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To Increase the Hardness of Material by Proper Heat Treatment Process

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A B S T R A C T

Steel has different quality of hardness in elasticity as per the application and concern of carbon diffusion to the Steel. Low carbon steel medium carbon steel and high carbon Steel are used as per the load bearing capacity and application of site. Karbonn is refused to the Steel from 0.30 to 1.5 percentages as per the requirement of hardness. To increase the hardness of material various heat treatment process are done with the alloy materials and also different types of Steel.

In industry different steel is used as per the requirement of hardness and application of material. Carbon percentage is mainly responsible for the hardness of steel. In this article, various property of steel is considered regarding the hardness of steel and stresses applicable to the steel t the time of live load.

Key words : Hardness of steel, Elongation of material, strength of steel, Axial load on the material, Strength of steel, percentage of carbon content.

1. Introduction.

As hardness of the material is increased by proper arrangement of grands inside the material. Cold work and cold pressed metal have higher hardness compared to the other hardness increasing process. Now a days various heat treatment processes are available to increase the hardness of material. Another issue is that whenever material is heated opposite critical temperature the metal will be melted and its restructure may not be arranged in proper way there for hardness of the material may not be achieved as per the criteria of the production engineer. Number of heat treatment process is like a tempering, surface hardening, Annealing etc are done on the metal to increase the hardness of material.

2.Property concern with Hardness of Ferrous and non ferrous metals

Number of heat treatment Processes are done to increase the hardness of material like hardening, annealing, normalising, stress relieving, case hardening, nitriding, and tempering etc. Ferrous material contains the iron and non ferrous does not. So heat treatment process are also preferred as per the contain of the material.For ferrous and non ferrous materials different heat treatment process are done as per the property of materials. It's not recommended that the processes which are done to increase the hardness of ferrous material the same heat treatment process can be performed for the non ferrous of materials. Ferrous materials include Steel and cast iron. Steel is a ferrous metals which contains the iron. The proportion of carbon which is responsible to increase the hardness of Steel as per the various divisions. As low carbon steel, medium carbon steel and high carbon steels are divided as per the percentage of

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carbon available inside the Steel.

Low carbon steel : In this steel percentage of carbon is up to 0.25%. Due to less percentage of carbon this steel has lower strength but it can be used in the application of ductile space. This still has higher ductility so it is very useful where lower strength and higher elasticity proposal is required.

Medium carbon steel : This still has carbon percentage between 0.30 to 0.75. Drishti has intermediate effect of strength and ductility so it can be used in the average application of toughness and elasticity.

High carbon steel : This steel has carbon percentage of 0.75 to 1.5 . It has maximum strength but lower ductility so it can not be used where property of electricity is required. This steel can bear maximum load but at the time of impact load it works as a brittle material and can't expand or contract to come up with the external load.

Nomenclature

HD	Hardness of steel
Temp of C	Temperature of carbon material
Graph.	Percentage of Graphite in the steel (%)
Carbon p	Percentage of Graphite in the steel .
Arran of Latt.	Lattice arrangement at the on cooling
Heat Tr.	Heat transfer
HE Temp	Higher Temperature .
LHE =	Lower Temperature

2. Processes like hardening, annealing, normalising, stress relieving, case hardening, nitriding, and tempering are generally done on ferrous metals

1 **Hardening Process**

In hardening process material is heated up to the level below the critical temperature and recrystallization of material does not occur. In this process metal is heated so grace of the metal can be arranged in a manner that all the science of grains maybe arranged in the same pattern and hardness of the material can be increased by the proper heat treatment process so in the handling process of material can be increased buttility and elasticity fall down. After proper heat treatment the metal is coinced in the water or alkaline water or oil or any other hide density fluid so the temperature of the material false down drastically and all the grains of the metal are arranged in proper manner. Quenching is a phenomena in which the metal is constant means immersed in the low temperature fluid this fluid maybe simple water or alkaline water or oil or any other high density fluid.

2. **Annealing Process**

Basically Annealing process concern with recovery stage,recrystallization stag and grain growth stage.
In analying process material is heated up to the recrystallization temperature and after that it is cooled slowly and periodically as per the requirement. The main concern of the production engineer is that metal must be cooled at required rate so all the grains of the material must be arranged in a proper way. To heat the metal there should be controlled temperature then metal is placed inside the oven and heated and circulated air flow occurs about the metal for the annealing process. It must be take into account that if air is circulated in proper way then and then material can be handled in proper way in terms of grain growth.

1st stage is recovery stage in which strain and other stresses that are available inside the metal are removed then further process can be performed on the metal for its better strength. Strain removing and stresses removing stage are very important because existing stresses can destroy the strength of material and metal may be broken at any stage of working.2nd stage is for recrystallization stage in which material is heated up to the critical temperature of the melting point of that metal so that metal may be melt and it will be converted into liquid form. After conversion of metal in the liquid form material is cooled up to the extent leavel so that it can be converted into its original solid structure. Then grain structure is observed for better strength of metal. As Metal is melted and grains are arranged on particular manner for better hardness.

3.**Normalising process**

In this process of normalising metal is heated at elevated temperature then it is cooled to the room temperature or at the atmospheric temperature so metal grens are arranged in required manner so that hardness of the material will reduce but the treaty of material can be increased. There for normalisation applied whenever ductility is required so material can be capable to absorbed the impact load.
Steel requires the desired Mechanical properties therefore it has capability for best ductile work property under pressure. Steel microstructure is rearranged and grains are rearranged in a manner so that elasticity of the Steel is achieved and hardness of the Steel will be decreased.
Steel is heated between 700 to 900 celcius.

4. **Stress reliving**

This process involves the predetermined temperature of metal but lower than the temperature of transformation. Air is continuously provided to the metal so it cannot go for the transformation but grains are arranged in a manner so that stress is relieved.
Stress which is present inside the metal it is responsible for the lower strength of material and this is also responsible for instance breaking property of material. Due to stress available in the material, material can't ae to bear impact load and also not capable to bear gradual load.

5.**Case Hardening**

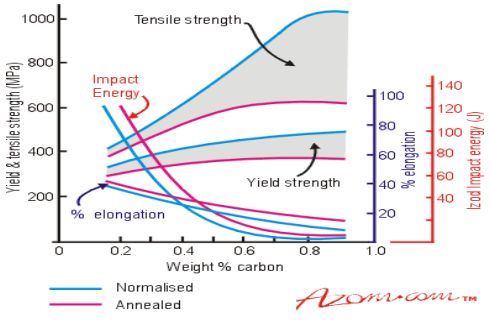
In this process layer of another durable material is applicable to the metal whose strength and material life is required for long time. This process is applicable to the forging of stainless steel, making of machine parts etc where highest ranked and long machine parts life is required. Carburizing process is also a hit treatment process which is used for the case hardening of material particular for the force the material machining parts and the material which is continuously in the abrasion of other parts. This process is specially used to increase the surface hardness of material.

6.**Nitriding**

Generally nitrogen is diffused to the best metal to increase the hardness of material. This process can be achieved at the temperature of 975 fahrenheitThis process is very useful to increase the hardness of material. In this process nitrogen is fed to the surface of material to increase the hardness of alloy Steel. This process is widely applicable to the titanium and low all Steel material. By nitriding process wear resistance,fatighe resistance and Corrosion restiance property of material is increased. Salt bath it high temperature carbon and nitrogen both are diffused in the material for its better strength and hardness.

The heat exchanger is an equipment which can exchange the heat from the hot fluid to the cold fluid. It concludes two fluid, one temperature is higher, gives off heat; the other kind of fluid temperature is low, absorption of heat. Due to the development of science and technology, the variety of heat exchanger emerges in endlessly, but it can be in accordance with certain rules to distinguish Number of heat exchangers are available like condenser compressor, Evaporator ,expansion device and all heat exchangers are used in Air conditioning systems. Basically in Air conditioning system heat is removed from inside space to the atmosphere. The space which is to be cold is at lower temperature and outside temperature is higher. According to the direction of hot fluid and cool fluid flow can be divided into downstream type, counter-current type and mixed flow. For various types of heat exchanger improved heat transfer technology research, mainly concentrated in the fluid flow changes inside the heat exchanger and the research on parameter optimization of components of two aspects, and the parameters of the main research object is the heat exchange tube heat exchanger components (plate) arrangement (rows or fork), (plate) heat exchange tube row number, heat exchange tube size (plate) spacing, fin spacing, fin shape and other options are also available.

3. Carbon percentage Vs steel strength:



1.1 Effect of carbon percentage

As percentage of carbon increases the strength of steel also increases. Carbon percentage affect the ductility of steel and also affect the sheet material at the time of application of steel object. Low carbon steel gives lower hardness but it will give better ductility so elastic property of the steel increases and the flexibility of steel increases. As on the other side higher carbon percentage will increase hardness but it will reduce the ductility of the steel so thiskind of material just becomes brittle and gets fail at the time of impact load.

4. Iron and carbon diagram of steel

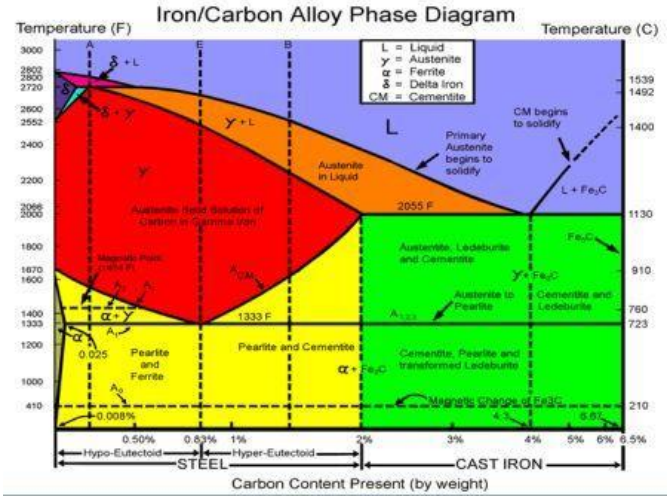
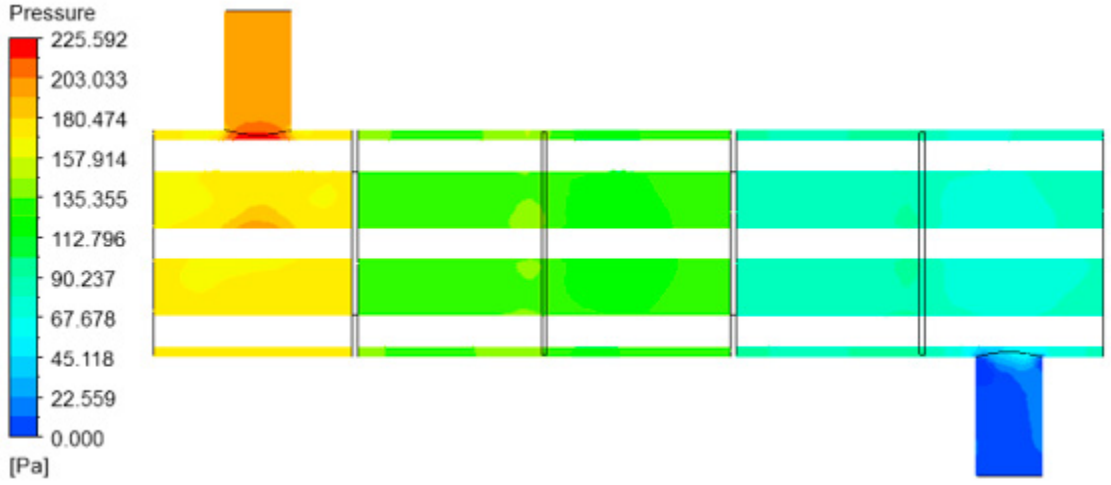


Fig 2 . Iron –carbon diagram for steel

0.50 % percentage of carbon considered as Hypo Eutectoid steel but whenever percentage of carbon increases the steel becomes hyper Eutectoid. As percentage of carbon increase more than 2 than steel will become cast Iron and strength of that material is extremely high. Just like steel cast Iron has also distribution like Hypo and Hyper Eutectoid cast Iron.

3. Outcome of Carbon percentage in material

Number of different materials that re used in the industry and also applicable for different process. But whenever strength is needed than percentage of carbon matters as per the Iron- Carbon diagram. Sometime it is also observed that the different alloys also help to increase the red hardness of the material and it will increase the overall strength of the material.



4. Conclusion

By heat treatment process- surface hardness of material is increased compared to the normal material. Whenever metal is heated up to the recrystallization temperature then grain structure is also important part of material for its internal strength. After melting of metal up to the recrystallization zone grain of material must be in the same direction for its better strength and hardness. It is also observed that formation of matensite is also very important aspect whenever a metal is heated up to the critical temperature point. Hardness of material and melting point of material can be achieved by its proper hardening and toughness process. Steel is used for the purpose of impact load bearing capacity and carbon is diffused to the Steel as per the requirement of hardness and flexibility of material.

Also arrangement of the internal structure affects on the strength of the material, as porous material cannot give better strength. Therefore at the time re construction of the structure minimum space should be kept between the molecules of the material. Number of parameters that affect the strength of the material like atomic mass, pressure of the system, temperature of the system, internal property of the system.

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REFERENCES

[1] Maki T. Steel, what a fabulous material. Nippon Steel Tech Rep. 2012;101:11

[2] Ushioda K, Tsuchiya H. Fundamentals for controlling the microstructure and properties of cold rolled and continuously annealed sheet steels. Trans Indian Inst Met. 2013;66:655. [Crossref],

[3] Ohmura T. The new developments on steel research that ultra-steel project has brought. Met Technol (Jpn). 2011;81:639.

[4] Karl Stephan, Boris Slipcevic. Heizen and Kuhlen-verfahre-nstechnische Aspekte[J]. Chem-Ing-Tech, 1989,61(9):694-701.

[5] Zhao L, Park N, Tian Y, et al. Combination of dynamic transformation and dynamic recrystallization for realizing ultrafine-grained steels with superior mechanical properties. Sci Rep. 2016;6:39127.

[6] M.A. Charpagne, T. Billot, J. M. Franchet, N. Bozzolo. J Alloys Compd 688(2016) 685-694

[7] S. Q. Zhu, H. G. Yan, X. Z. Liao , S. J. Moody, G. Sha, Y. Z. Wu, S. P. Ringer. Acta Mater 82(2015) 344-355

[8] S. F. Medina, C. A. Hernandez. Acta Mater 44(1996) 165-171

[9] M. Winning, G. Gottstein, L. S. Shvindlerman. Acta Mater 50(2002) 353-363

[10] M.Avrami. . Chem Physics 7 (1939) 1103-1112.