A NEW POST-SINTERING PROCESS TO IMPROVE THE MECHANICAL PROPERTIES OF PM PARTS BY GAS ALLOYING

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ABSTRACT

A new (patent applied) post sintering process has been developed to produce high strength, low alloy iron PM parts with a structure of hard transformation products by gas alloying. The first stage is Nitrogen alloying which causes the formation of austenite in the metal matrix and interstitial Nitrogen throughout the section of the parts or to a substantial depth below the surface depending on process parameters and the properties of the PM parts such as density, thickness and alloying elements. A frequently employed second stage is ageing wherein the previously formed austenite is converted to hard transformation products. No rapid cooling is involved in either stage. Timing sprockets (Fe +2% Cu+0.5% C) were subjected to this low distortion process (which we have named the POWNITE process) and compared to traditionally carbonitrided & quenched sprockets.

INTRODUCTION

The traditional method of improving the mechanical properties of PM parts is to subject them to well documented heat treatment processes after the parts have been sintered and cooled [1]. This method involves additional manufacturing steps and undesirable side effects like distortion and pollution which increase the manufacturing cost.

A process technology has been developed at the Fluidtherm Technology Development Center where unalloyed PM parts are hardened by alloying the parts with Nitrogen at temperatures between 590°C to 720°C either as an extension of the sintering process or as a separate standalone process. Nitrogen is infused into the steel matrix so as to create a nitrogen rich austenite phase which is then converted by aging [2] at 200°C to 500°C into hard transformation products. This hardening process has most of the advantages of sinter hardening and in addition, reduces manufacturing cost further by reducing the use of expensive alloying elements and improving shape retention. As the authors could not find exactly such a process in literature it has been christened as the 'POWNITE Process' and is referred to it as such hereafter.

This process differs from Nitriding type processes in that it is not a surface hardening technique which relies on the formation of a layer of iron nitride with or without the formation of supporting substrate layers as well as the processes of diffusion of Nitrogen without the formation of iron nitride. The positioning of conventional gas Nitriding, Ferritic & Austenitic Nitrocarburising are shown on the Lehrer diagram in red as against the positioning of the POWNITE process in the figure below. (Fig.1).