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Comparative Study of the Three Nitriding Processes on Parts Carbon Steel.

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Title: Comparative study of the three nitriding processes on parts carbon steel.

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ABSTRACT

The paper present a review of investigations on the tree types of nitriding, salt bath nitriding, gas nitriding and ionic nitriding on a stainless steel samples. In this study we will see the properties of each sample after each nitriding type, taking the principal parameters (the tomperature and holding time).

Keywords:
investigations
Nitriding
Thin films
Steel

1. Introduction

The development of mechanical production and the wide use of steels in the industry always requires a development of surface characteristics, which demands the application of surface treatment such as thin films, in this abstract we will focus on nitriding with these three types and make a small comparison to identify the best type to study.

2. Theory about nitriding types processes

Nitriding processes carried out at temperatures below AC1 on the phase diagram do not cause a phase transformation; consequently the hardness of the base material should not be affected.The hardness increase in this type of process arises from lattice distortion, caused by interstitially placed atoms and even more so by the formation of nitrides of alloying elements.[1]

2.1. Salt bath nitriding

Salt bath Nitro carburizing is a thermo chemical process in which nitrogen diffuses on to the substrate, which combines chemically and formsFe3N outer layer which is hard and ductile. Salt bath Nitriding was done in a alumina crucible using a muffle furnace. The bath consists of salts like potassium nitrate (K2NO3), sodium carbonate (Na2CO3) and carbamide (CO (NH2)2). When suitable temperature is attained salt melts. Now the specimens are immersed in a salt bath for certain soaking time. The nitrided samples were taken out and then oil quenched. The salt bath nitrocarburising was performed at 480 c for 3 h.[2]

Fig. 1. Salt bath nitriding Equipment

2.2. Gas nitriding

Nitrogen gas is a surface-hardening process in which nitrogen is introduced into the steel surface by keeping the metal at an appropriate temperature and exposure to permeable air, typically ammonia or ammonia and nitrogen mixtures, ammonia mixtures with nitrogen or hydrogen. Permeable temperature for all types of steel in the range of 495 - 565°C. When heated in the ammonia gas stream, within this temperature range, the ammonia is decomposed rapidly by the reaction: [3]

$$2NH_3 \rightarrow 3H_2 + 2N$$

Fig. 2. Gasnitriding Equipment

2.3. Plasma nitriding

The nitriding cycle begins by placing the product into the vacuum chamber and evacuating the chamber to a desired vacuum pressure. Upon reaching the desired vacuum, the unit is back-filled with a process gas to begin the preheating cycle.The standard preheating cycle ranges in temperature from 850 to 1050 Fahrenheit. he process gas is ionized by a voltage that is applied to the product.

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Fig. 3. Plasma nitriding Equipment

A controlled flow of nitrogen, hydrogen and methane are introduced into the chamber and ionized by the voltage applied to the product. The plasma generated by the ionization envelops the surface of the product with a blue-violet glow. he combination of the heat and energy of the plasma cause the gasses to react with nitride forming elements in the steel.[4]

3. characteristics comparison

Table 1 characteristics comparison.

Nitridingprosesses	Advantages	Disadvantages
Salt bath nitriding	-improved corrosion resistance of the steel. -micro hardness improvment	Hard working condition (toxic gas)
Gas nitriding	-improved corrosion resistance of the steel. -micro hardness	Higtfurnace costs due the long lime of treatment.
Plasma nitriding	Greater surface hardness. -Greate fatigue strength under corrosive conditions	Midium used is expensive [5]

4. Conclusion

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This comparative study of the three nitriding processes shows the importance of thermochemical treatments on mechanical parts, in particular cutting tools, after citing the advantages and disadvantages of each process, a topical technique is chosen, plasma ion nitriding, this is why we chose it and applied it to an XC35 type steel.
In my doctoral research, I will do characterizations on several XC35 steel specimens.

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