"INVESTIGETING THE EFFECT OF HEAT TREATMENT PARAMERTERS ON EN31-REVIEW"

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ABSTRCT

Investigating the effect of heat treatment in industry, more focus was found on the use of optimization technique. The main aim of this process is to maximize of Hardness in of Steel material using Heat Treatment. The Experiment was conducted with a view to refer and research on Hardness and improving machinability. Heat treatment process done in various stages after selecting the material. For removing internal stresses from material process done. Value of hardness and strength will increase after the experiment. Rate of hitting, rate of cooling, socking time, loading & unloading temperature, Quenching media are different types of parameters for the heat treatment process. Hardness of material increase due to the percentage of carbon increases & Hardness values differ in various quenching media. Due to that strength of the material will increases. Strength of material will check on the load tester. Values coming out from the experiment will provide us proper information about the steel material.

Keyword :- *Heat Treatment, Hardening, Alloy steel, EN31*

1. INTRODUCTION

As Steelworkers, we are interested in the heat treatment of metals, because we have to know what effects the heat produced by welding or cutting has on metal. We also need to know the methods used to restore metal to its original condition. The process of heat treating is the method by which metals are heated and cooled in a series of specific operations that never allow the metal to reach the molten state. The purpose of heat treating is to make a metal more useful by changing or restoring its mechanical properties. Through heat treating, we can make a metal harder, stronger, and more resistant to impact. Also, heat treating can make a metal softer and more ductile. The one disadvantage is that no heat-treating procedure can produce all of these characteristics in one operation. Some properties are improved at the expense of others; for example, hardening a metal may make it brittle. [1]

1.1 Heat Treatment Theory

The various types of heat-treating processes are similar because they all involve the heating and cooling of metals; they differ in the heating temperatures and the cooling rates used and the final results. The usual methods of heat-treating ferrous metals (metals with iron) are annealing, normalizing, hardening, and tempering. Most nonferrous metals can be annealed, but never tempered, normalized, or case-hardened.

Successful heat treatment requires close control over all factors affecting the heating and cooling of a metal. This control is possible only when the proper equipment is available. The furnace must be of the proper size and type and controlled, so the temperatures are kept within the prescribed limits for each operation. Even the furnace atmosphere affects the condition of the metal being heat-treated.

The furnace atmosphere consists of the gases that circulate throughout the heating chamber and surround the metal, as it is being heated. In an electric furnace, the atmosphere is either air or a controlled mixture of gases. In a fuel-fired furnace, the atmosphere is the mixture of gases that comes from the combination of the air and the gases

released by the fuel during combustion. These gases contain various proportions of carbon monoxide, carbon dioxide, hydrogen, nitrogen, oxygen, water vapor, and other various hydrocarbons. Fuel-fired furnaces can provide three distinct atmospheres when you vary the proportions of air and fuel. They are called oxidizing, reducing, and neutral. [2]

1.2 Stages Of Heat Treatment

Heat treating is accomplished in three major stages:
Stage l—Heating the metal slowly to ensure a uniform temperature
Stage 2—Soaking (holding) the metal at a given temperature for a given time and cooling the metal to room temperature
Stage 3—Cooling the metal to room temperature [3]

1.3 Types Of Heat Treatment

Four basic types of heat treatment are used today. They are annealing, normalizing, hardening, and tempering. The techniques used in each process and how they relate to Steelworkers are given in the following paragraphs [4]

1. Annealing:-

In general, annealing is the opposite of hardening, You anneal metals to relieve internal stresses, soften them, make them more ductile, and refine their grain structures. Annealing consists of heating a metal to a specific temperature, holding it at that temperature for a set length of time, and then cooling the metal to room temperature. The cooling method depends on the metal and the properties desired. Some metals are furnace-cooled, and others are cooled by burying them in ashes, lime, or other insulating materials. [5]

2. Normalizing:-

Normalizing is a type of heat treatment applicable to ferrous metals only. It differs from annealing in that the metal is heated to a higher temperature and then removed from the furnace for air cooling.
The purpose of normalizing is to remove the internal stresses induced by heat treating, welding, casting, forging, forming, or machining. Stress, if not controlled, leads to metal failure; therefore, before hardening steel, you should normalize it first to ensure the maximum desired results. Usually, low-carbon steels do not require normalizing; however, if these steels are normalized, no harmful effects result. Castings are usually annealed, rather than normalized; however, some castings require the normalizing treatment. [6]

3. **Hardening:-**

The hardening treatment for most steels consists of heating the steel to a set temperature and then cooling it rapidly by plunging it into oil, water, or brine. Most steels require rapid cooling (quenching) for hardening but a few can be air-cooled with the same results. Hardening increases the hardness and strength of the steel, but makes it less ductile. Generally, the harder the steel, the more brittle it becomes. To remove some of the brittleness, you should temper the steel after hardening. [7]

4. Tempering:-

After the hardening treatment is applied, steel is often harder than needed and is too brittle for most practical uses. Also, severe internal stresses are set up during the rapid cooling from the hardening temperature. To relieve the internal stresses and reduce brittleness, you should temper the steel after it is hardened. Tempering consists of heating the steel to a specific temperature (below its hardening temperature), holding it at that temperature for the required length of time, and then cooling it, usually instill air. The resultant strength, hardness, and ductility depend on the temperature to which the steel is heated during the tempering process. [8]

5. Quenching Media:-

The cooling rate of an object depends on many things. The size, composition, and initial temperature of the part and final properties are the deciding factors in selecting the quenching medium. A quenching medium must cool the metal at a rate rapid enough to produce the desired results. [9]

2. LITERATURE SURVEY

(1) Author name : Ashish Bhateja, Aditya Varma, Ashish Kashyap and Bhupinder Singh -2012 ***[1]***
Summary: After annealing value of hardness of specimen is 55 HRC as compared to untreated specimen annealed specimen becomes softer. Therefore specimen machine-ability properties increase. They used HRA scale because after annealing EN-31 becomes soft and below 20 HRC value HRC scale is not gives the accurate value and also value is not valid.

(2) Author name: Sikander , Swati Gangwar – 2016 ***[3]***
Summary: The specimen austempered for 15 min has a higher value of tensile strength and for 45 min time has the least value of tensile strength, because of retained austenite present in the microstructure. The specimen austempered for 30 min has a higher value of ductility, and 30 min has the least amount of ductility, because of bainite ferrite and carbide formation.

(3)Author name: Priyank Ramoliya ,Brijesh Vora ,Navneet Vaghasiya ,Hardik Vaghasiya.- 2017 ***[4]***
Summary: After performing experiments we can conclude that as austenizing temperature increases the value of hardness also increases and as tempering temperature increases and the hardness value decreases in respective quenching media. We are getting maximum value of hardness at austenizing temperature is 8500 C, Quenching medium is water, Tempering temperature is 1500 C and the value is 62 HRC measured in Rockwell hardness tester. Also we came to conclude that as Austenizing temperature increases the tensile strength also increases and as tempering temperature increases the tensile strength decreases compare to the tensile strength of the material before tempering.

(4) Author name: Kiran S. Phad , Ravidra Gite – 2016 ***[5]***
Summary: This experimental study is to be very useful approach for selection of tool steel grade which will more beneficial for industrial point of view. From the literature review, it is observed that less research work has been seen for Tool Steel i.e. EN-31, EN-9, D-3, D-2 and OHNS after Heat Treatment Processes Such As Annealing and Hardening & Tempering. Also very less work has been reported for Tool Steel. It is observed that the effect of hardness of work piece material after treatment of Tool Steel i.e. EN-31, EN-9, D-3, D-2 and OHNS have not been explored yet, so it's interesting to Study the Effect on the Hardness of five Sample Grades of Tool Steel i.e. EN-31, EN-9, D-3, D-2 and OHNS after Heat Treatment Processes Such As Annealing and Hardening & Tempering.

(5)Author name: Bhupinder Singh, Singh Bajwa - 2016 ***[6]***
Summary: After annealing specimen of EN-31 becomes more softer then untreated specimen as hardness value shown. After normalizing hardness is more as compared to untreated specimen. After hardening and tempering specimen are hardest then other three specimens and microstructure will change after heat treatment. Moreover after heat treatment specimen become have good corrosion resistant.

(6)Author name: Anmol Singh ,Amit sharma – 2017 ***[7]***
Summary: From all the characterizations and study of various parameters involved in heat treatment, welding and post weld Heat Treatment we conclude that Heat treatment of carbon steel always results in improvement in hardness, tensile strength and also refines grain boundaries that can be confirmed from study of mechanical properties after HT. Welding results in introduction of stress in the welded specimen, which reflects some kind grain boundary deformation in specimen. This results in decreases in tensile strength of material (Metal or alloy). Post weld heat treatment results in increase in strength of welded joint, thus stress relieving objective can be achieved by suitable HT mechanism, along with improvement in other mechanical properties.

(7)Author name: Sujit Raj ,Rahul Davis -2014 ***[8]***
Summary: The following conclusions are derived during turning of hardened AISI 4340 steel with multilayer coated carbide (single point) tool insert .during experiment, Heat treated specimen have got mild and at different cutting parameters finishing of surface is better than non heat treated specimen. After all surface roughness will depend upon the combined effect of cutting parameter and the contributing factors .BHN of heat treated specimen is less than non heat treated specimen.

(8)Author name: Sanjib Kumar Rajpura – 2009 ***[9]***
Summary: From the various results obtained during the project work it can be concluded that the mechanical properties vary depending upon the various heat treatment processes. Hence depending upon the properties and applications required we should go for a suitable heat treatment processes. However if strength is also desired along with hardness, this should not be done. It is seen that annealing causes a tremendous increase in % elongation (ductility). It can be clearly seen comparing all the heat treatment processes, optimum Combination of UTS, Yield Strength, % Elongation as well as hardness can be Obtained through austempering only

(09)Author name :Kurri Rohan Ramesh, Jagtap Tukaram. -2015 ***[10]***

Summary: As a overall concluding remark we can say that the surface roughness increases with increase in Pulse on time and Peak current, while decreases with increase in pulse off time and servo voltage. Similarly double tempering after hardening reduces surface roughness compared to single tempering.

(10)Author name: Amit kumar Tanvar -2014 ***[11]***
Summary: Tensile strength, yield strength and elongation have best results in normalized heat treated mild steel specimen than all other specimens of mild steel and stainless steel. Without heat treated stainless steel specimen shows better results for Tensile strength and yield strength than heat treated stainless steel specimens.. Without heat treated stainless steel specimen shows poor results for elongation in Tension than heat treated (Normalizing, Annealing and quenching) stainless steel specimens .In Testing of without heat treated specimens of mild steel and stainless steel, Tensile strength and yield strength are more and elongation is less for stainless steel than mild steel specimen.

(11)Author name: Harichand ,Sachin Chaturvedi , Sumit Sharma-2012 ***[12]***
Summary: we summarize the things 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.

(12)Author name: D.A.Farade , T.G.Farade ,O.Y .Akanbi. – 2011 ***[13]***
Summary: we summaries the from research paper is Tensile strength, yield strength and hardness of medium carbon NST 37-2 steel increased with plastic deformation while ductility and impact strength decreased due to strain hardening effect. Normalization treatment had also resulted in higher tensile strength and hardness than annealed samples. This treatment is recommended as final treatment after manufacturing and mechanical properties of NST 37-2 steel can be altered through heat treatment.

3. CONCLUSIONS

Based on research paper study, concluded point that describe below

- EN-31 steel has carbon content of 1% the most common form of steel as it's provides material properties that are acceptable for the manufacture of parts such as general purpose axles and shafts, gears, bolts and studs
- For high hardness heat treatment is done.
- For high strength of material heat treatment is necessary
- To increase the hardness of the material and increase the life of the material against the failure occurs due to high loading on the axles, gears, bolts and studs we are going to use heat treatment on the material at different temperature and through different quenching media.
- For removing or relieve strains or stresses induced by cold working (drawing, bending etc.) or non-uniform cooling of hot metal.
- For improving machinability.

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