DEVELOPMENT INSTALLATION AND TESTING OF CASE HARDENING SETUP

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ABSTRACT

This paper aims towards developing The heat treatment processes are generally carried out to the low carbon steels in the production field to change or modify the physical and mechanical properties of steals. The content of carbon in mild steel is less than 0.3% and in certain applications it requires sufficient hardness on surface of a component. Because of the lack of carbon, the metals are subjected to the carburizing Process. The carburizing process diffuses carbon in to the surface of heat treated components in an atmosphere controlled furnace. The purpose of carburizing is to increases the surface carbon content, on the surface region or case depth/layer. Fick's law describes the instantaneous flow of diffusing atoms in the case layer. The case depth can be controlled by controlling the diffusion of carbon atoms through the surface layers of the work piece. Hard surface with tough core of work piece is obtained during subsequent quenching in a suitable quenching medium.

Among the several types of carburizing process we selected pack carburizing process. We designed our own furnace set up for pack carburizing process. A case hardening mix with 13 parts of hardwood charcoal, 3 parts of barium carbonate, 2 parts of sodium carbonate and 1 part of whiting powder was prepared to get carburizing medium. Test specimens were placed at the centre of this carbon mixture in steel container. This mixture would work on the principle of "carburization" of the mild steel surface. The carbon content in the charcoal penetrates the steel surface, and changes it to a carbon-steel ot tool-steel. This was then hardened by heating and quenching in water or oil in the normal manner. Investigations were carried out to study the effects of heat treatment on the mechanical properties of low carbon steel by conducting Impact test, Tensile test and Rockwell Hardness Test and the properties before and after surface hardening process were analyzed. The result shows that the case hardened steel has excellent combination of tensile strength, impact strength and wear resisting surface which is very attractive for power transmission use.

Key words: *carburizing, charcoal, heating and quenching, mechanical properties.*

1. INTRODUCTION

We are pleasure to introduce our idea "Low carbon steel usually has carbon content less than 0.2%. Low carbon steel has wide applications in areas such as car body panels, tubes, plates, reinforcement for concrete, steel tanks as well as other engineering applications and therefore produced in millions of tones per year. Carbon steels are utilized because of their low cost, ease of fabrication, properties, availability and weldability. Low carbon steel is characterized by low tensile strength, ductility, toughness and provides properties that are acceptable for many applications. A small variation in the percentage of carbon, heat treatments, materials fabrication, component fabrication and fabrication processes introduce significant differences in strength, hardness and other properties of low carbon steel.

Hardness or strength primarily at the surface, and complex service stresses frequently require not only a hard, wear–resistant surface, but also core strength and toughness to withstand impact stress. To achieve these different properties, two general processes are used:

1) The chemical composition of the surface is altered, prior to or after quenching and tempering; the processes used include carburizing, nitriding, cyaniding, and carbonitriding. Such processes are carried out for low carbon steels

2) Only the surface layer is hardened by the heating and quenching process; the most common processes used for surface hardening are flame hardening and induction hardening. Such processes are applicable only for medium and high carbon steels.

2. OBJECTIVE

- To increase the surface hardness of the work piece by using pack carburizing method.
- Analysing the workpiece with various powder after analysis we are finding which one is the effective and used in carburizing.

3. PROBLEM IDENTIFICATION AND SOLUTION

- In recent days laboratory testing has been somewhat difficult and hence this fabrication would provide benefit to students and testing will be more easier than before.

- Cost increment might be an problem in former methods but this fabrication helps to meet costs in an efficient manner.

4. PACK CARBURIZING

In this process, the part that is to be carburized is packed in a steel container, so that it is completely surrounded by granules of charcoal. The charcoal is treated with an alternating chemical such as barium carbonate (BaBo3) that promotes the formation of carbon dioxide (CO2). This gas in turns reacts with the excess carbon in the charcoal to produce carbon monoxide (CO) .carbon monoxide reacts with low carbon steel surface to form atomic carbon which diffuses into the steel. Carbon monoxide supplies the carbon gradient that is necessary for diffusion. The car bruising process does not harden the steel. It only increases the carbon content to some predetermined depth below the surface to a sufficient level to allow subsequent quench hardening.

$CO2+C \rightarrow 2CO$

↓

$2CO+3Fe \rightarrow Fe3C+CO2$

The oxygen of the entrapped air (in the carburizing box) initially reacts with the carbon of the carburizing medium as follows:

$C+O2 \rightarrow CO2$…… (1)

$2C+O2 \rightarrow 2CO$……... (2)

As the temperature rises the following reactions take place and the equilibrium shifts towards right that is gas becomes progressively richer in CO. at high temperature (> 800°c) the boudoirs reaction occurs as follows

$CO_2 + C \leftrightarrow 2CO$ …… (3)

At the steel surface the decomposition of CO gas occurs as follows:

$2C + O_2 \rightarrow CO_2 + C$ (atomic)

$Fe + C$ (atomic) $\rightarrow Fe(C)$

Where Fe(C) is carbon dissolved in austenite.

This atomic and nascent carbon is radially absorbed by the steel surface, and subsequently it diffuses towards the centre of steel sample. CO_2 thus formed react with the carbon (C) of the carburizing medium (reaction 3) to produce CO, and thus, the cycle of the reaction continues. Charcoal is the basic source of carbon during pack carburization. As entrapped air inside the box may be less to produce enough CO_2 (reaction 1) particularly in the beginning of the carburization, it is thus it is common practice to add energizer (usually $BaCO_3$) which decomposes during the heating up period as:

$BaCO_3 \rightarrow BaO + CO_2$

$CO_2 + C \rightarrow 2CO$

The CO_2 thus formed then react with the carbon of the carburizer to produce CO gas. Thus $BaCO_3$ makes CO_2 available at an early stage of carburization and hence it is called energizer.

The case depth increases with rise in carburization temperature and time. The best carburizing temperature is 900°c, the steel surface absorbs carbon at a faster rate and the rate at which it can diffuse inside, thus producing super saturated case which may produce cracks during quenching. In pack carburization it is difficult to control exactly the case depth because of many factors affecting it, such as density of packing amount of air present inside the box, reactivity of carburizer, etc….

5. APPLICATIONS

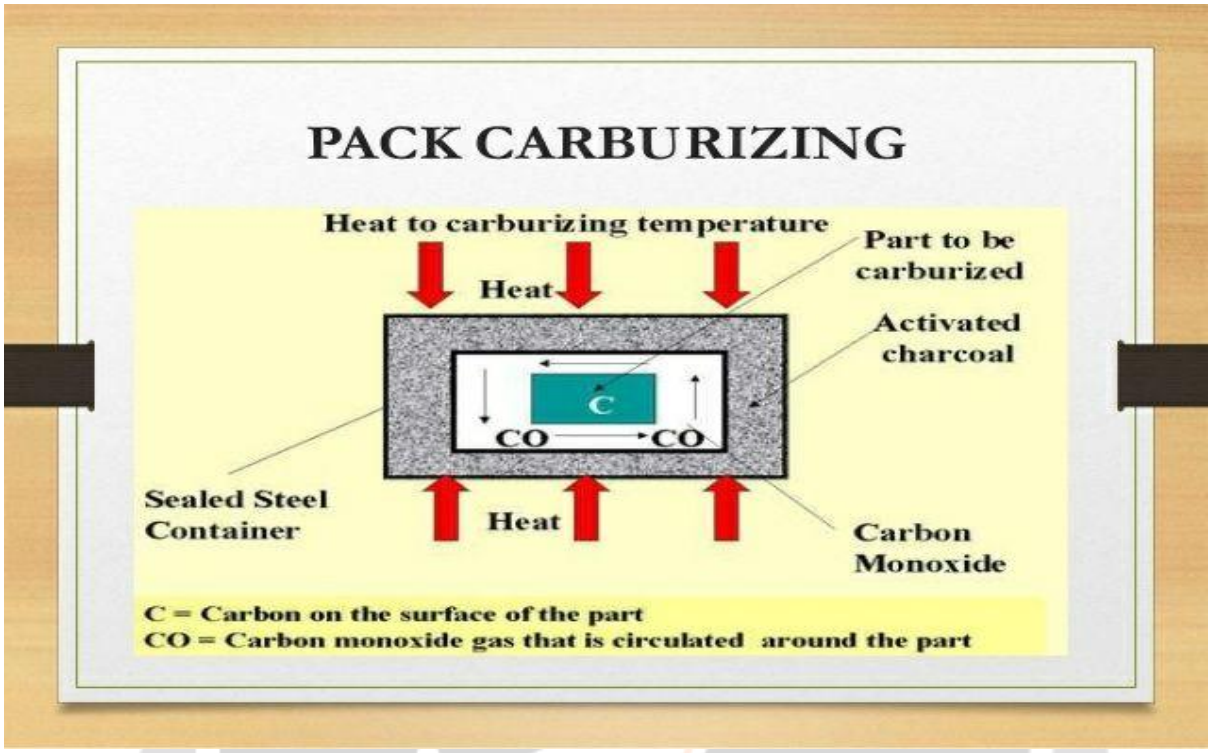
The possible applications of low carbon steel are very wide. The properties are such As to extend the field of usefulness of mild steel and enable it.

Some popular uses of Low carbon steel for various engineering application are for:

1. Crane wheels.
2. Crane cable drum.
3. Gear wheel and pinion blanks and brake drum.
4. Machines worm steel.
5. Flywheel.
6. Ball bearing.
7. Railway wheels.
8. Crankshaft.
9. Shackles of lock.
10. Bevel wheel.
11. Hydraulic clutch on diesel engine for heavy vehicle.
12. Fittings overhead electric transmission lines.

13. Boiler mountings, etc.

6. PROCESS OF PACK CARBURIZING



7. WORKING PRINCIPLE

Carburizing is a process used to harden low carbon steels that normally would not respond to quenching and tempering. The component is packed surrounded by a carbon-rich compound and placed in the furnace at 900degree Celsius. Over a period of time carbon will diffuse into the surface of the metal. Then the hardness of the surface is increased at 0.02mm.Sodium carbonate, potassium carbonate, calcium carbonate are used as a energizer, which is used for improving the carbon content in a specimen. In our project the box is heated up to 800 to 1000^0c.At that stage the carbon particles are going to combined with specimen and it improves the properties of mild steel. There are 3mm holes are drilled on the sides of the box, which is used for removing the pressure occurrence inside the box. Zink is coated inside the box for avoiding the reaction between the carbon contents with the box. But Zink allows the heat from furnace to specimen.

8. CONCLUSION

The project that we have done is on the pack carburizing in the mild steel material. The existing carburizing is only based on packing charcoal but we have added the extra energizer like “calcium carbonate, potassium carbonate and sodium carbonate”. This increase the thickness of material with 0.01mm greater than the existing carburizing methods. This will replace the future carburizing technique.

9. REFRENCE

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