TCR Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

Power | Petrochemical | Fertilizer | Chemical | Refinery | Engineering | Automobile

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Significance of nitriding heat treatment

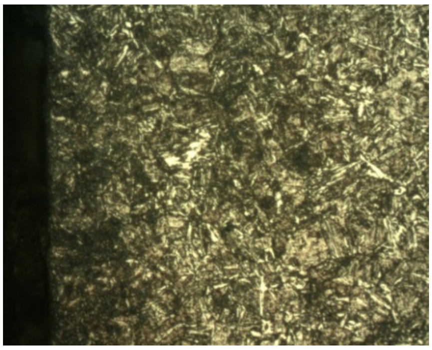
An insight.

Nitriding heat treatment is carried out with a view to bring about following improvements in the properties of the steel.

1) High surface hardness and wear strength, together with resistance to galling.
2) High resistance to tempering and high temperature hardness
3) High fatigue strength and low fatigue notch sensitivity
4) Improve corrosion resistance to non-stainless steels
5) High dimensional stability

Typical applications of nitriding include gears, crankshafts, camshafts, cam followers, valve parts, extruder screws, die-casting tools, forging dies, extrusion dies, firearm components, injectors and plastic-mold tools. These processes are most commonly used on low-carbon, low-alloy steels. However, they are also used on medium and high-carbon steels containing titanium, aluminum and molybdenum.

Unlike case carburizing, in which case interstitial addition of carbon by diffusion in austenite phase takes place, nitriding involves introduction of atomic nitrogen in to ferritic phase much below the lower critical temperature. Consequently, no phase transformation occurs on cooling to room temperature. The high surface hardness obtained in nitriding is due to formation of finely dispersed nitrides which distort the ferrite lattice. Following image shows microstructure of nitrided steel.



Methods of Nitriding:

Principally there are four methods of nitriding heat treatment. The selection of particular method depends on intended use application and material requirements.

Microstructure of the Month

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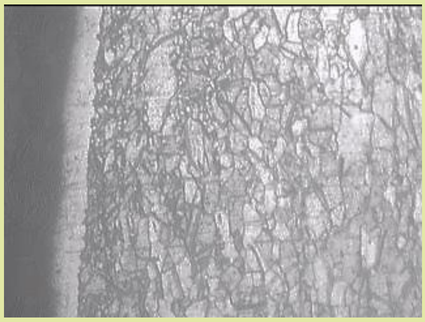


Magnification: *500X*

MOC: *BS 970 Grade EN 8*

Component: *Nitrided semi shaft*

Observation: *The optical microstructure image shows porous white layer developed during gas nitriding process.*

Useful hint: *Porous undesirable white layer forms due to diffusion of excessive nitrogen during the nitriding process.*

Gas nitriding:

In gas nitriding, ammonia is allowed to flow over the parts to be hardened, normally at 510°C. When ammonia comes into contact with the heated work piece it disassociates into nitrogen and hydrogen. The nitrogen then diffuses onto the surface of the material creating a nitride layer. Limitation: The reactivity of nitride formation is influenced by surface condition - an oily or dirty surface tend to deliver poor results.

Salt bath nitriding:

In salt bath nitriding the components are kept immersed in molten salt mixtures which normally contain 60-70% by weight sodium cyanide and potassium cyanide. The mixture is held at around 550°C. The advantage of salt nitriding is it can achieve higher diffusion in lesser time compared to any other method. There are few additional ingredients added the salt mixture which are proprietary make.

Plasma nitriding

Now a days plasma or glow discharge nitriding is gaining popularity due to its ubiquitous use on all grades of steels, which is normally feasible on small sized components. This method makes use of gas that serves as medium for both heating and nitriding. The parts to be treated are charged into an air tight chamber which constitutes the anode of the plasma nitriding unit.

Powder nitriding:

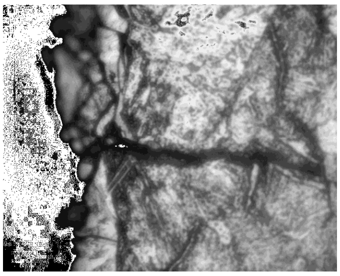
In powder nitriding, which is similar to pack carburizing, parts which need to be treated are paced into boxes which contain about 15% weight of energizer and the nitriding powder. Energizer is normally at the bottom that does not come in contact with the parts.

Nitridability:

The concept of metal Nitridability is the ability of the steel to absorb nitrogen and at the same time increase the hardness. Alloying elements which can form nitrides like Al, Mo, V enhance Nitridability. However, the depth of nitriding decreases with increasing content of alloying elements. Depending on the requirement 1200 μm depth of nitriding can be achieved.

Defects during nitriding:

During nitriding, formation of discrete iron nitride needles and deposition of nitrides at prior austenite grain boundaries is highly undesirable. In such cases, the fatigue resistance is reduced drastically and also the steel becomes susceptible to case spalling. Following microstructure shows a crack originated from nitrided surface and propagating in core.



Evaluation of Nitriding:

TCR Advanced can evaluate nitriding quality by measuring case depth through microhardness traverse and microstructure. When case hardening treatment is unknown nitrogen analysis at surface by EDS (Energy Dispersive Spectrum of X-Ray) analyzer with metallurgical expertise can differentiate between Carburizing, Nitriding or Carbo- nitriding. Our expert metallurgists can help in improving quality of nitriding heat treatment.

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