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OPTIMIZATION OF HEATTREATMENT PROCESS FOR 45C8 STEELS

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Abstract

The requirement of mechanical properties of the material depends on the application of the material. As the alloying elements have tendency to change the mechanical properties of the material but an alternative can also be used to change the mechanical properties by heat treatment process after keeping a fixed alloying element and this will serve great reduction of cost paying for alloying element. By experiment it is found that heat treatment process on the alloy steel can change the mechanical properties of the material without the variation of alloying element in iron.. In this paper a comparative statement has been made for obtaining maximum hardness for a highly stressed environment parts and optimum value has been selected for 45C8 material with number of heat treatment processes.

KeyWords: *Heat treatment, Hardness.*

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1. INTRODUCTION

Heat treatment is process of heating and cooling of material. It is possible to obtain the desirable mechanical properties for steel or alloys by heat treatment. In heat treatment temperature variation with time is basic parameter to alter mechanical property of the component. If this variation is proper so that phase transformation is according to part application requirement, because the basic requirement of mechanical properties is different for different environment. In this paper a grade of steel 45C8 has been taken for experiment purpose in highly stressed application and number of heat treatment processes has been carried out which impart the optimum value of mechanical properties. In these heat treatment processes a variation is made over temperature and time and optimum value has been selected. The most important heat treatments are Stress relieving, Annealing, Normalizing, Hardening and Tempering.

2. LITERATURE REVIEW

In heat treatment area number of researcher contributed lot for attaining the desired mechanical properties for particular application of the product, since here few of researchers view toward heat treatment is given as: **Harichand** International Journal of Engineering Science and Technology (IJEST) ISSN: 0975-5462 Vol. 4 No.03 March 2012 998

Kuma and Gupta (1990) studied the abrasive wear behaviour of mild, medium carbon, leaf and high carbon, Low Cr. Steel by means of a dry stand rubber wheel abrasion apparatus. They found that the heat treated high Carbon low Cr. Steel and mild steel carburized by their own technique to be the best abrasion resistance materials. The abrasive wear resistance values of the two materials wear found to be very much comparable with each other.

Lancaster (1989) has suggested that graphite crystallite are embedded into the surface valley aspirates and acts as nuclei as a for lubrication film building and thus reduced the Effectiveness of abrasive wear of aspirates physically.

Stevenson and hutchengs (1994) have reported that sinter particles wear cause to ease gross fracture of the carbide and so those materials with a high volume fraction of carbide shared the greatest resistance to erosive wear.

3. EXPERIMENTAL SETUP

The samples was prepared and subjected to solid solution heat treatment processes with chemical composition given as:

Carbon	0.42-0.50	Chromium	0.25max.
Silicon	0.10-0.35	Molybdenum	0.05max.
Manganese	0.60-0.90	Vanadium	0.05max.
Phosphorous	0.035max.	Copper	0.35max.
Sulphur	0.035max.	Nickel	0.25max.

3.1. ANNEALING

a) The specimen was heated up to a temperature of 950 degree C.
b) At temperature 950 degree C the specimen was held for 2 hour.
c) Then the furnace was switched off so that the specimen temperature will decrease with the same rate as that of the furnace the objective of keeping the specimen at 950 degree C for 2 hrs is to homogenize the specimen. The temperature 950 degree C lies above Ac1 temperature. So that the specimen at that temperature gets sufficient time to get properly homogenized .The specimen was taken out of the furnace after 1 day when the furnace temperature had already reached the room temperature.

3.2. NORMALIZING

a) At the very beginning the specimen was heated to the temperature of 950 degree C.
b) There the specimen was again kept for 2 hour.
c) Then the furnace was switched off and the specimen was taken out.
d) Now the specimen is allowed to cool in the ordinary environment i.e. the specimen is air cooled to room temperature. The process of air cooling of specimen heated above Ac1 is called normalizing.

3.3. QUENCHING

This experiment was performed to harden the 45C8. The process involved putting the red hot specimen directly in to a liquid medium.
a) The specimen was heated to the temp of around 860 degree C and was allowed to homogenize at that temp for 2 hour.
b) An oil bath was maintained at a constant temperature in which the specimen had to be put.
c) After 2 hour the specimen was taken out of the furnace and directly quenched in the oil bath.
d) After around half an hour the specimen was taken out of the bath and cleaned properly.
c) Now the specimen attains the liquid bath temp within few minutes. But the rate of cooling is very fast because the liquid doesn't release heat readily.

3.4. TEMPERING

Tempering is the one of the important experiment carried out with the objective of the experiment being to induce some amount of softness in the material by heating to a moderate temperature range.
a) Firstly all the six specimens were heated to from 250 degree C to 750 degree C for 2 hour.
b) The hardness of all six specimens was calculated.
c) Now again all six specimens were heated to 860 degree C and after quenching in the oil bath then again heating to250 degree C to 750 degree C for 2 hour.

d) The hardness of all six specimens was again calculated after the specimens got heated to a particular temperature for a particular time period, they were air cooled. The heat treatment of tempering at different temp for different time periods develops variety of properties within them.

4. 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.

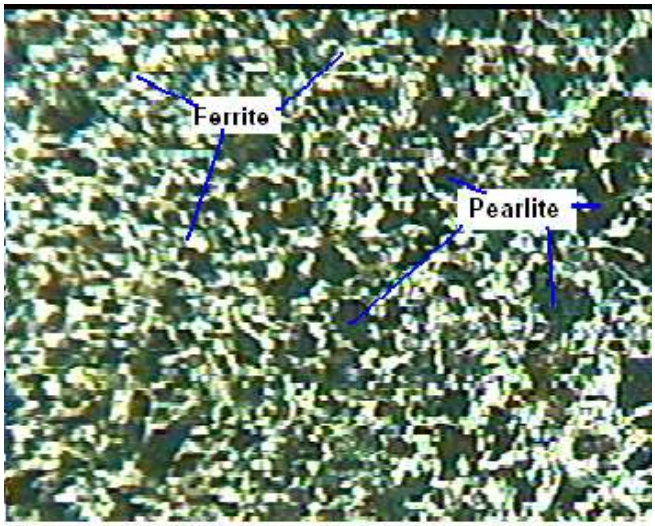
4.1. HARDNESS TESTING

The heat treated specimens hardness was measured by means of Rockwell hardness tester. The procedure Adopted can be listed as follows:

1. First the indenter was inserted in the machine; the load is adjusted to100kg.
2. The minor load of a 10 kg was first applied to seat of the specimen.
3. Now the major load applied and the depth of indentation is automatically recorded on a dial gage in terms of arbitrary hardness numbers. The dial contains 100 divisions. Each division corresponds to a penetration of .002 mm. The dial is reversed so that a high hardness, which results in small penetration, results in a high hardness number. The hardness value thus obtained was converted into C scale by using the standard converter chart.

5. STUDY OF MICROSTRUCTURE

The micro structure of the test specimen was observed under metallurgical microscope at a magnification of 100X and 400X. Before and after heat treatment, the samples were prepared for the observation of micro structure under metallurgical microscope. These slices are firstly mounted by using Bakelite powder then polished in silicon SIC paper of different grades (emery paper) then in one micro meter cloth clotted with diamond paste. The samples were etched using 2% nital (2% concentrated nitric acid) in methanol solution. Then the micro structures were taken for different heat treated specimen.



Material: IS: 45C8. Normalized structure. ASTM Grain size is 6 - 7. Ferrite & Pearlite is seen.

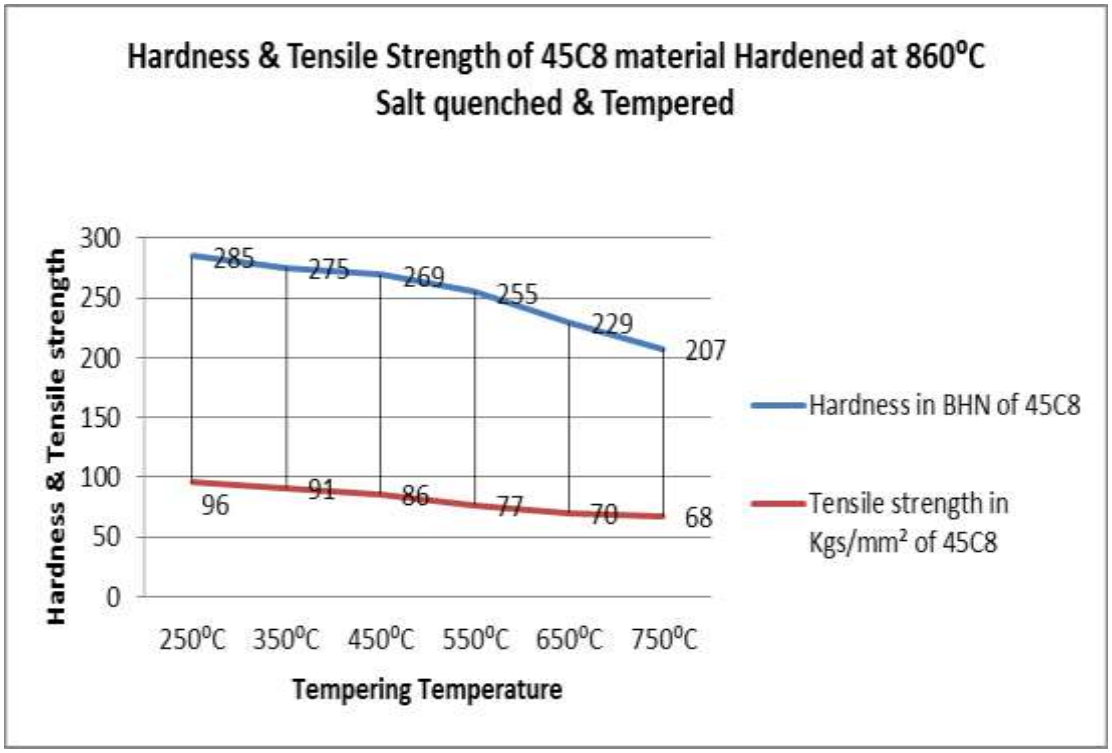
6. RESULTS

From experimental setup following results are obtained from hardness testing

6.1. HARDNESS TESTING

Table below shows the values of hardness for the specimen at different tempering temperature and found that specimen has highest hardness at tempering temperature 250°C for the time Period of 1hrs.

Sample	Temperature(degree C)	Hardness before Hardening	Hardness after Tempering
A	250	285	285
B	350	285	285
C	450	285	269
D	550	285	255
E	650	285	229
F	750	285	207



7. CONCLUSION

Thus in this paper a comparative statement has been made for different heat treatment processes and results obtained during the experiments concluded that there is tremendous variation of mechanical properties depending upon the various heat treatment processes. Hence depending upon the properties and applications of the work material we should select a suitable heat treatment processes. When there is only ductility is criteria tempering at high temperature for 2 hours gives the optimum result among all tempering experiments. Whenever we require hardness of the alloy steel of grade 45C8, we should select low temperature tempering for 1 hour. From the results and observation it is found that annealing causes a tremendous increase in ductility. The hardenability of steel is influenced by its carbon content. Carbon can be used to increase hardness of steels. It is evident that the formation of pearlite becomes more difficult with higher the carbon content of steel.

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