DUPLEX TREATMENT - PLASMA NITRIDING PLUS TIALN COATING - TO PROTECT MARTENSITIC STAINLESS STEEL FROM SEVERE WEAR AND CORROSION

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A combination of plasma nitriding and Hyperlox Gold® coating was designed to protect AISI 420 martensitic stainless steel against adhesive wear with high contact loads and abrasion. Both surface treatments were carried out in industrial facilities in Argentina and analysed and tested in laboratory.

Plasma nitriding was carried out at 390 C in IONAR S.A., with certain parameters to assure not only hardness but corrosion resistance as well. The Hyperlox coating, mainly TiAlN was developed by Cemecon but deposited in Coating.Tech, Argentina, with a TiN coating on top, so is called Hyperlox Gold ®.

The coating and nitrided layer were characterized by optical and electronic microscopy, XRD and nanoindentation. Wear tests were carried out in a pin-on-disk machine designed following ASTM G99 standard and abrasion, following ASTM G65. Confocal microscopy, SEM and Raman Spectroscopy were used to analyse wear scars and mechanisms. Adhesion was assessed by Scratch Test and Rockwell C indentation. Corrosion was analyzed in Salty Spray Fog and potentiodynamic tests.

The nitrided layer resulted 10 mm width, even though the hardness penetration was deeper. Surface hardness reached 1180 HV. The whole coating was about 3.5 mm thick and adhesion was outstanding, 90 N Lc in the scratch test and HF1 in the RC indentation according VDI 3198. Corrosion resistance was improved in both tests regarding the plain steel and the nitrided steel.

In the abrasive wear test, using 130 N load, the wear volume loss was indetectable in the duplex coated samples. However, in the adhesive wear test changing loads, unexpected results have arisen. The duplex coated samples lost less volume at 10 N, but at lower loads, 7 N and 5 N, it lost more. The discussion will show that the trapped debris, the stress distribution in depth and the structural properties of the system determined the wear behaviour.

Keywords: martensitic steel, plasma nitriding, duplex hard coatings

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