EFFECT OF SALT BATH NITRIDING ON SURFACE ROUGHNESS BEHAVIOUR OF AISI 4140 STEEL

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Received: 22.10.2016
Accepted: 23.01.2017

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Abstract
In the present research, AISI 4140 steel was nitrided in salt bath to study and analyze the behaviour of the surface roughness. The structural surface characterization behaviour of the nitrided steel was compared to the behaviour of the same steel which was untreated. The nitriding process was implemented in the salt bath component at ten different times (from 1 h to 10 h) when the temperature was constant at (580ºC). The influence of nitriding treatment on structural properties of the material was studied by scanning electron microscopy (SEM), microhardness tester and surface profilometer. It was found that salt bath nitriding was effective in improving the surface properties behaviour of this steel. Experimental results showed that the nitrides ε-Fe2-3(N,C) and γ'-Fe4(N,C) present in the compound layer increase the microhardness (406–502 HV0.3), the initial surface roughness values of nitrided samples were higher than those of unnitrided specimens, it also observed that the increasing the nitriding time increases the surface roughness parameters (Ra, Rq and Rz).

Keywords: salt bath nitriding, AISI 4140 steel, microhardness, surface roughness

1 Introduction

Surface topography is an important characteristic that determines, among other things, catalytic activity, electrochemical potential, adhesion, friction coefficient, susceptibility to wear and scuffing failure and aesthetic appearance [1-2].
Salt bath nitriding [3,4,5] is one of the most widely used thermo-chemical methods [6,7,8], which produces strong and shallow case with high compressive residual stresses on the surface of steel components such as gears, crankshafts, dies and tools [9,10,11].
Surface roughness of industrial components strongly affects their performance, i.e, many surface properties such as friction [12-13], surface wear [14], fluid flow in rough pipes [15] and the functioning of vacuum seals [16] are strictly dependent on surface roughness. In addition, surface roughness seems to be important in bioengineering for example in the joints of the bones [17]. Quite often small roughness is desired since small roughness reduces wear and energy loss, but when high friction is needed also the roughness should be larger. Hence, the inspection of surface roughness of the work piece is very important to assess the quality of a component.
The quality of surface roughness is an important requirement for coated parts [18].
There are at least five different mechanisms by using the surface modification methods to increase the fretting resistance: (1) to induce a residual compressive stress; (2) to decrease the coefficient of friction; (3) to increase the surface hardness; (4) to alter the surface chemistry; (5) to increase the surface roughness [19].

DOI 10.12776/ams.v23i1.816 p-ISSN 1335-1532
e-ISSN 1338-1156