

EFFECT OF TIME ON THE COMPOUND LAYER FORMED DURING SALT BATH NITRIDING OF AISI 4140 STEEL

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Abstract

This research was carried out to study the effect of time on the compound layer of AISI 4140 steel in salt bath nitriding. The nitriding process were implemented on AISI 4140 steel in salt bath component for different times (from 1 h to 10 h) at 580 °C. Samples of AISI 4140 steel were treated and characterized (at surface and core of samples) through the following technique: optical microscopy, scanning electron microscopy, X-ray diffraction (XRD) and microhardness tester. Shows that thick compound layers are formed during continuous salt bath nitriding. The thickness of the compound layer and surface hardness increases with increasing time.

Keywords: Salt bath nitriding, AISI 4140 steel, compound layer, time

1 Introduction

Thermochemical nitriding treatments are used heavily in many kinds of steel because frequent use of steels in all ranges of industry [1, 2]. Nitriding is a surface thermochemical treatment technique used to introduce and install nitrogen atoms into metallic materials, surface to improve their surface hardness, mechanical properties, as well as wear [3, 4] and corrosion resistance [5, 6], as well as fatigue life [7, 8, 9]. The most important and old method of thermo chemical surface hardening operation is nitriding operation of steel which changing chemical properties of surface layer [10]. Currently there are several ways to add nitrogen to a surface, for example, you can add nitrogen to surface the metal from contact with another surface with nitrogen content at a proper temperature. Various nitriding operations are developed by this method. For instance, gas nitriding, salt bath nitriding, plasma nitriding, laser accumulating operation, reactive magnetron spraying (injecting), nitrogen implanting and plasma [11]. The primary aim of the process of salt bath nitriding (SBN) [12] is to obtain high surface hardness, improve mechanical properties and increase wear resistance, fatigue life, dimensional stability and corrosion resistance as a result of the presence of compounds formed at the surface, in addition to a zone of diffused nitrogen in solid solution with the base material, subjacent to the compound layer [13, 14, 15].

Nitriding is one type of the most widely used thermo-chemical treatments in the industry, which produces strong and shallow case with high compressive residual stresses on the surface of steel components such as gears, crankshafts, dies and tools [16, 17, 18, 19]. The machine components working under cyclic loads are severely subjected to the threat of fatigue failure [20, 21]. Salt bath nitriding is commonly used as an alternative to high temperature conventional heat