

VARIABLE KINEMATICS OF HONING PROCESS – INFLUENCE ON MACHINED WORKPIECE

Piotr Sender
Gdansk University of Technology
Gabriela Narutowicza 11/12
80-233 Gdansk
Poland

ABSTRACT

Surface quality of holes plays an important role in machine manufacturing industry especially in the production of car engines and hydraulic cylinders. Investigations of honing process were carried out by 6 years on horizontal CNC Sunnen's honing machine HTH 4000S, on vertical conventional honing machine WMW's SZS 200 and on CNC milling machine of Haas VF 3SS with equipment of Honingtec for honing. Measurements of cylindricity of holes was done on CNC coordinate measuring machine Zeiss Accura, measuring of roughness was done using surface roughness measurement instrument of Mitutoyo SJ-210.

The influence of variable kinematics of honing process has a positive impact for many aspects of performing of efficient and accurate honing process.

Keywords: honing, variable kinematics, thermal honing

1. EXPERIMENTAL RESEARCH STADIES

1.1. CNC Sunnen HTH 4000S

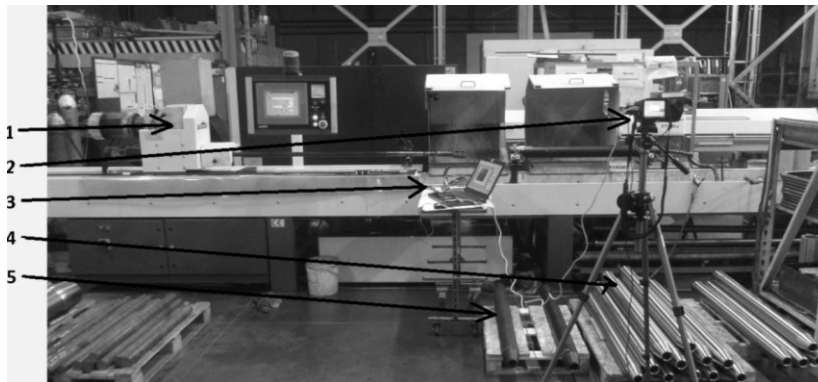


Fig.1 Research stand: 1 – Sunen HTH 4000S horizontal CNC honing machine from Sunnen, 2 - Vigocam V50 infrared camera, 3 - computer with THERM 2.23.2 software, 4 - unpainted workpieces, 5 - painted black machined workpiece

CNC horizontal honing machine had no possibility for making the change of rotation during one stroke of honing had. HTH 4000S was prepared to have the possibility for making the change of RPM. Preliminary studies have been carried out which confirmed the positive effect of the variable kinematics of honing on reducing the temperature generated in the honing process in machined workpiece. [<https://www.dropbox.com/sh/vq0itqekpeirfhv/AADhIshPBWS4OhvlAB8VwRh-a?dl=0>]

1.2. Conventional vertical hydraulic honing machine WMW SZS250

The most efficient and interesting for making research of honing process due to possibility of making changes of technological parameters in process was the vertical conventional hydraulic honing machine WMW's SZS 200.

[<https://www.dropbox.com/s/xpfb59qgl3idw74/wi%C4%99cej%20szczeg%C3%B3%C5%82%C3%B3w%20o%20procesie.MOV?dl=0>]

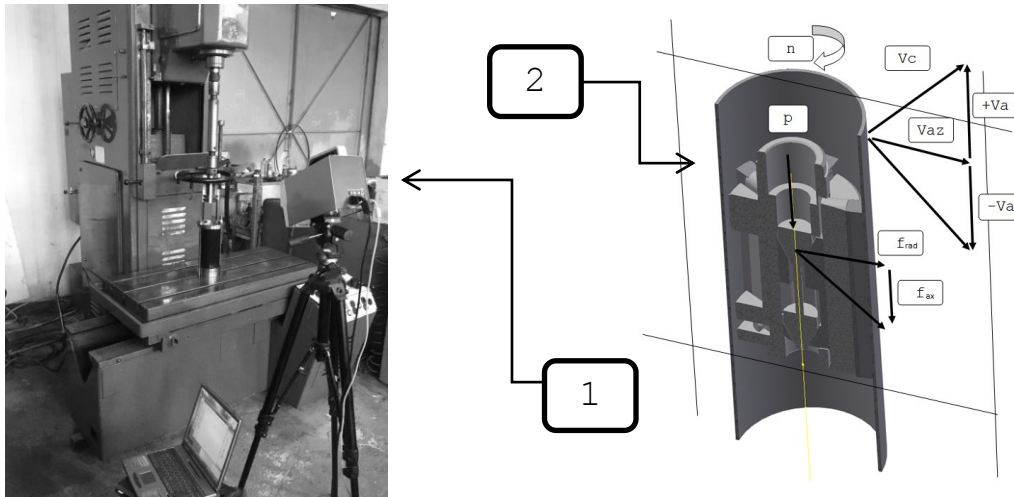


Fig.2 Research stand: WMW's SZS 200 vertical conventional hydraulic honing machine
1 – infrared camera; 2 – honing head

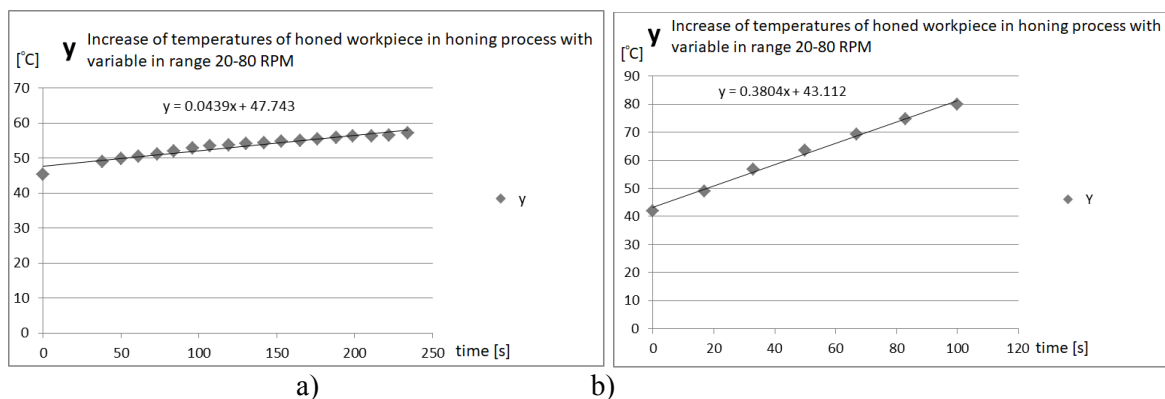


Fig.3 a) Change of RPM's in the range of 20-80 RPM, $p = 0.5$ [MPa]; inclination angle of a trend line $a = 2,5$ [deg]; temperature increase in 1 minute of honing 3.025 [°C];

b) Change of RPM's in the range 100-200 RPM, $p = 0.5$ [MPa]; inclination angle of a trend line $a = 20,8268$ [deg]; temperature increase in 1 minute of honing: 22.701 [°C]

Constant 60 RPM, $p = 0.5$ [MPa]; inclination angle of a trend line $a = 4,05$ [deg]; temperature increase in 1 minute of honing: $4,09$ [°C]

Constant 80 RPM, $p = 0.5$ [MPa]; inclination angle of a trend line $a = 5,41$ [deg]; temperature increase in 1 minute of honing: $5,705$ [°C]

Constant 100 RPM, $p = 0.5$ [MPa]; inclination angle of a trend line $a = 10,89$ [deg]; temperature increase in 1 minute of honing: $10,497$ [°C]

As shown on Fig.3 the variable RPM is generating less temperature of honed workpieces in the range 20-80 RPM than in honing with constant RPM. Variable RPM in the range 100-200 [RPM] is generating bigger temperature of honed workpieces than in honing with constant RPM.

1.3. CNC Haas VF 3SS milling machine VF 3SS and Zeiss Accura CNC coordinate measuring machine

On Haas VF 3SS vertical CNC milling machine with equipment of Honingtec for honing (Fig.4) have been conducted many of tests of honing process with variable kinematic of honing process. The influence of variable feed and variable RPM have been measured on Zeiss Accura CNC coordinate measuring machine.

[<https://www.dropbox.com/sh/2nvmmz3s5v2g245/AADma8bCk19aANMpVENG78b5a?dl=0>]

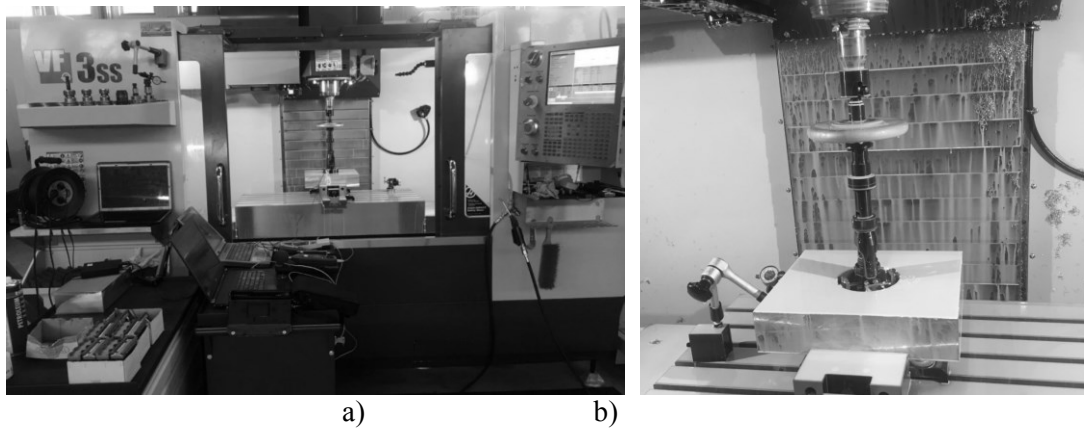


Fig. 4 Research stand: a) Haas VF 3SS vertical CNC milling machine; b) equipment of Honingtec for honing

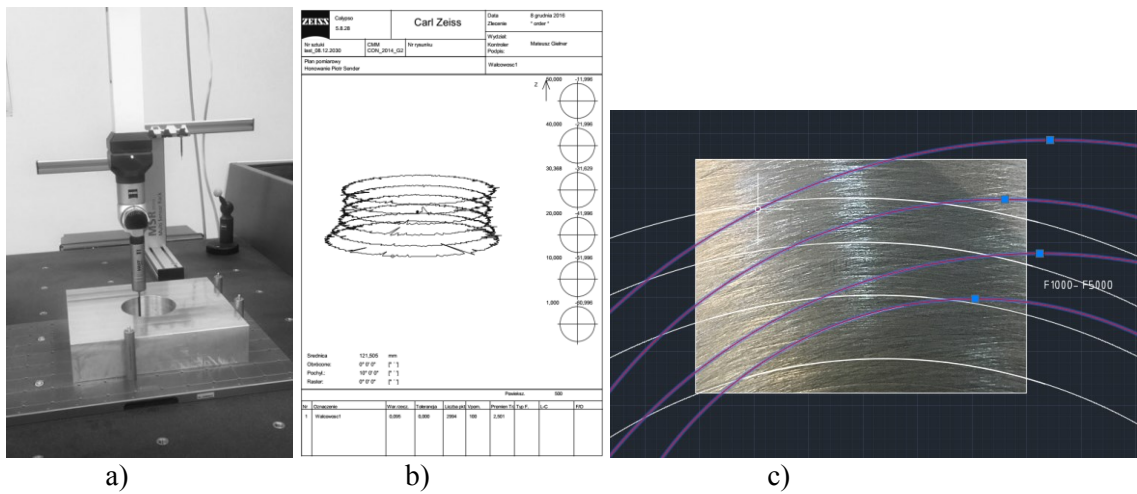


Fig. 5 Research stand: a) Zeiss Accura CNC coordinate measuring machine; b) raport of measurements of shape deviations of honed holes; c) honed surface with variable feed with some paths of grain

As shown on Fig. 6 constant RPM of honing head in honing process gives bigger deviations of honing holes than with variable kinematic (with variable feed and variable RPM, below 100RPM).

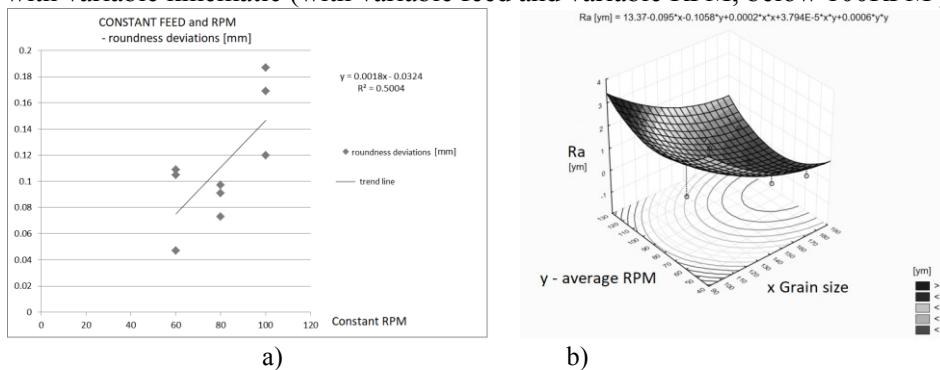


Fig. 6 a) Constant parameters of honing - cylinder deviation; b) Variable RPM – Ra [μm]

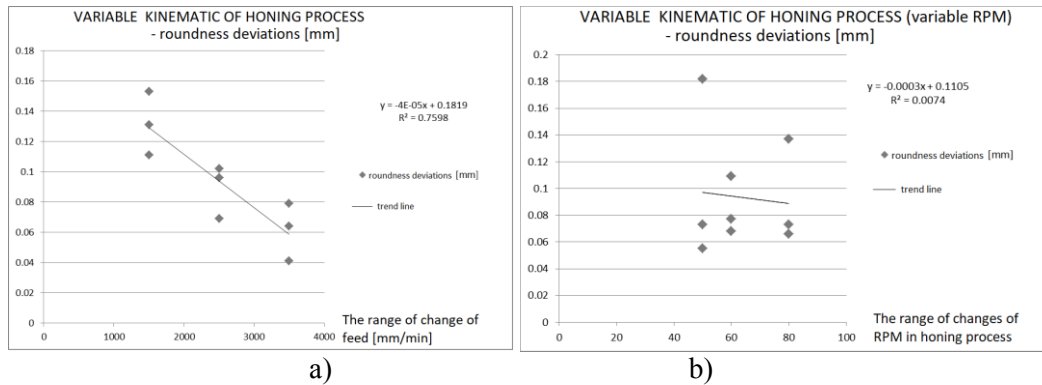


Fig. 7 Variable kinematic of honing process - cylinder deviation: a) variable feed of honing head; b) variable RPM of honing head

Bigger change of feed and RPM (below 100 RPM) of honing head in honing process gives smaller deviations of roundness of honed holes.

2. CONCLUSION

- [1] Variable RPM and variable feed affect the minimization of cylindricity deviation.
- [2] Variable RPM is reducing the surface roughness.
- [3] Variable feed doesn't reduce the surface roughness.
- [4] Variable RPM (below 100 RPM) affect the reduction of temperature generated in honing process in honed workpieces.
- [5] Variable RPM in the range of 100-200 RPM increased the temperature of the honed workpieces by nearly 23°C / 1 minute. Total whetstone usage may occur in 1 minute.

3. REFERENCES

- [1] Barylski A., Sender P. (2014): Badania przyrządów średnic i temperatury przedmiotów podczas gładzenia długich otworów w warunkach produkcyjnych: *Mechanik* 9. <http://www.mechanik.media.pl/artykuly/badania-przyrostow-srednic-i-temperatury-przedmiotow-podczas-gladzenia-dlugich-otworow-w-warunkach-produkcyjnych1.html>
- [2] Buj-Corral I., Álvarez-Florez J., Domingurz-Fernandez A. (2018): Acoustic emission analysis for the detection of appropriate cutting operations in honing processes. *Mechanical Systems and Signal Processing* 99. <http://dx.doi.org/10.1016/j.ymsp.2017.06.039>.