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Analysis and Improvement of Distortion of Lathe Machine Main Spindle

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***Abstract**: In lathe machine, main spindle is an important component which is generally made with En353steel. It undergoes distortion or bending due to high stresses and is controlled by the heat treatment process called carburizing. It is the process where the component is heated to a specified temperature, generally above the critical temperature and cooled for long period of time such that the microstructure of the material gets changed from austenite to martensite. Retained austenite reduces the hardness, wear resistance and thermal conductivity of steel and makes its dimensions unstable. A sub-zero treatment has been devised to reduce the retained austenite in hardened steel which is done by cooling the metal to sub-zero temperature. This treatment is suitable only when the temperature at which the martensite transformation is completed is below zero. Due to this change in material from austenite to martensite, the material improves in its properties like change in microstructure, hardness, carbon percentage and composition of the material. Here, in this paper an attempt is made to apply a heat treatment called sub-zero treatment to check the changes in the material and results are compared with conventional properties of specimen material En353.*

Key Words: lathe, main spindle, distortion, heat treatment, sub-zero treatment, Austenite, Martensite , hardness

1. INTRODUCTION

Lathe main spindle undergoes various types of stresses, and bending stress is one of them. It is made up of En353 material. It is made by following some sequence of operations. Cryogenically treated high speed steel tools which shows micro structural changes in the material that can influence tool life and productivity. It shows the improvements when using the cryogenically treated HSS tools in industry [1], and a cooler fan drive gears used in the MGB to cool the oil in the ALH Helicopters. By the implementation of the fixture at time of heat treatment and tested to see that distortion could be reduced [2] and an example calculations using DANTE software shows, it has very advanced features, and its predictions were shown to agree in a relative sense (within about 15%) with measurements reported on heat treatment distortion on Navy-C rings made from 4140 and 8620 steel quenched in water and in oil [3], and the optimum process parameter for XW-5 and XW-42 were determined where XW-5 is recommended for applications demanding maximum wear resistance and XW-42 is a versatile tool steel used for cold work applications like blanking and other processes [4]. A low pressure carburizing (LPC) and high pressure gas quenching (HPGQ) heat treatment processes reduces distortion significantly and HPGQ provides a very uniform heat transfer coefficient [5]. The ultimate tensile strength and the yield strength decrease while the elongation increases with an increase in tempering temperature and tempering time of different tempered specimen, when specimen of quenched, hardened AISI1040 steel was tempered at temperature (650, 450 & 250^0 C) for 60, 90 & 120 minutes to modify desired properties [6] and the effects of cooling rate on the microstructure and mechanical properties of AISI 1050 steel, was studied and find out that it varies by using various quenching medium on the hardness of AISI 1050 Carbon steel [7], various types of heat treatment on fracture toughness and hardness is analysed using UTM with the help of sample specimens of low carbon steels and Stainless Steels[8], and quenching produces a martensitic microstructure characterized by significant increase in material's hardness and a significant decrease in its impact energy when E110 case hardening steel is subjected to different heat treatment processes[9] and the cutting parameters that have the highest influence on the dimensional changes are the feed rate and the depth of cut. Residual stresses induced by soft-machining lead to an increase of the ring diameter, depending on the machining parameters [10].

2. DISTORTION

Distortion is defined as an irreversible and usually unpredictable dimensional change in the component during processing by heat treatment due to temperature variations in the material. The term dimensional change is used to denote changes in both size and shape. The heat-treatment distortion is therefore a term often used by engineers to describe an uncontrolled movement that has occurred in a