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RESEARCH OF ROUGHNESS OF HARD TURNED BORES

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This paper reports an extensive characterization of the surface roughness generated during hard turning operations performed with conventional PCBN tools and during combination turning and grinding machining. Hard turning has been applied in many cases such as producing bearings, gears, axles and other mechanical components. The PCBN is widely used for finish machining of hardened steel parts (HRC 45–65). The special condition of dry hard cutting is the required cutting speed must be ranged from 90 to 180 m/min. After the hard turning and combination machining tests, the relevant changes of surface profiles and surface roughness parameters were successively registered and measured by a profilometer. Based on the experimental results, this paper shows and analyse the modification of the surface roughness parameters in case of hard turning and combination machining[1].

Keywords: hard turning, grinding, surface roughness, combination machining

Introduction

This work aims to investigate the machining of hardened steels using cubick boron nitride (CBN)

The combining of processes in the machining of high-precision hardened workpieces is catching on. Since the introduction of the first combined turning and grinding center at Metav 1998 the new technology has found wide-ranging acceptance. One of the leading exponents is the Emag Group Experimental set-up, cutting parameter control is shown by *Fig. 1. Table 1* contains the parameters of surface roughness and the tool edge geometry [2, 3].

Table 1: Nomenclature

a_p –	cutting depth (mm)
f –	feed rate (mm/rev)
v_c –	cutting speed (m/min)
R_a –	arithmetical roughness (μm)
R_m –	equivalent mechanical resistance (ηm)
Rz –	rougness (ηm)
R_q –	quadrotic roughness (ηm)
K_r –	tool cutting edge angle (°)
α_r –	rake angle (°)
γ_r –	relief angle (°)
VB –	flank wear (mm)

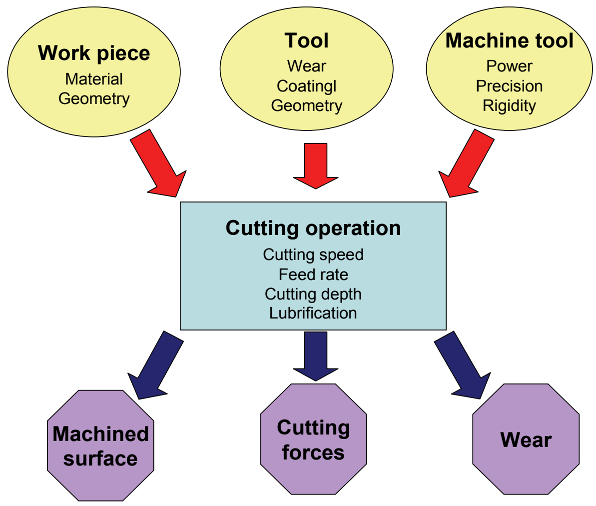


Figure 1: Experimental set-up, cutting parameter control [4]

Experimental conditions

Work pieces

All the tests were carried out with parts machined under industrial. The cutting parameters were taken from the practice. The machined material was the steel DIN 20MnCr5, quenched to 62 HRC. The machined work piece was on gear with a cylindrical section with a diameter of 53 mm and length of 49.3 mm and the other gear was diameter of 60 mm and length of 45.3 mm.

Table 2 shows the chemical composition of the material [2].

Table 2

Cemical Composition	%
C	0.17/ 0.22
Mn	0.15/ 0.40
P	0.02 0.035
S	0.035 max.
Si	0.15/ 0.4
Cr	1.00/ 1.30
Al	0.020 min.

Tool

The inserts conformed to the ISO cod. Hard turning: conventional MITSUBISHI: NP-CNGA120408TA2 MB8025 (roughing) and the tool holder C5-PCLNR/L-17090-12 and smoothing wiper: NP-CNGA120408GSW2 MBC010 and the tool holder C5-PCLNR/L-17090-12.

Combinated machining: SOMITOMO: 4NC-CNGA120412, and the tool holder C5-PCLNR/L-17090-12 Grinding wheel: 97A 602 I 5 V112

CNC turn

It was employed a turn PVS Pittler, this equipment presents the stiffness and accuracy enough for the demands of the hard turning operations.

Combinated turn and grinding machine

Improved component and end product quality, as the workpiece is machined in a single setup, whereby the rough hard turning operation leaves a grind-finishing allowance of just 0.02 mm (relative to the diameter).

Compared to conventional grinding methods the minute grinding allowances required for the application of HDS-technology allow you to grind with a minimum of coolant and even dry, in which case there is no need for costly grinding sludge disposal measures [3].

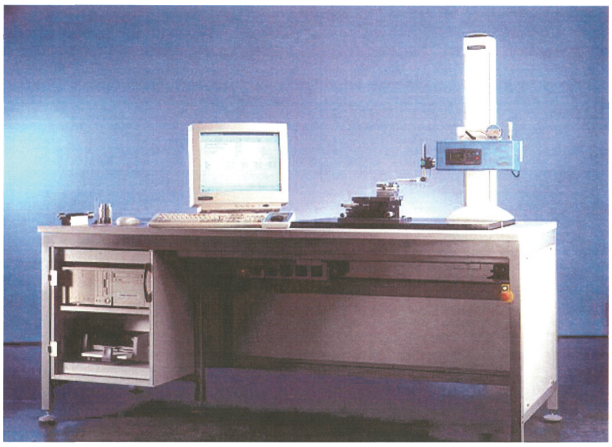


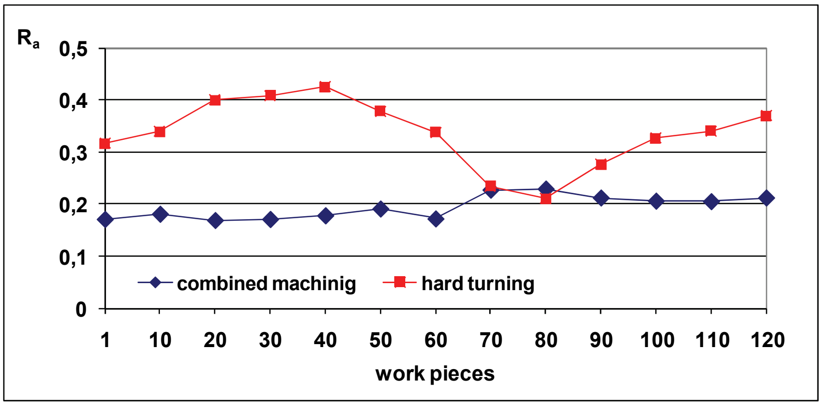
Figure 3: PGK 120 prfilometer [2]

Surface roughness measurements

After each individual test, part surface finish was measured with a stylus profilograph. In this investigation, a shop floor PGK 120 profilometer *(Fig. 3)* with a 5 μm diamond stylus radius was used. I used a special computer programs.

Conclusion

Significant difference could be found among the surface roughness number as the function of number of pieces on the worpieces surface machined by hard turning and by combined machining *(Fig. 4)*. In case of hard turning significant fluctuation can be seen in the values of surface roughness, which makes uncertain the planning of the machined roughness. This manifestation can be disadvantageous in case of production certain machine elements. This can be explained by the tool wear mechanism of PCBN single point cutting tools, because the tool is machining on one point, and its geometrical errors can be copied into the workpieces. In spite of this in the case of combined machining roughness height mad by hard turning can be grinded by the grinding wheel truined at each worpiece *(Fig. 5)*. So, the surface roughness to be produced can be regular, can be planned. Furthermore the micro-thread can be avoided which occurs in hard turning. However, hard turning can be pretend to quasy absolute environmentally friendly procedure for neglecting of coolants and lubricants, but because of fluctuation of surface roughness its change to combined machining is suggested, which involves a little load of environment.



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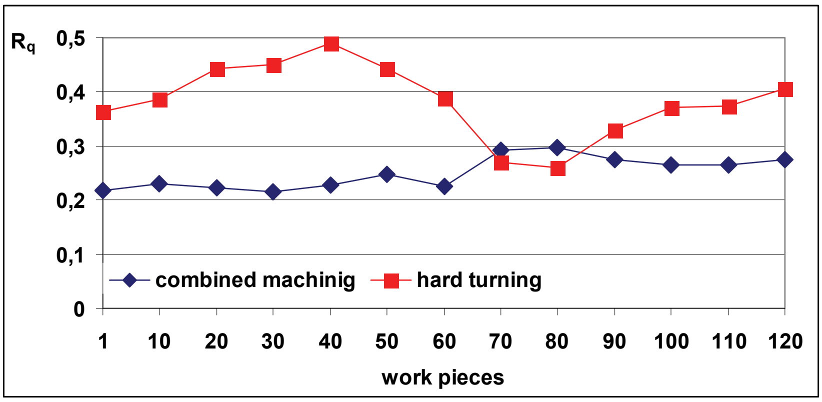

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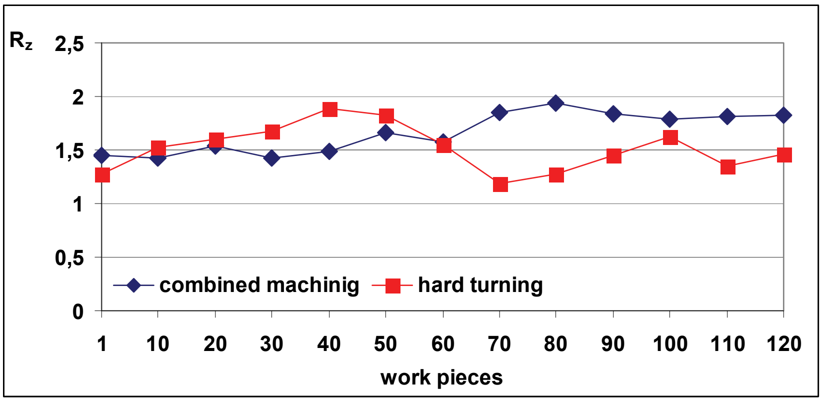

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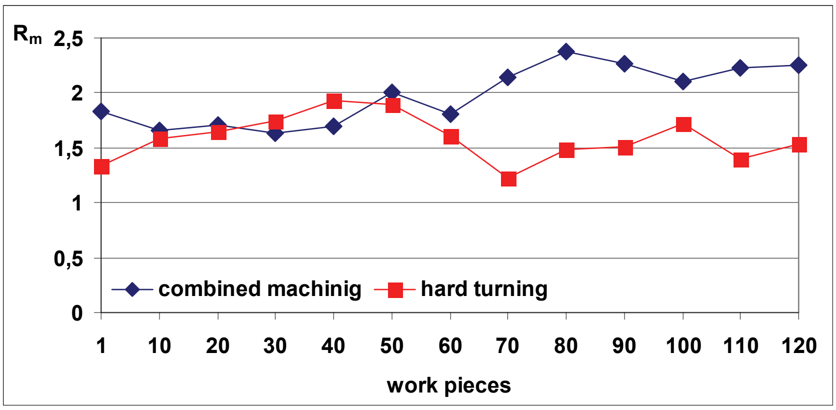

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Figure 4: Roughness parameters as a fuction of work pieces for different machining conditions

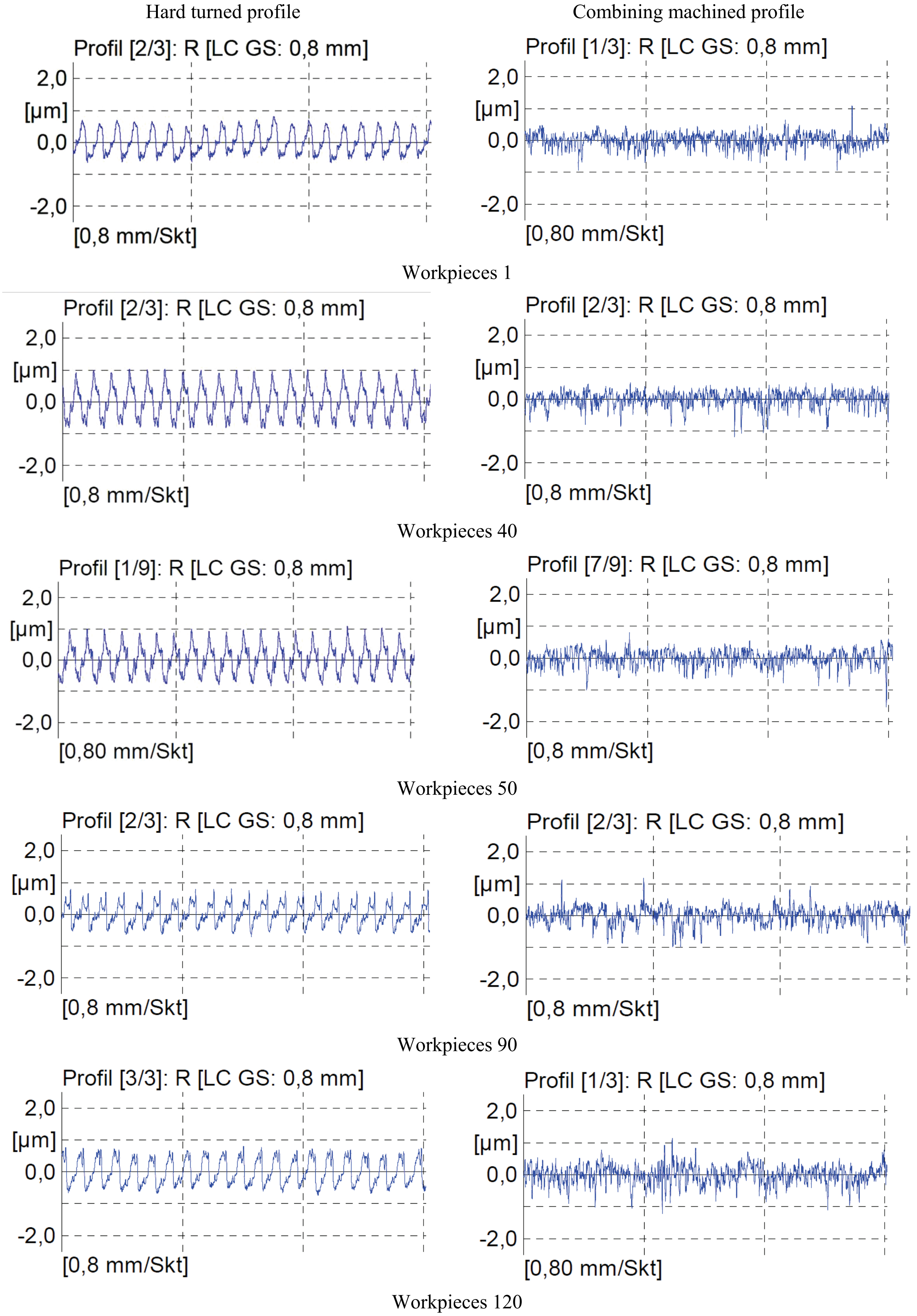

Figure 5: Charasteristic surface profiles

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