NITRIDING AND CARBO-NITRIDING

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NITRIDING

INTRODUCTION :-

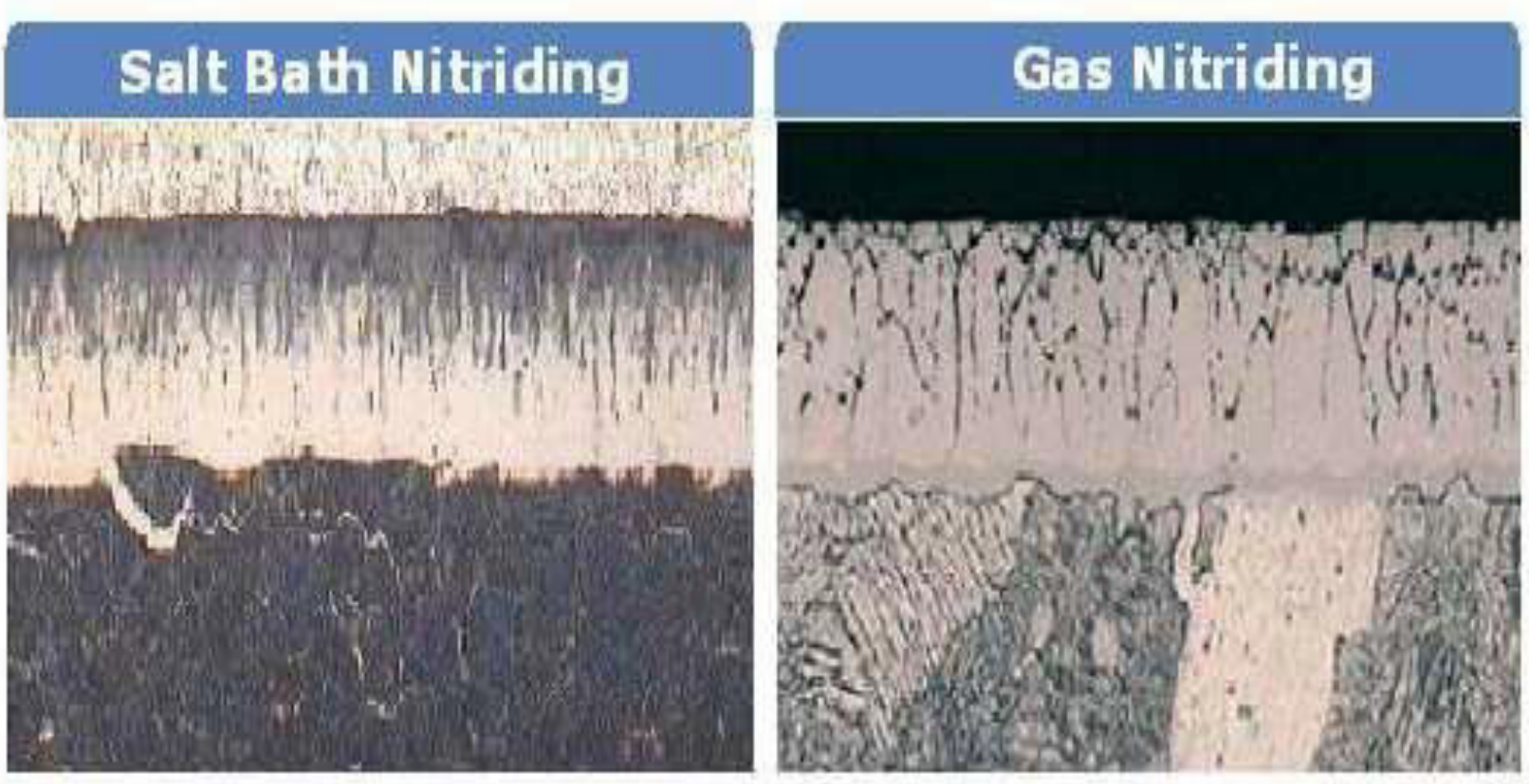
- Nitriding is a heat treating process that diffuses nitrogen into the surface of a metal to create a case hardened surface.
- Nitriding of steels produces less distortion and deformation than either carburizing or conventional hardening.
- These processes are most commonly used on low-carbon, low-alloy steels.
- However they are also used on medium and high-carbon steels, titanium, aluminum and molybdenum.

- **MECHANISM OF NITRIDING**

NITRIDING.

- Case-hardening process.
- Solid ferrous alloy.
- Diffuse nitrogen.
- At some suitable temperature.

- THERE ARE THREE MAIN METHODS OF NITRIDING :-
- Gas nitriding .
- Salt bath nitriding.
- Plasma nitriding.



- # MEHANISM OF NITRIDING
- ## GAS NITRIDING

1. Case-Hardening Process
2. Nitrogen Introduction
3. Surface of a Solid Ferrous Alloy
4. Nitrogenous Gas
5. Ammonia

- ## CHEMICAL REACTION

1. Nitrogen & Iron
2. Core Properties Not Effected

- ## TEMPERATURE RANGE

1. 495 - 565 ºC
2. Below Tempering Temperature

- ## WHITE LAYER BY-PRODUCT

1. Thin
2. Hard Iron Nitride

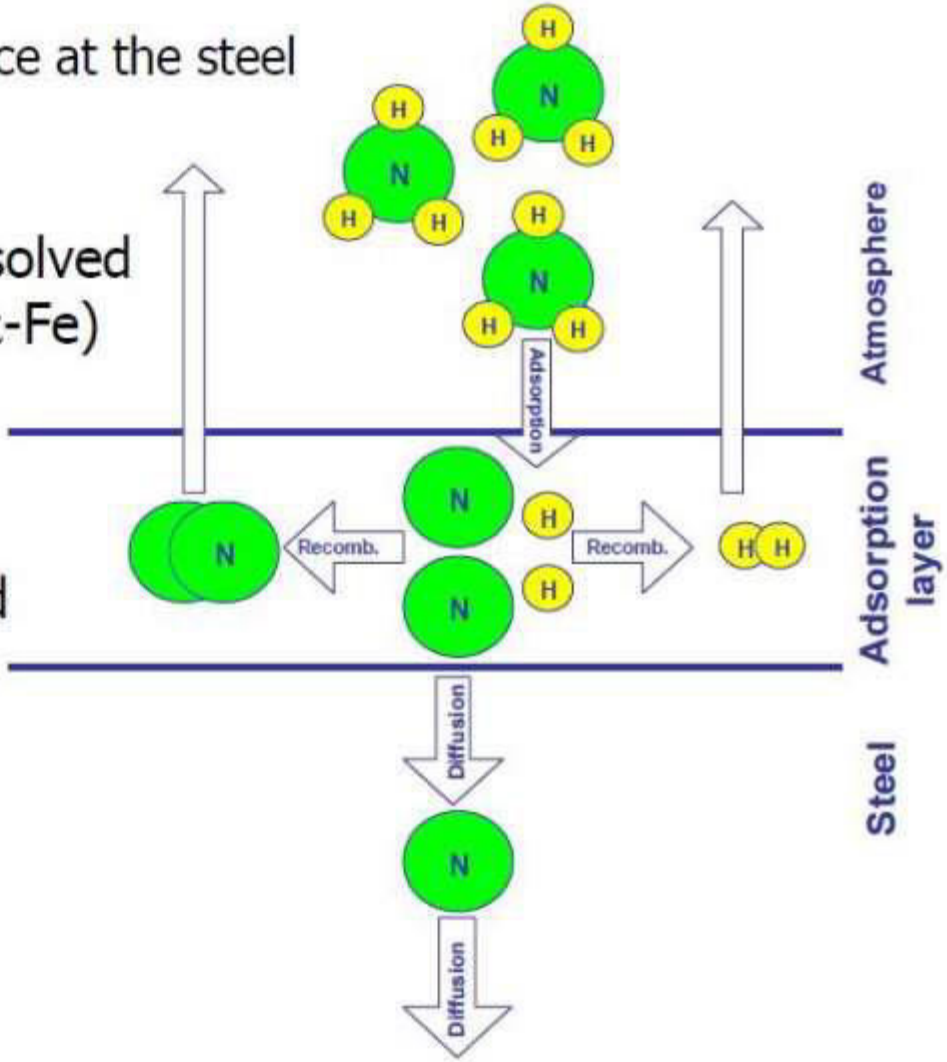
CHEMICAL REACTION :-

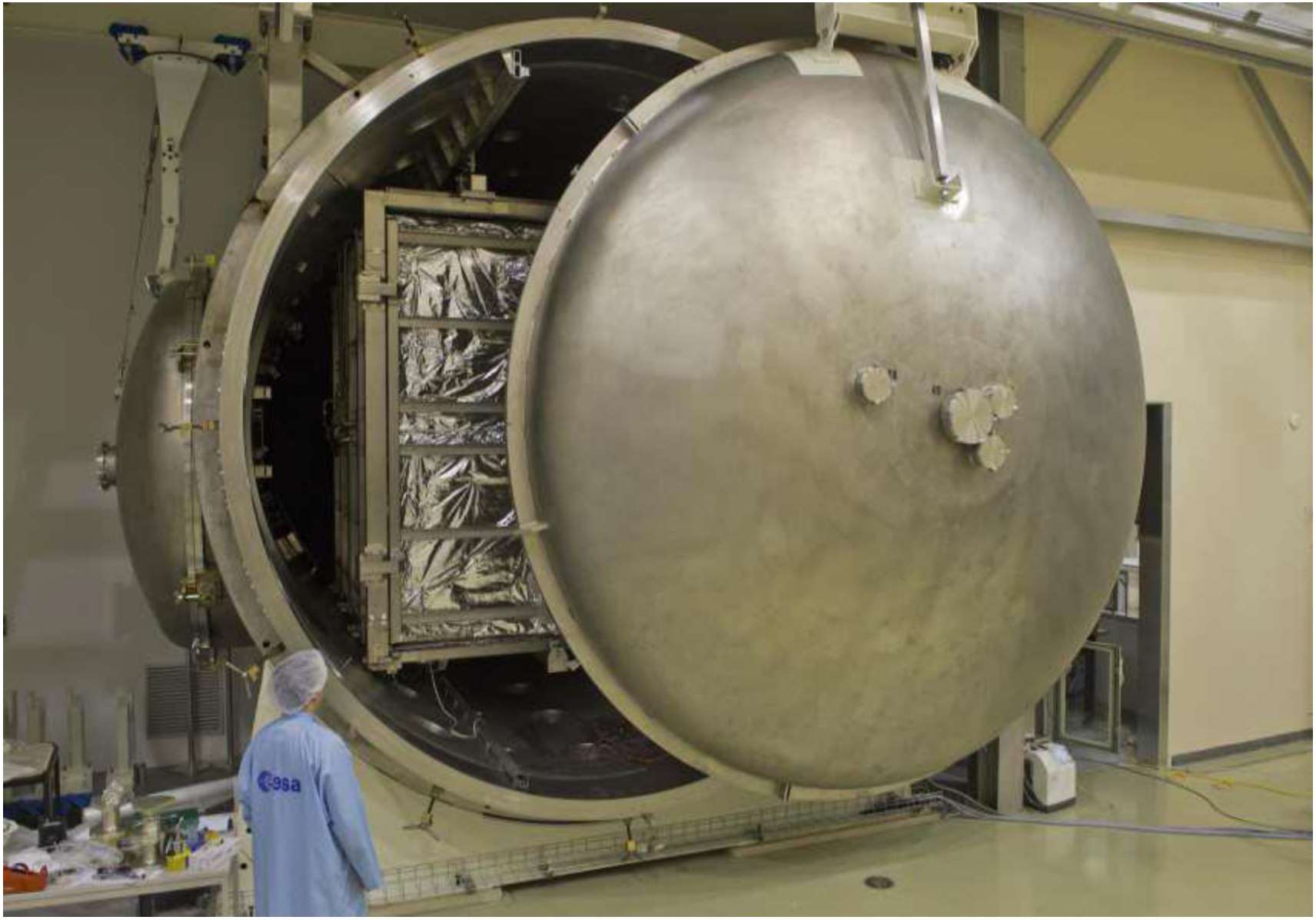
Possible reactions taking place at the steel surface:

$$2NH_3 \xrightarrow[\text{(heat)}]{\text{(catalyst)}} 3H_2 + 2N \text{ (dissolved in } \alpha\text{-Fe)}$$

$$\longrightarrow 3H_2 + N_2 \text{ (gas)}$$

$$\longrightarrow N_2 + 6H \text{ (dissolved in } \alpha\text{-Fe)}$$

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SALT BATH NITRIDING :-

- Thermo-chemical Diffusion Treatment
- Hardening Components With
- Repeatability.
- Use salt nitrogen-containing
- Salt Bath, at sub-Critical Temperatures.
- Higher diffusion nitrogen
- Corrosion Protection

PLASMA NITRIDING :-

VACUUM CHAMBER :-

1. Pressure = 0.64 Pa

2. Pre-Heat Cycle

3. Surface Cleaning

4. Intense electric field.

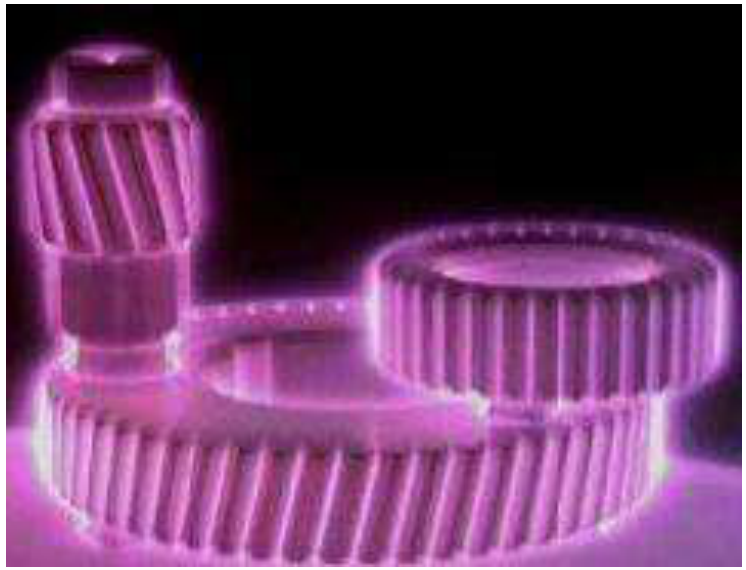
5. Control Gas Flow

6. N, H, CH_4

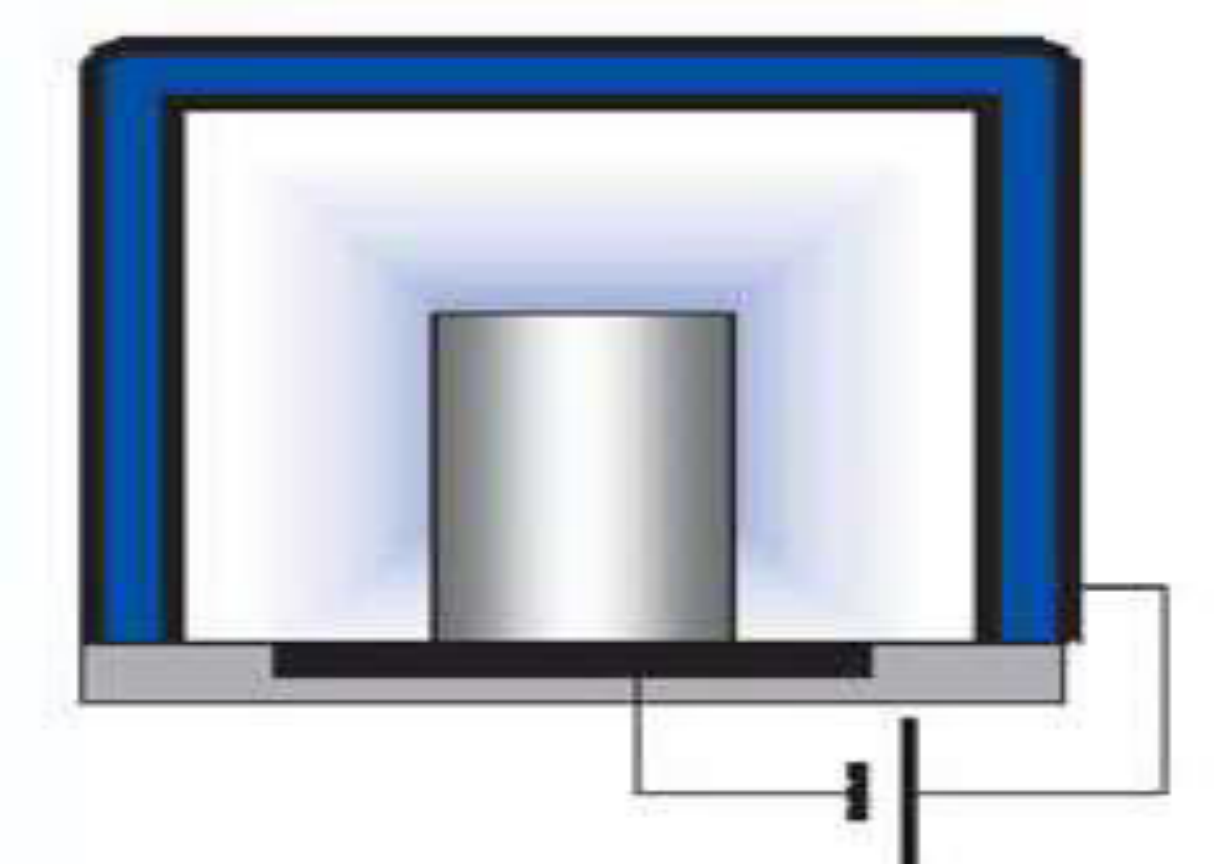
7. Ionization by Voltage

8. Blue-Violet Glow

9. Wear Resistant Layer



- PLASMA NITRIDING :-

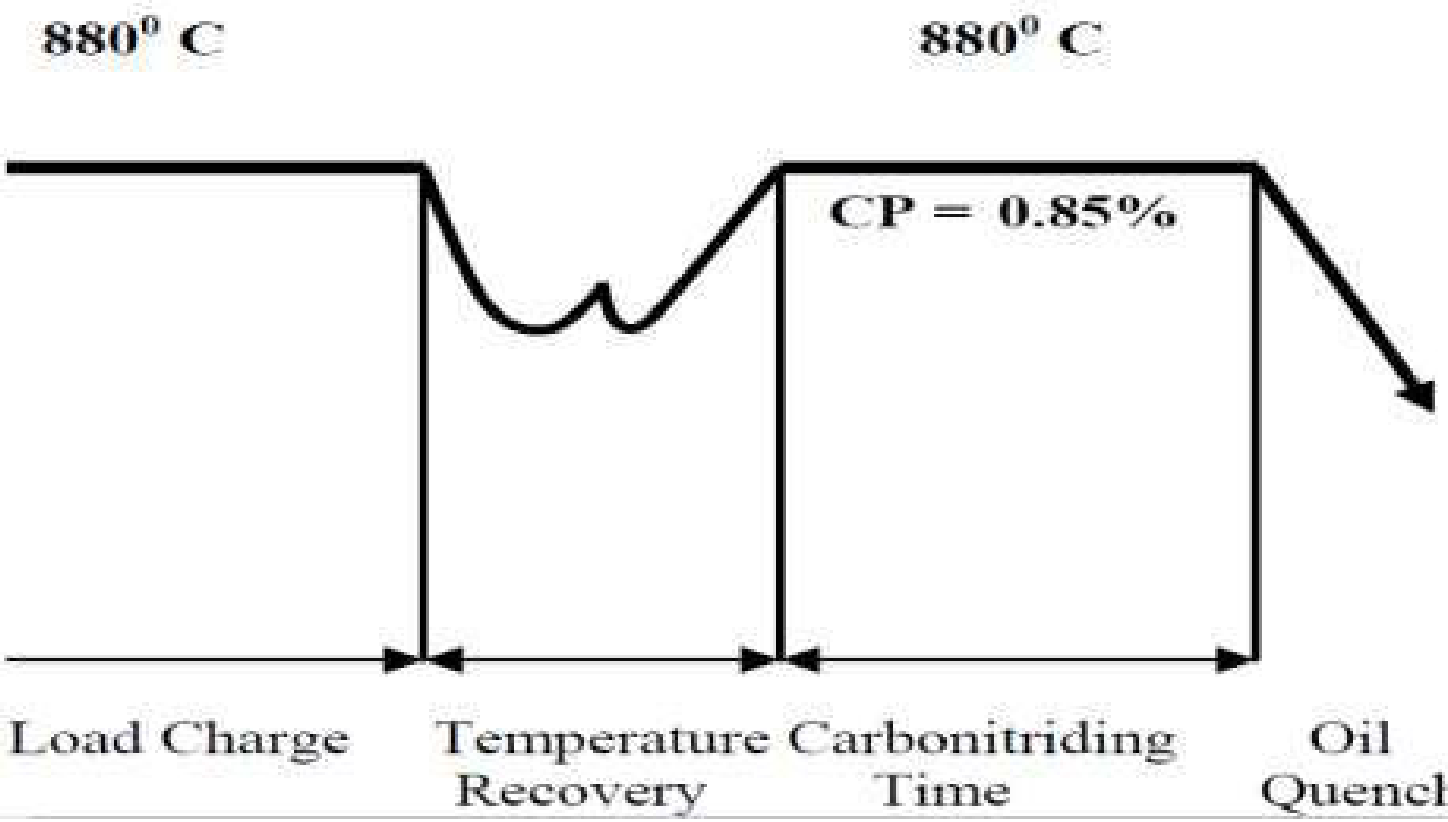


CARBONITRIDING

MECHANISM OF CARBONITIDING

- Carbonitriding is similar to gas carburization with the addition of ammonia to the carburizing atmosphere, which provides a source of nitrogen.
- Nascent nitrogen forms at the work surface by the dissociation of ammonia in the furnace atmosphere; the nitrogen diffuses into the steel simultaneously with carbon.
- Typically, carbonitriding is carried out at a lower temperature and for a shorter time than is gas carburizing, producing a shallower case than is usual in production carburizing.

- CARBONITRIDING IN FC-35 ATMOSPHERE
- Ammonia and CO2 flows are maintained constant through out the process during Carbonitriding in the FC35 process.
- A typical Carbonitriding process cycle using the FC35.
- Carbonitriding (around 850 °C / 1550 °F) is carried out at temperatures substantially higher than plain nitriding (around 530 °C / 990 °F) but slightly lower than those used for carburizing (around 950 °C / 1700 °F) and for shorter times.
- A typical Carbonitriding process cycle using the FC35


880⁰ C
880⁰ C
CP = 0.85%
Load Charge
Temperature Recovery
Carbonitriding Time
Oil Quench

- Carbonitriding forms a hard, wear-resistant case, is typically 0.07mm to 0.5mm thick.
- Maximum case depth is typically restricted to 0.75mm; case depths greater than this take too long to diffuse to be economical.
- Its carried out in a salt bath or in a furnace gas atmosphere.
- FOR EXAMPLE :- Aircraft Industry, Military technology, Automotive Industry, Internal combustion engines, Compressors, Crank Shafts, Cam shafts, Gears etc

ADVANTAGES :-

- It gives high surface hardness.
- Nitriding increase wear resistance.
- It increase the tensile strength and yield point.
- Improves fatigue life by 30% to 100%.
- It is good for high temperature applications.
- It has a greater resistance to softening during Tempering.
- The carbonitrided case has better wear and temper resistance than a straight
- carburized case.
- It is carried out at a lower temperature and for a shorter time than is gas
- carburizing.
- Reduced distortion due to lower temperature.

- Since nitrided parts are not quenched,this minimizes distortion or cracking.
- Whereas in a carburized part, hardness begins to fall at about 200°C, a nitrided part retains hardness up to 500°C.
- No machining is required after nitriding.
- Some complex parts which are not carburized satisfactorily, can be nitrided without difficulty.

DISADVANTAGES :-

- Asymmetric products could buckle due to unequal cooling effects
- Maximum dimensions are determined by the furnace dimensions Blind holes cannot be treated during plasma - nitriding.
- Toughness and impact resistance decrease.
- It produces shallower cases.
- It is not possible to obtain higher core hardness and deeper case depths.
- Only useful for Plain carbon steel or Low alloy Steel.
- Ammonia can produce harmful effects.
- Long cycle times (40 to 100 hours).
- The brittle case formed is Brittle.

- Only special alloy steels (containing Al, Cr and V) can be satisfactorily treated.
- High cost of the nitriding process.
- Technical control required.
- If a nitrided component is accidentally overheated, the surface hardness will be lost completely and the component must be nitrided again.