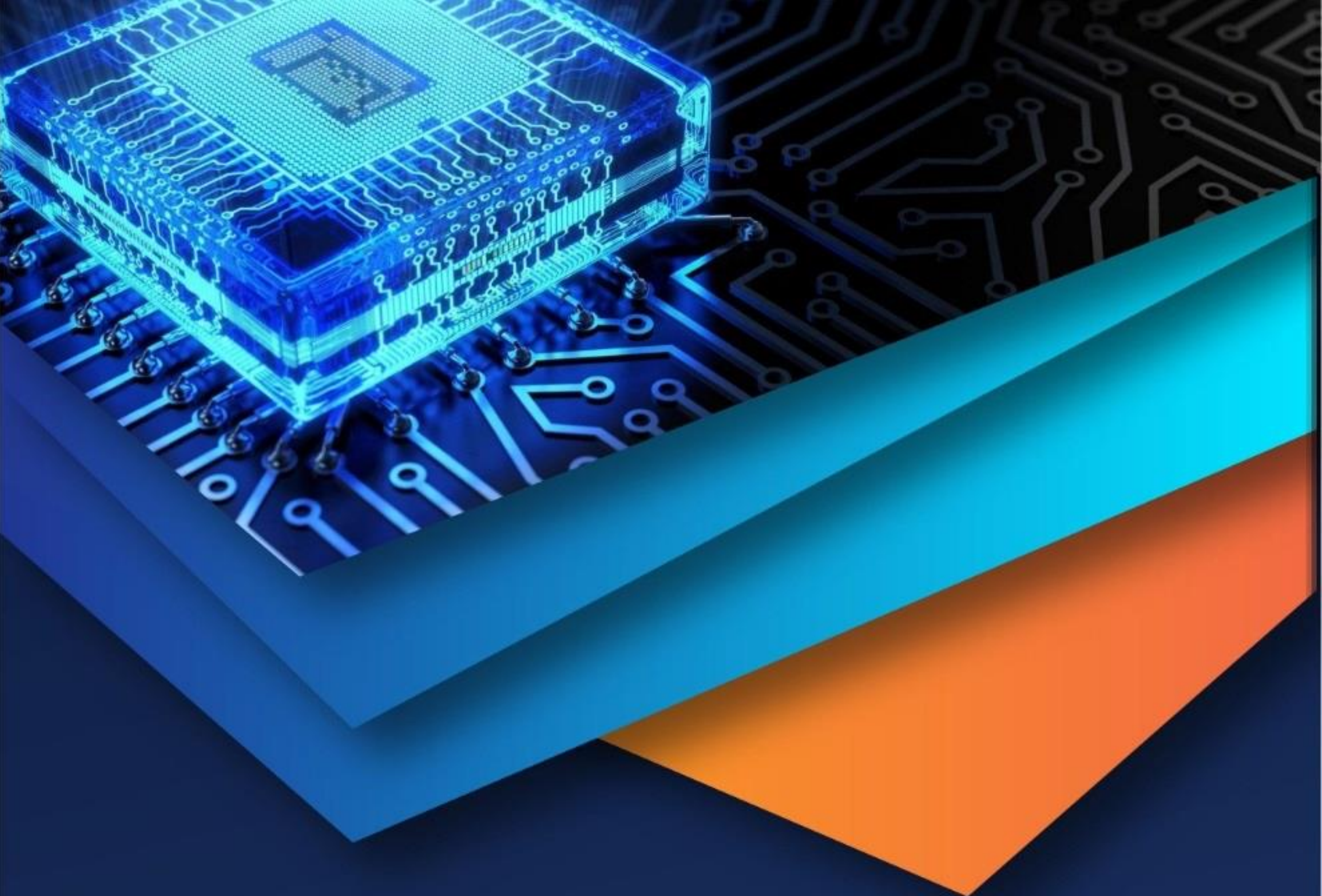

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