

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



CARBURIZING

Presented To

Engr. Ubaid-ur-Rehman Ghouri

Department of Industrial & Manufacturing
Engineering, UET Lahore (RCET Campus).

GROUP MEMBERS

- Zahid Mahmood 2012-IM-136
- Muhammad Zeeshan 2012-IM-111
- Ali Iqbal 2012-IM-157
- Muhammad Waqas 2012-IM-144

AREAS OF PRESENTATION

- Introduction
- Types of Carburizing
- Advantages/Disadvantages
- Temperature-Time Relation of Carburizing
- Comparison of Carburizing with other HTPs.
- Applications
- Conclusion

INTRODUCTION

- It is a heat treatment process.
- Increasing Carbon on the surface of iron or steel followed by heat treatment.
- Absorbs Carbon liberated when the metal is heated in the presence of Carbon bearing materials.
- Carbon bearing materials can be Charcoal, Carbon Monoxide or Carbon gases.

WORKPIECE MATERIAL

- Low Carbon alloy steels.
- Carbon contents should be ranging from 0.2 to 0.3%.
- Work piece surface should be free from contaminants.



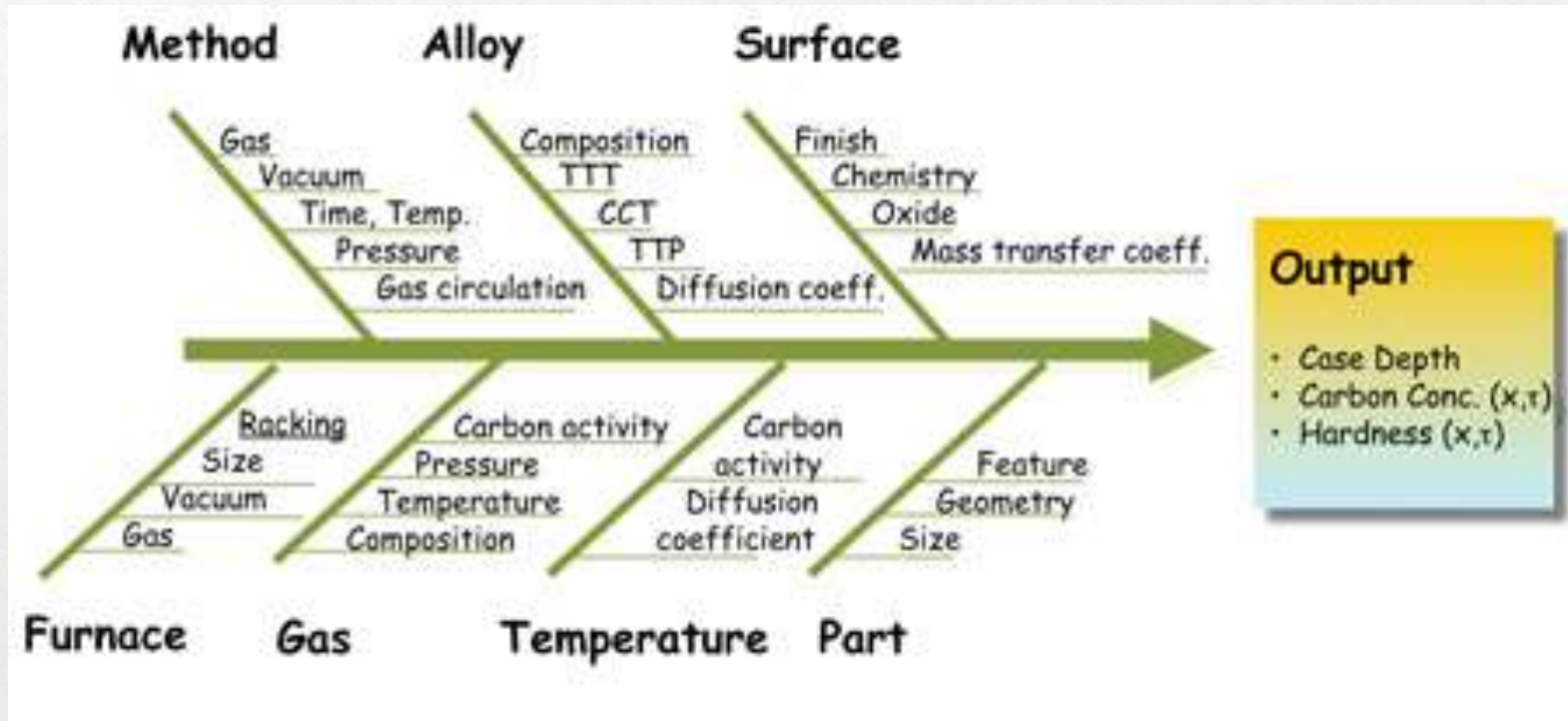
HARDENING AGENTS

- Carbon Monoxide Gas
- Sodium Cyanide
- Barium Carbonate
- Hardwood Charcoal

EFFECTING FACTORS

- Longer Carburizing time and higher temperatures lead to greater diffusion of carbon into the metal/alloy.
- Rapid Cooling/Quenching results transformation of austenite to martensite.
- While core remains soft and tough as a ferritic or pearlitic microstructure.

FLOW SHEET DIAGRAM



WHY CARBURIZING IS USED?

It is used to increase

- Ductility
- Toughness
- Hardness
- Strength

It is also used to relieve internal stresses.

TYPES OF

CARBURIZING

TYPES OF CARBURIZING

- Gas Carburizing
- Vacuum Carburizing
- Pack Carburizing
- Liquid Carburizing

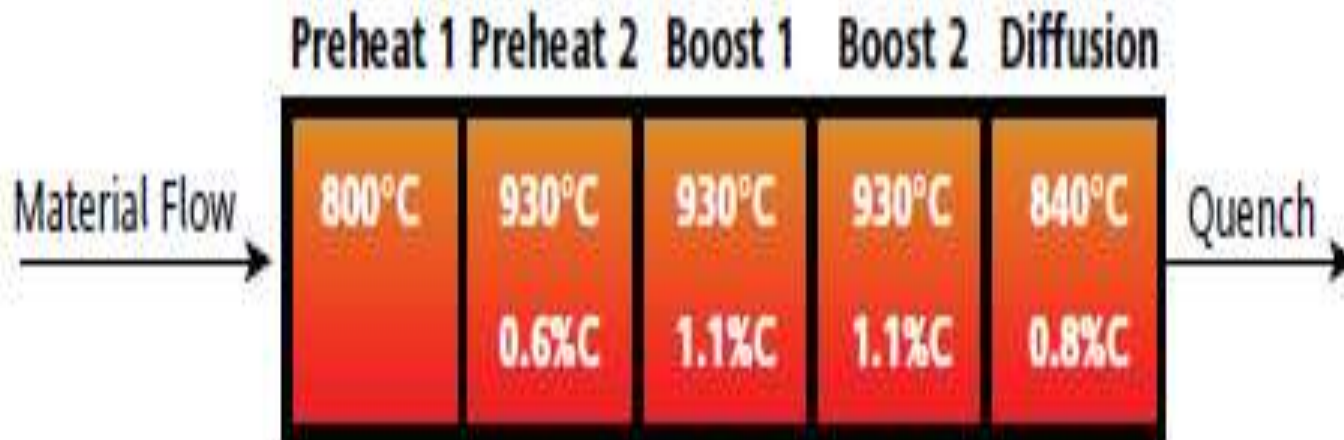
GAS CARBURIZING

Process Description:

- Surface chemistry process.
- Main carburizing agent can be either Methane, Propane, Natural Gas or any other Carbon carrying gas.
- Work pieces are heated with carbon carrying gas.
- Then held for period of time at specific temperature between 800°C - 950°C.
- After that quench the sample.

GAS CARBURIZING

Temperature Ranges:



GAS CARBURIZING



VACUUM CARBURIZING

- It is done under very low pressure.
- Sample is heated in vacuum above transformation temperature.
- Then exposed to carbon carrying gas or mixture under partial pressure.
- **Temperature Range:** 800°C to 1100°C
- **Pressure Range:** 1 to 20 torrs

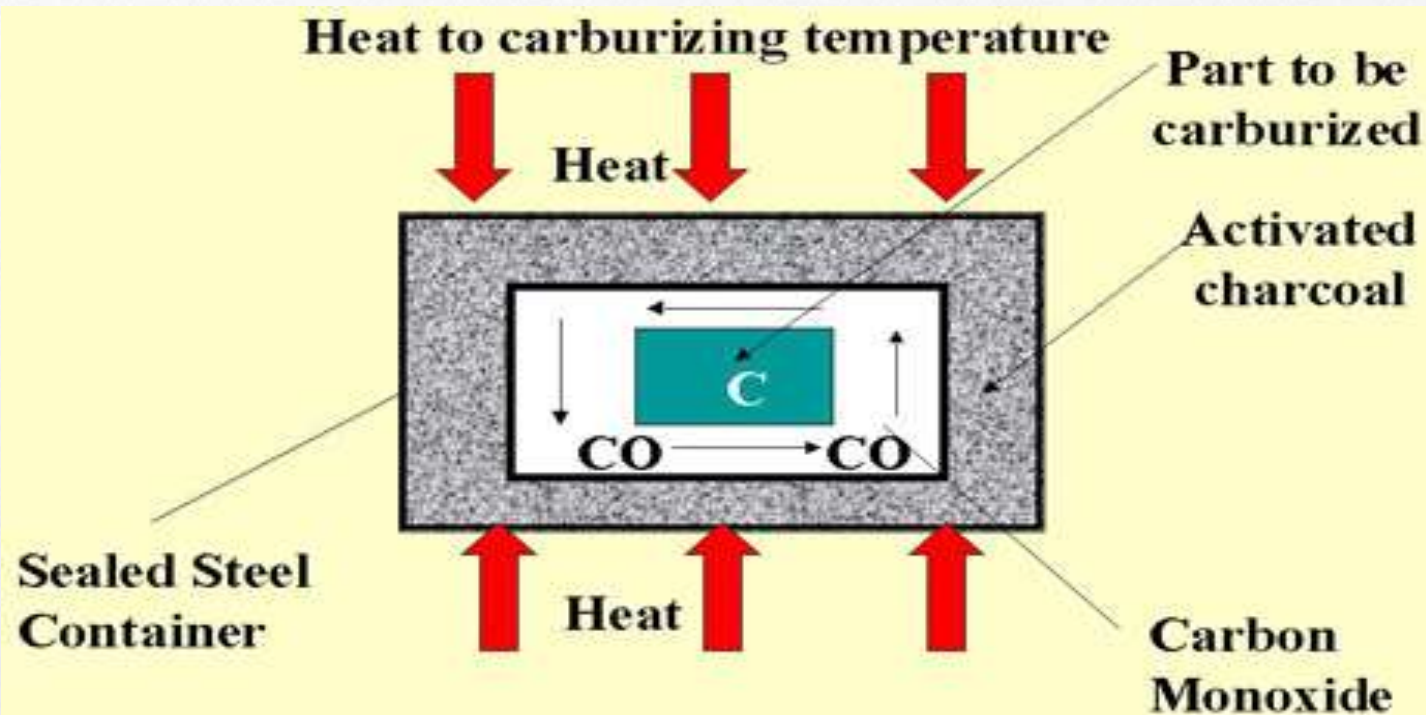
VACUUM CARBURIZING



PACK CARBURIZING

- Sample is packed in a steel container & sample is completely surrounded by granules of charcoal.
- Then heated in a furnace for 12 to 72 hours at 900°C.
- Due to high temperature, carbon diffuses into the surface of sample.

PACK CARBURIZING



C = Carbon on the surface of the part

CO = Carbon monoxide gas that is circulated around the part

LIQUID CARBURIZING

- Sample is placed in molten cyanide's bath so that carbon will diffuse into the sample.
- Diffusion of carbon into sample is greater than nitrogen.
- Low temperature salt bath contains 20% cyanide & operate between 1550°F to 1650°F.
- High temperature salt bath contains 10% cyanide & operate between 1650°F to 1750°F.

LIQUID CARBURIZING



LIQUID CARBURIZING



ADVANTAGES

DISADVANTAGES

GAS CARBURIZING

Advantages:

- Surface Carbon contents & case depth can be controlled accurately.
- It is much cleaner and more efficient method.

Dis Advantages:

- Furnace & gas generator are expensive.
- Handling of fire hazards & toxic gases is difficult.

VACUUM CARBURIZING

Advantages:

- Absence of inter-granular oxidation.
- The process is clean, safe & simple to operate and easy to operate.

Dis Advantages:

- Higher initial equipment cost.
- Formation of soot & tar due to pressure and Hydrogen gas introduced.

PACK CARBURIZING

Advantages:

- It is simple method and less capital investment.
- No atmosphere control furnace is required.

Dis Advantages:

- Carburizing time is very long.
- Difficult to control surface carbon & case depth.

LIQUID CARBURIZING

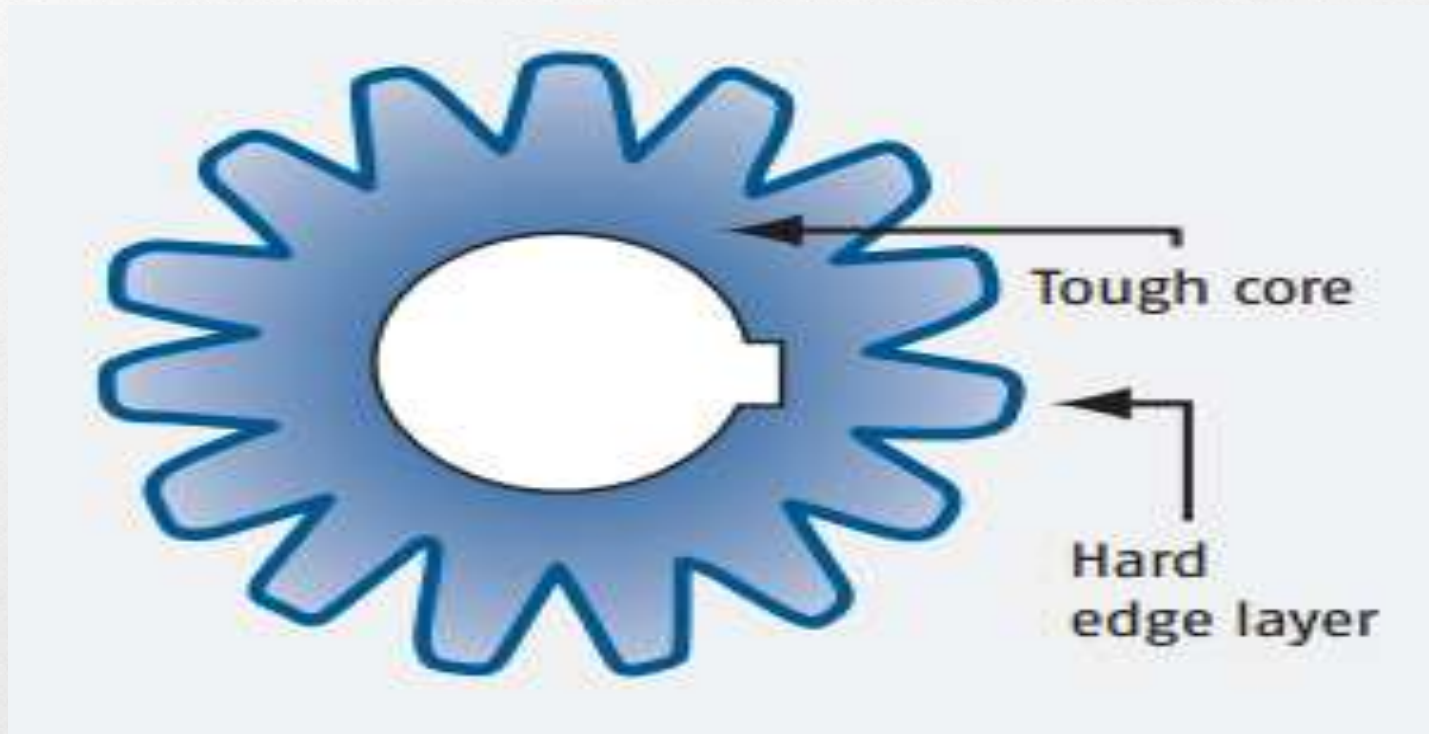
Advantages:

- Freedom from oxidation & soot problems.
- A rapid rate of penetration.

Dis Advantages:

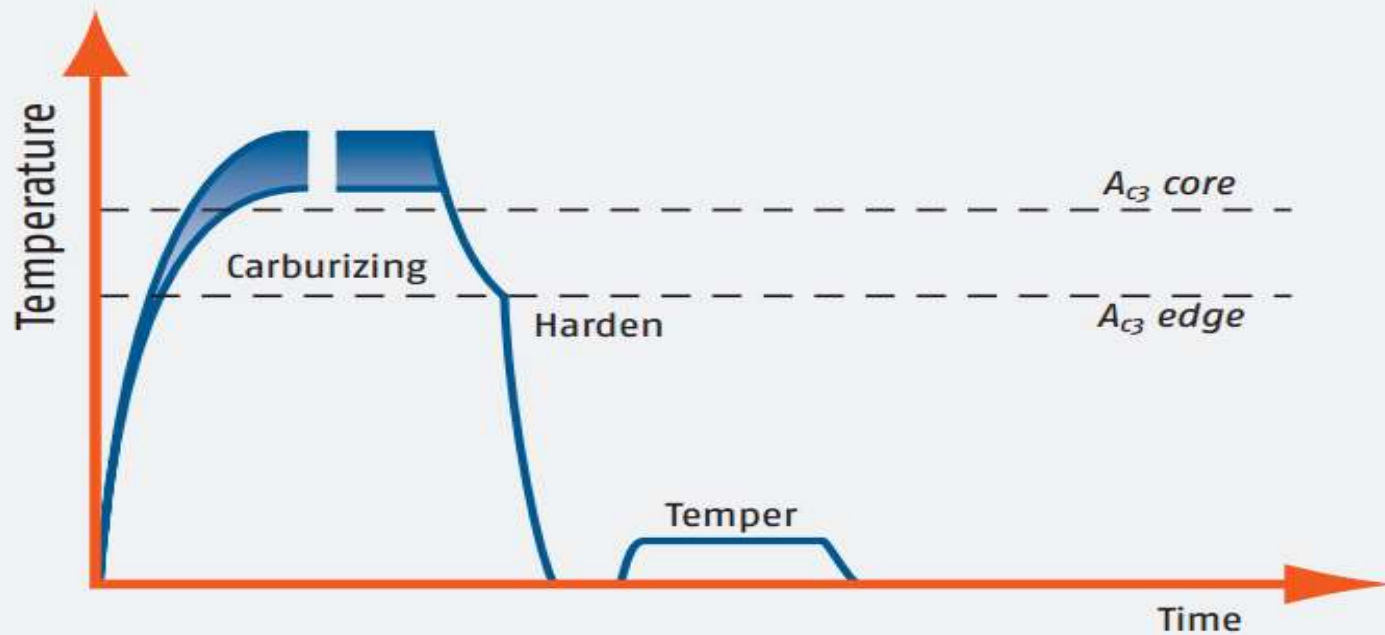
- Proper composition is necessary to obtain uniform case depth.
- Parts must be washed after doing the process.

ANALYSIS OF CARBURIZING (STEEL COMPONENT)



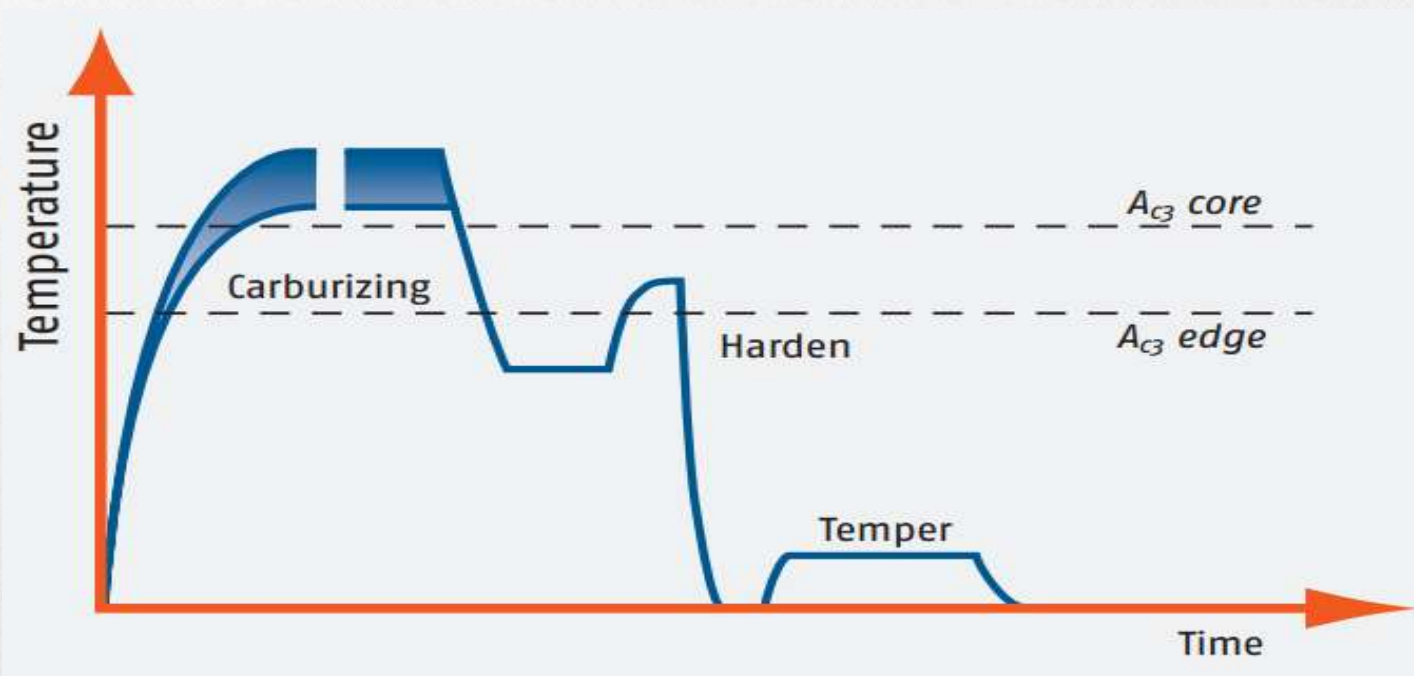
TEMPERATURE-TIME RELATION OF CARBURIZING

- Direct Hardening



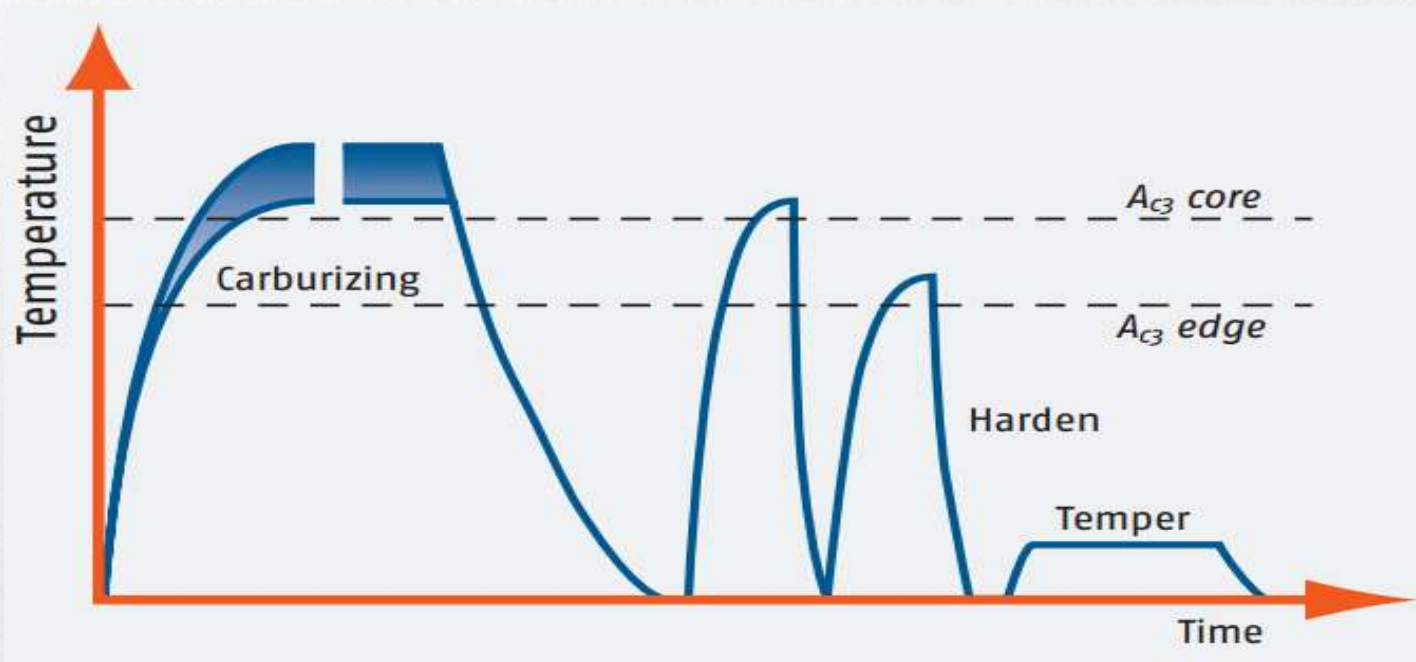
TEMPERATURE-TIME RELATION OF CARBURIZING

- Single Hardening



TEMPERATURE-TIME RELATION OF CARBURIZING

- Dual Hardening



**DIMENSIONAL
CHANGES**

**&
COMPARISON**

DIMENSIONAL CHANGES

Mechanical Changes:

- Increase surface hardness
- Increase wear resistance
- Increase Fatigue strength
- Increase Tensile Strength

DIMENSIONAL CHANGES

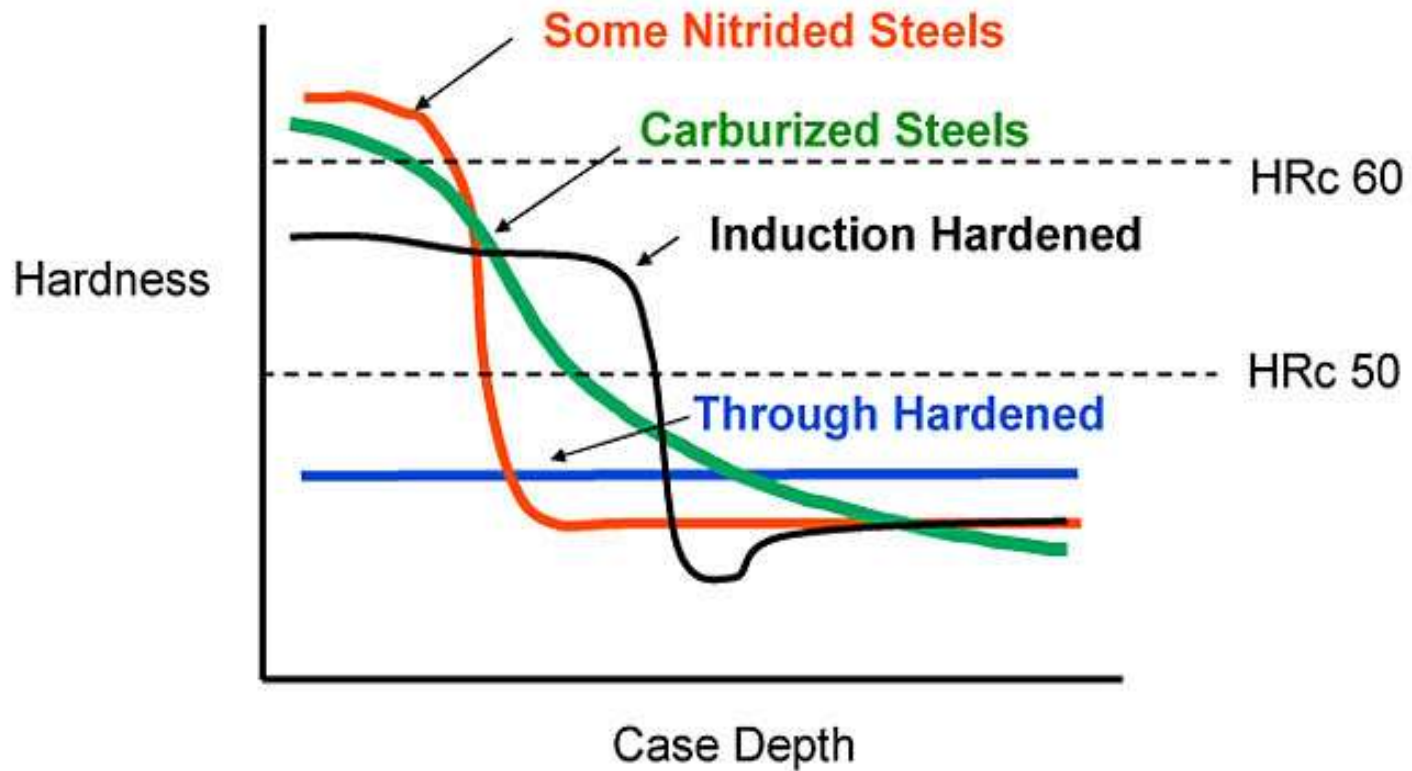
Physical Changes:

- Grain growth may occur.
- Changes in Volume may occur.

Chemical Changes:

- Increased surface carbon content.

CASE DEPTH vs HARDNESS



CARBURIZING vs OTHER HEAT TREATMENT PROCESSES

- In Carburizing, Carbon diffuses onto the steel surface and we get carbon layer on surface.

While

- In Nitriding, Nitrogen diffuses into the surface of steel alloys.
- In Carbonitriding, Carbon and Nitrogen diffuse into the surface of steel alloys.

CARBURIZING vs OTHER HEAT TREATMENT PROCESSES

- In Boronizing, Boron diffuses into the surface of steel alloys.
- In Induction/Flame hardening process, There is no deposition of further atoms into the surface of steel.
- In Induction Hardening, part is placed inside a water cooled copper coil & then heated by applying current.

APPLICATIONS

- Gear teeth profiles
- Crane wheels
- Crane cable drum
- Support bracket for agricultural tractor
- Machines worm steels
- Hydraulic clutch

APPLICATIONS

- Fly wheels
- Ball bearings
- Gear wheels & pinion blanks
- Railway wheels
- Crankshaft
- Shackles of lock
- Bevel Gears

CONCLUSION

- The mechanical properties of the steels strongly influence by carburizing.
- Carbon plays important role in increasing the toughness, hardness and other mechanical properties of steels.
- Gas Carburizing is used for large parts, liquid carburizing is used for medium & pack carburizing is used for small parts usually.

**ANY
QUESTION
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**THANK
YOU**