Description

Process schematic

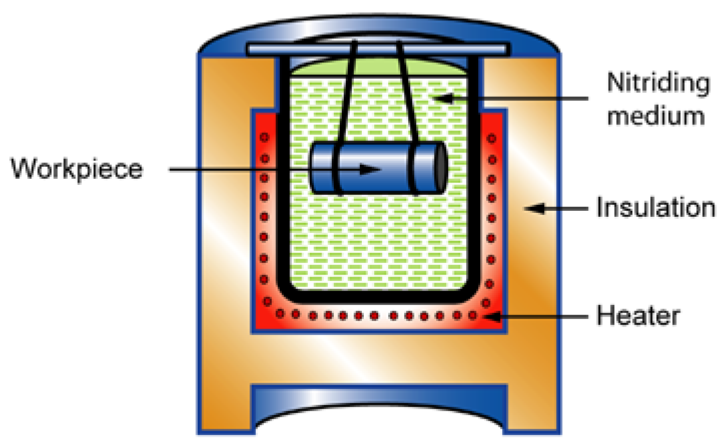

Figure caption

A nitriding bath.

The process

In NITRIDING, nitrogen is introduced into the surface of a steel component by heating it in a fused salt bath containing nitrogen-baring salts (typically, sodium cyanide, NaCN) or in a gas stream containing cracked ammonia (NH3). Steels suitable for nitriding contain aluminum, vanadium, tungsten or molybdenum; these form stable nitride precipitates that harden the surface to a depth of about 500 microns. The temperature - 495 to 565 C - is lower than that for carburizing, giving less distortion, and the surface does not require later heat treatment (as carburizing does) to acquire its hardness. Nitriding gives a high surface hardness, retained to high temperatures, increased wear resistance, improved fatigue life, and enhanced corrosion resistance.

Material compatibility

Metals - ferrous	✓

Function of treatment

Corrosion protection (aqueous)	✓
Hardness	✓
Wear resistance	✓
Fatigue resistance	✓
Friction control	✓

Economic compatibility

Relative tooling cost	low
Relative equipment cost	medium

Labor intensity	medium

Physical and quality attributes

Surface roughness (A=v. smooth)	A			
Curved surface coverage	Very good			
Coating thickness	125	-	600	µm
Surface hardness	600	-	1.2e3	Vickers
Processing temperature	340	-	590	°C

Process characteristics

Discrete	✓

Supporting information

Design guidelines

Carburizing, nitriding and carbonitriding all achieve the same thing: the creation of a hard, wear-resistant surface on a tough, cheap steel body. Before treatment, the steel is easily worked and machined. After treatment it can only be finished by grinding or polishing. All three processes are very widely used in mechanical design.

Technical notes

Nitriding is most effective when applied to steels containing nitride-forming elements such as chromium, molybdenum, vanadium, and aluminum. Examples are members of the AISI 4100, 4300, 5100, 6100, 8600, 8700, 9300 and 9800 series. The process can also be stainless steels, some tool steels and certain cast irons. Ideally, steels for nitriding should be in the hardened and tempered condition, requiring that the tempering temperature be higher than nitriding temperature. A fine-turned or ground surface finish is best.

Typical uses

Nitriding is widely used in automotive, mechanical and aeronautical engineering. Typical components are gears, crankshafts, camshafts, cam followers, valve parts, extruder screws, die-casting tools, forging dies, aluminum-extrusion dies, injectors and plastic-mold tools.

The economics

Nitriding is of immense economic significance. The equipment can be expensive, but tooling costs are generally low, and many parts can be treated simultaneously, keeping labor cost low.

The environment

The word 'cyanide', mentioned above, is sufficient warning that this process requires stringent safety precautions, and that disposal of spent baths must follow proper procedures. Nitriding is energy-intensive, but the ability to enhance the performance of cheap, low-energy, recyclable steels more than compensates.

Links

MaterialUniverse
Reference