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Comparison between mathematical models for roughness obtained in test machine and in industrial machine in semifinish honing processes

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Abstract

In the present work second order mathematical models for semifinish honing are presented for average roughness Ra as a function of abrasive stone characteristics and honing parameters. Several tests were performed in both a test machine and in an industrial machine. Results from both machines were compared. Although roughness depends on the five variables studied (grain size, density, pressure, linear speed and tangential speed) in both cases, most important factors are grain size and pressure. It is possible to use the model for the test machine in the industrial machine, in a way that only a few tests will be performed in the industrial machine in order to translate the model.

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Keywords: honing; semifinish; roughness; design of experiments; mathematical models

1. Introduction

Many variables influence surface roughness in honing processes, for example type of bond, type of abrasive, grain size of abrasive, pressure of the honing head, speed of the honing head, etc. [1]. Several authors have obtained mathematical models for roughness in honing processes. For example, Troglio et al. employed three-level design of experiments with grain size of abrasive, oil and workpiece material as factors and average roughness Ra and Rk-

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family parameters as responses [2]. Kanthababu et al. used three-level design of experiments with rotation speed, linear speed, pressure and honing time as variables, and different roughness parameters (Rk, Rpk, Rvk, Mr1, Mr2) as responses [3].

In a previous paper, mathematical models were presented for both average roughness Ra and material removal rate Qm in the rough honing process [4]. Two-level design of experiments was employed. Main variables affecting roughness were grain size and density of abrasive while main variables influencing material removal rate were grain size of abrasive and pressure of honing stones on the workpieces' surface.

In honing processes, it is usual to perform successive operations, each time with finer grain in order to achieve a smooth surface. Moreover, some vertical machines provided with three honing heads allow three honing operations in the same cylinder [5]. Since behavior of the honing process is different depending on grain size, in the present work research was divided into three types of experiments, related to rough honing, semifinish honing and finish honing respectively. In the present paper, second order statistical models were obtained from surface response design of experiments for surface roughness in semifinish processes. Tests were performed both in a test and in an industrial machine, and results from both machines were compared. Five variables were considered: grain size of abrasive (Gs), density of abrasive (De), linear speed (Vl), tangential speed (Vt) and pressure of the honing stones on the workpieces' surface (Pr).

2. Materials and methods

Cubic boron nitride (CBN) stones were chosen with metallic bond. Both a horizontal test machine (Fig. 1) and an industrial vertical machine (Fig. 2) were used in honing experiments.

Fig. 1. Horizontal test machine.

Fig. 2. Vertical industrial machine.