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A Review on Performance Evaluation of Gas Carburising Chamber

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Abstract: Heat treatment is controlled method for heating and cooling of a material to achieve certain mechanical properties, such as hardness, strength, flexibility, and the reduction of residual stresses. But the main focus is on hardness. Many heat treatment processes require precise control of temperature over the heating cycle. The result obtained makes it possible for the heat treatment of both ferrous and non-ferrous metals and their alloy in order to alter their microstructure and enhance their properties. Heat treatment may be defined as heating and cooling operations applied to metals and alloys in solid state so as to obtained the desired properties. Heat treating by using gas carburizing chamber is the deposition of carbon on a work material by controlled heating and cooling of a material to achieve certain mechanical properties. The following operating parameters furnace temperature, soaking time and quenching time were taken for optimization of taguchi technique and design of experiment. By the using gas carburizing chamber certain properties like hardness can be increased.

Key Words: Gas carburizing chamber, Mechanical properties, Heat treatment, Taguchi method

1. Introduction

Steel is an alloy of two major constituents iron and carbon. Carbon steel (plain-low) is graded by its carbon content 0.1% to 0.3% its called mild steel, it cannot be hardened by direct heat treatment because of low strength of carbon content. Thermo chemical carburizing case hardening and heat treatments of atoms in metals and alloys and a corresponding marked variation in physical, chemical and mechanical properties. Among the most importance of these treatments are heat treatment processes such as immersion hardening, induction hardening and case hardening. The case hardening heat treatment process perform on gas carburizing chamber which is easy to operate and less costly furnace. Carburizing and case hardening are “thermo chemical” treatment, usually conducted at temperature in the range 800-950° C in the first stage of case hardening [3]. In carburizing, controlled level of carbon is introduced at the surface and allowed to diffuse to a controlled depth. In the gas carburizing process original toughness and ductility remains unaffected even after the heat treatment.

2. Methodology

Heat treatment processes: As steel worker we are interested in the heat treatment of metals, since we have to know what are the effects of heat produced by the by welding and 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 metal is heated and cooled in a series of specific operation that never allow the metal to reach the molten state. The purpose of heat treating is that we can make a metal harder, stronger and more resistance to impact. Also heat treating can make a metal softer and more ductile. There are several different types of heat treatment processes, by controlling the soak temperature and the cool down rate of the steel [6].

The processes are as follows:

1) Annealing
2) Normalizing
3) Hardening
4) Tempering

Hardening: The hardening treatment for most steel consist of heating the steel to a set temperature and then cooling it rapidly by plunging it into oil, water. Most steels require rapid cooling (quenching) for hardening but a few can be air-cooled with the same result. Hardening increasing 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 brittleness one should temper the steel after hardening. To harden steel, one should cool metal rapidly after thoroughly soaking it at a temperature slightly above its upper critical point. The addition of alloys to steel decreases the cooling rate required to produce hardness. A decrease in the cooling rate is an advantage, since it lessens the danger of cracking and warping. Pure iron, wrought iron and extremely low carbon steel have very little hardening properties and are difficult to harden by heat treatment [6].

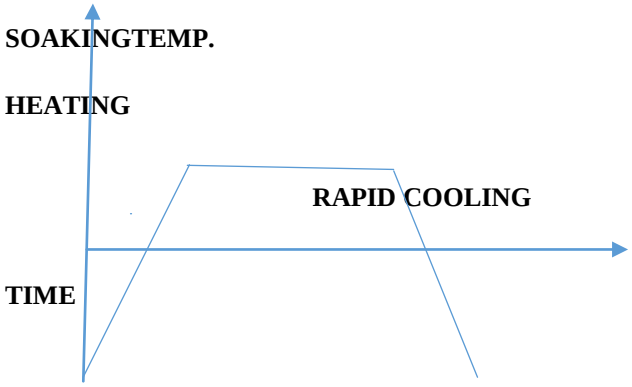

Fig 1: schematic diagram of heat treatment

3. Process plan

Process plan for performing experiment on gas carburizing chamber as follows [4]:

1) Selection of materials .
2) Testing of material (composition of material and hardness)
3) Selection of parameter for experiment (hardness, % of carbon etc.)
4) Design of experiment.
5) Experiment performance on gas carburizing chamber
6) Testing of material (final composition of material)
7) Implementation of experiment by taguchi method.
8) Conclusion

4. Experiment details

For performing experiments on gas carburizing chamber to increase the required property i.e hardness of the material, the first step considered is the material selection is most important. For increasing the hardness of material the better material is steel, because steel have lower carbon content and hardness, and it can be easily increased by increasing carbon % of steel. For first experiment set, gas carburizing chamber is set at required temperature, generally the temperature for gas carburizing is 800-950°C [3] Then at constant temperature it leaves for soaking for required time period, then it can be cooled rapidly at quenching medium and leave it for some time. Testing the material after quenching and similarly for different material with change in time and parameter.

We are using gas carburizing chamber for the performance of experiment [6]. It is an enclose chamber in which material can be heated to the required temperature. The function of chamber in heat treatment process is to provide heat and carbon to work piece and also requires control system [7].

Specifications table of the furnace:

Sustaining temp.	1600^0c
Dimension of furnace	OR=177 mm, IR=175 mm, Height =360 mm, Shell thickness =2mm
Components of furnace	M.S shell, ceramic blanket, heating coil, PID controller, thermocouple, fluid reservoir

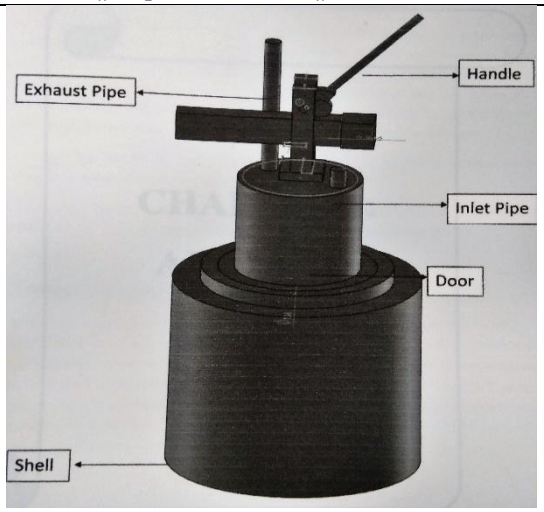

Fig: Gas carburizing furnace

5. Taguchi method

Taguchi method is a statistical method or sometimes it also known as robust design method developes by genichi taguchi to improve of quality manufacturing goods and more recently also applied to engineering, biotechnology, marketing and advertising. The taguchi method is based on orthogonal arrays to minimize the number of experiments and to effectively improve product quality[2].

Some of its many advantages include:

1) Design orthogonal arrays (OA) to balance process parameter and minimize test runs.
2) Employ single to noise (S\N) ratio to analyze experiment data and conclude more information. Taguchi recommends using the S\N ratio for determining quality characteristics implemented in engineering design problems [1].

6. Conclusion

Since the purpose of this study is to optimize value of hardness within optimal levels of process parameter, the higher the better quality characteristics is selected. Each parameter has three levels. The current study considers hardness as optimization criteria and also analyzes the influence of each heat treatment parameter on the quality of the research object.

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