STUDY OF DIFFERENT PROCESS PARAMETERS ON THE SURFACE ROUGHNESS AT SUPERFINISHING

[1]Lucian Grama, [2]Marius Gabor, [3]Vito Dattoma, [4]Jozef Beno
[1,2]"Petru Maior"University of Târgu Mureş, Romania
[3] Universita di Salento -Lecce - Italy, Faculty of Engineering
[4]Technical University of Kosice Slovakia, Faculty of Machanical Engineering
lgrama@upm.ro

ABSTRACT

Surface finishing and tool flank wear have been investigated in finish turning of AISID2 steels (60HRC) using ceramic wiper (multi-radii) design inserts. Multiple linear regression models and neural network models are developed for predicting surface roughness and tool flank wear. In neural network modeling, measured forces, power and specific forces are utilized in training algorithm. Experimental results indicate that surface roughness Ra values as low as 0.18–0.20μm are attainable with wiper tools. Tool flank wear reaches to a tool life criterion value of VBC=0.15 mm before or around 15 min of cutting time at high cutting speeds due to elevated temperatures. Neural network based predictions of surface roughness and tool flank wear are carried out and compared with a non-training experimental data. These results show that neural network models are suitable to predict tool wear and surface roughness patterns for arrange of cutting conditions.

Keywords: Superfinishing, Roughness, Tool Flank, ceramic wiper, wear

1. Introduction

The finishing machining methods of the metallic surfaces was conceived to be used specially to diminish the negative influences on the working accuracy and on the structural modification of materials which appear at the previous roughing and semifinishing operations, made by the temperature which arises at tool-part contact, by the destroyed of the metal cristaline structure in the external layers and by big stress in the cutting zone [1, 2].

Machining by superfinishing or honing is recommended as final operation to improve surface finish to the values of Ra = 0.0125 µm [1], and in a small rate to improve dimensional and geometrical accuracy.

Due to the great demands regarding the surface roughness which has a great influence on the service life and reliability of parts and the researches of the technical and economical performances of finishing processes were made to optimize the process parameters and constructive parameters of the abrasive tools [1, 2].

Other parameters that have a great influence on the surface roughness obtained through superfinishing are the dimensional and geometrical accuracy conditions at previous operations [1]. The modeling of machining by superfinishing according with the influences of various factors on the surface finish was made in the literature [2, 3, 4, 5, 6], especially based on the processing of data base obtained in the working conditions. Starting on these considerations in the paper is presented a method of roughness modeling based on the cutting volume material in unit time. The mathematical modeling elements of the surface roughness and quantitative analyses are the aspects based on the original graphic dependences of the paper.

2. Experimental Procedure

The main objective of this experimental work was to investigate the influence of cutting parameters on tool flank wear and surface quality in hard turning of AISI D2 cold work tool steel using ceramic inserts with wiper (multi-point radius) nose geometry. Hard turning experiments were performed using a high rigidly CNC lathe with18kW spindle power and a maximum spindle speed of 4500rpm. The following cutting parameters were used: cutting speed(Vc) of 80, 115 and 150m/min, feed rates(f)of0.05–0.10 and 0.15mm/rev and constant depth of cut(ap) of 0.2mm.

The AISID2 cold work tool steel with the following chemical composition were used as work piece in turning: 1.55%C; 0.30%Si; 0.40%Mn; 11.80%Cr; 0.80%Mo; 0.80%V. After heat treatment (quenching in a vacuum atmosphere at1000–1040◦C) an average hardness of 60 ±1HRCwas obtained.

3. Experimental Results

Using the values from the literature [2, 8], in figures 1 ÷ 6 is shown the graphic dependences between surface quality and process parameters. From relation (6), in the working conditions with *Rai* = 0.4 ÷ 1.6µm; *T* = 0.005 ÷ 0.027 (IT5); *lact* = 20 ÷ 100 mm; *A* = 1 ÷ 6 mm; *tp* = 0.7 ÷ 0.9; *l* = 0.25 ÷ 0.8 mm; τ = 0.5 ÷ 2 min.

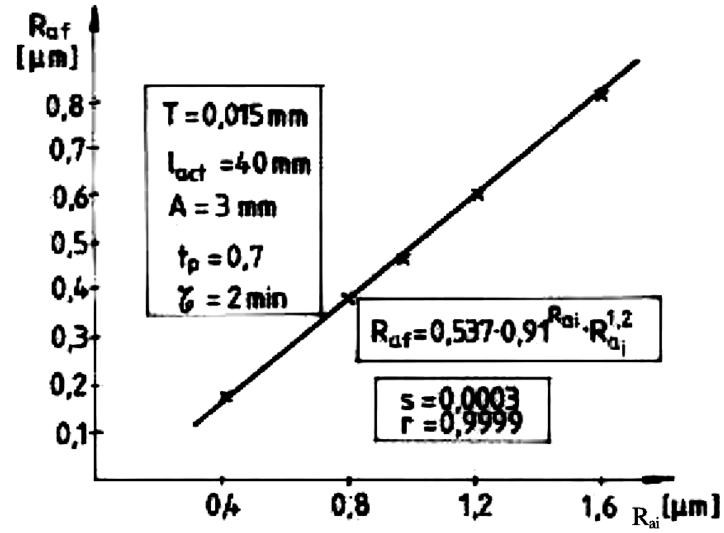

Figure 1. The roughness Raf, function on initial roughness Rai

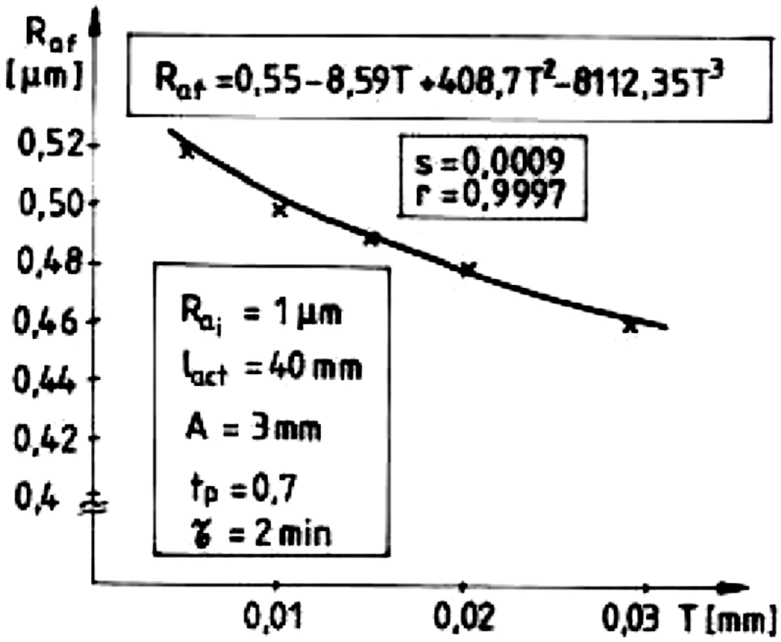

Figure 2. Roughness Raf functions on initial tolerance T of machining surface

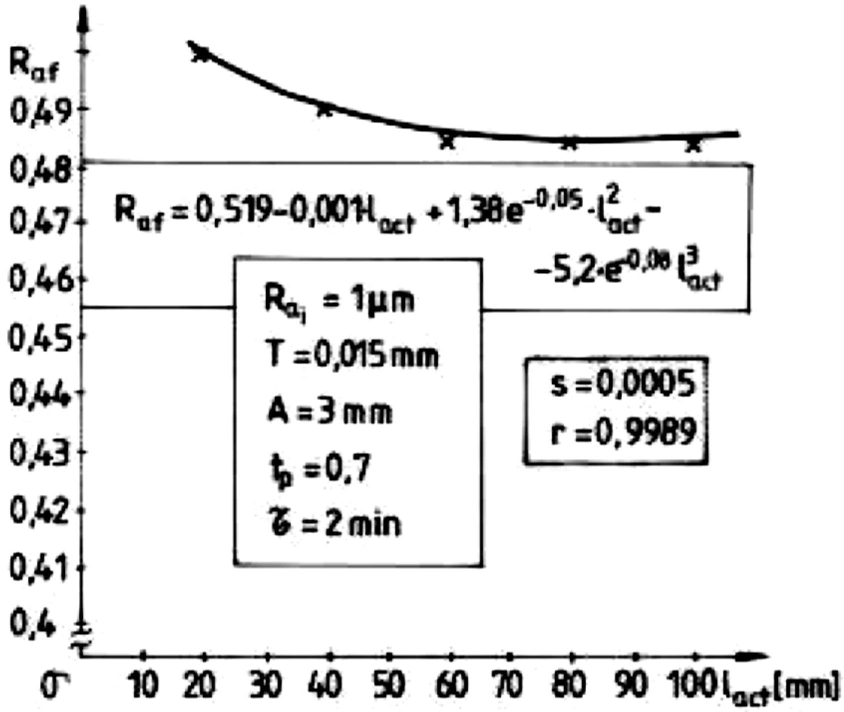

Figure 3. Roughness Raf function of the active length lact of abrasive stones

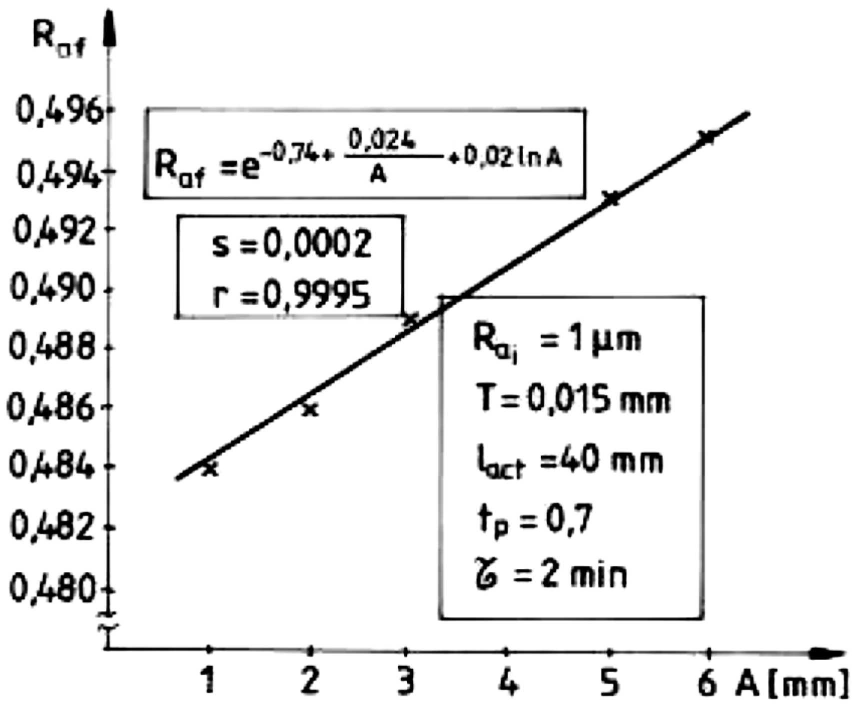

Figure 4. Roughness Raf function of the amplitude of tool reciprocal motion A

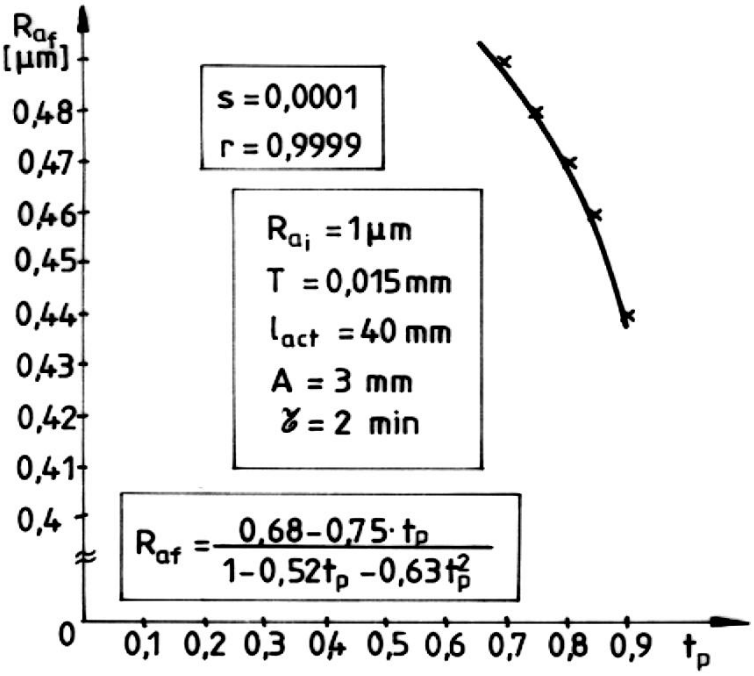

Figure 5. Roughness Raf function of bearing ratio tp

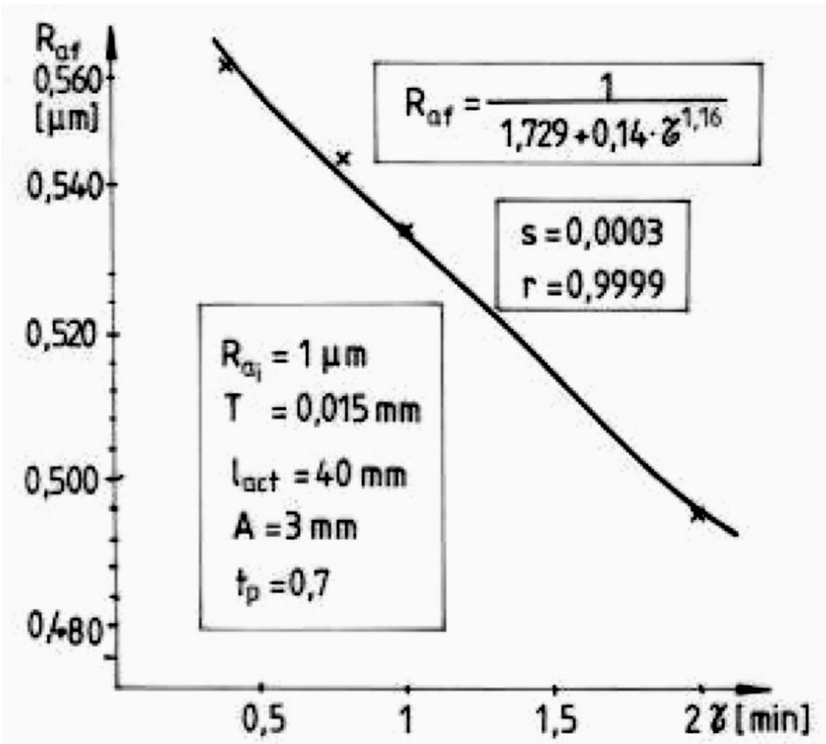

Figure 6. Roughness Raf function of the machining time τ

4. Observations and Conclusions

Based on the previous data appear the next observations and recommendations:

1. Relation (5) of the roughness after machining and the graphic dependences presented in figures 1 ÷ 6, permit in the designing step to make a quantitative and qualitative analysis of the influence of different factors on the surface finish.

2. Between all the factors that were studied, it is easy to see (figure 3) that the most important factor on the roughness surface is the surface quality obtained at the previous operation; other factors like profile bearing length ratio *tp*, active tool length *lact*, dimensional tolerance *T* of the surface after previous process, have a small influence on the roughness.

3. The limits of mathematical modeling showed in the paper is about the fact that wasn't into account two parameters with great influences on the surface finish: the granulation of abrasive stones and pressure between tool and workpiece surface which have influences especially on the process machining efficiency.

5. References

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