UNIVERSITY OF NIŠ
The scientific journal **FACTA UNIVERSITATIS**
Series: **Mechanical Engineering** Vol.1, N° 4, 1997 pp. 433 - 438
Editor of series: Nenad Radojković
Address: Univerzitetski trg 2, 18000 Niš, YU,
Tel: (018) 547-095, Fax: (018)-24-488

ASPECTS CONCERNING THE CERAMIC SURFACE ACCURACY IN PLANE LAPPING

UDK: 620.19

Corina Barleanu

Technical University from Cluj - Napoca

Abstract. *There is increasing interest in the use of advanced ceramic in machine building. This is primped by the attractive properties of ceramics such as good high temperature, strength, low thermal conductivity, chemical inertness, high hardness and also good tribological properties - low wear and low friction. On the other hand near the honing and grinding it is possible to obtain high precision surfaces using lapping and polishing. This paper intend to find the most propitious for advanced ceramics by changing the normal load speed and the size of lapp medium. The samples used was the* Al_2O_3*–99.7%-RK38. After lapping the surfaces roughness was measured using Perthometer device and the wear was measured using the weight loss method requires careful weighting of samples before and after test, using an electronic microbalance.*

1. INTRODUCTION

Lapping means the processing of ceramic, metallic or non-metalic materials by micro-cutting. This procedure allows the obtaining of dimensional accuracy and of high level geometrical form as well of some surfaces with very low roughness $Ra \leq (0{,}01\text{-}0.02\mu m)$.

Lapping is used on a large scale when we process parts made of ceramic materials as it is carried out without a great mechanic stress of the semi-product goods as a consequence of the very small additions from processing. At the same time the interaction between the cutting edges of the abrasive microgranules (diamond or boron cubic nitride) and the material of the lapped surfaces is lacking coarse damaging of the layer of the material sampled under the form of micro-shavings. That is why the surfaces resulting from lapping is free any hair-coacks, peeling as well as from remanent stress, a fact that made the resistance at wear and at the chemical agents or corrosive action to increase considerably.

Received October 3, 1996

2. CHARACTERISTIC FEATURES OF THE LAPPING PROCESS APPLIED TO CERAMIC PARTS OF THE TYPE AL_2O_3

Lapping of plane surfaces of the parts made of ceramics has been achieved by the lapping machines with an epicycloid device (see Fig. 1).

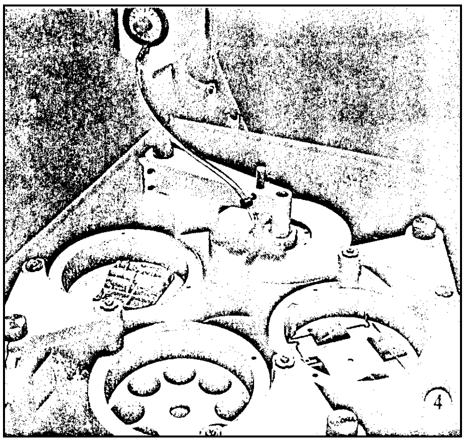

Figure 1.

Between the lapping disc surfaces and the part's surfaces to be lapped has permanently been a stable film of abrasive emulsion.

The parts that have undergone lapping are discs of approx. 6mm thickness and 50mm diameter, made of Al_2O_3 – 99.7% of RK38 type having the physical - mechanical properties as follows (see table 1).

Table 1

Density	3.95g/cm^3
Vickers Hardness	2000 (DlN 51065)
Flexural Strength	500MPa
Weibull's Modulus	8 (DIN51110)
Compressive Strength	4100MPa
Fracture Toughness	5.9MPam$^{1/2}$
Young's Modulus	410GPa
Poisson's ratio	0.23
Thermal Expansion Coeff.	7.5 *10^{-6}K^{-1} (DIN 51065) between 120 -500^{0}C
Specific Heat	0.9J/gK
Maximin service temperature	1500^{0}C
Thermal Conductivity at 20^{0}C	30W/mK (DIN 0335)

The process of lapping consists of removal of a layer of material of t=0.004-0.012mm thickness from the part's surface to be process. The process was curried out under the action of abrasive microgranules of boron cubic nitride produced by Peter Woltters (PWB) with the size of granules of 7μm and 30μm which formed together with water an emulsion with a volume concentration of 1:5 having been in continues circulation in the working area.

The boron powder of 30μm - PWB 30 is rather coarse and it has served for the eliminating from the part's surface the damages produced by roughing (by preliminary processing). If we want to polish the surface, we must continue lapping with powder having a granulation of 7μm.

As it results from fig.2, under the action of microparticules of boron suspended in the water film limited by the plane surface of the lapping disc (which is made of cast iron) and the plane surface of lapping (the part of Al_2O_3) both rotating, the forming and sampling of microshavings take place.

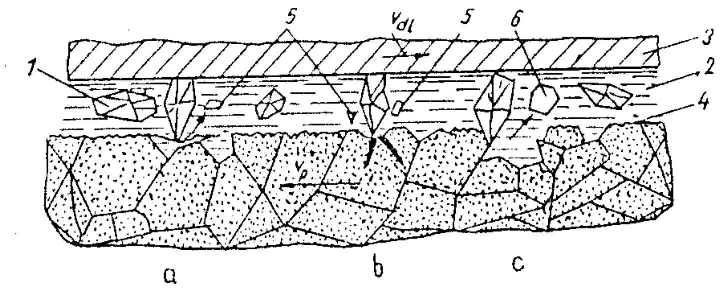

Figure 2.

The aims of the work is that by means of varying the processing parameters with : normal stress on the surface unit, r.p.m., lapping medium (varying the particle size) to find the best sizes for ceramics used in tribological couplings.

3. Process parameters carrying on the work

In the lapping machine (see Fig. 1) were putted four cylindrical samples made of Al_2O_3. In the first part of the paper there were modified the following process parameters: normal load on surfaces unit and number of rotations.

One could notice that changing the number of rotations (speed of processing) did not have a too great influence on the surfaces parameters. On the other hand the influence of a normal load of the surfaces unit was evident. A greater load led to a finer processed surfaces.

Table 2

Time (min)	0	10	20	30	40
Ra (μm)	0,79	0,58	0,45	0,50	0,48
Rz (μm)	4,63	3,51	3,27	3,21	3,07
G (g)	42,23	41,93	41,79	41,59	41,40
h (μm)	5641,7	5601,6	5578,9	5556,2	5530,8
Δh (μm)	0	40,1	62,72	85,43	110,8

In the second part of the paper we want to see the influence of the lapping liquid (granules size) on the surfaces quality of the processed part.
In table 2 there are shown the resultates under the influence of the following process parameters :

-r.p.m.= 70min^{-1}
-normal load F = 0.0108N/mm^2
-area of contact surface S = 1844.487 mm^2
-lapp medium PWB 30 + PWB 7.

In the next step the same process parameters were kept , changing only the lapping liquid for the last 20 minutes (PWB 7 was used). Results can be seen in table 3.

In tables 2 and 3 Ra stands for the average tolerance of roughness , *Rz* stands for the average depth at 10 points of the roughness, h is height of the part , Δh is weight variation due to loss of mass by the lapping process.

Table 3

Time (min)	0	10	20	30	40
Ra (μm)	0,68	0,58	0,50	0,34	0,29
Rz (μm)	4,38	3,55	3,21	2,36	2,01

The results were obtained by surfaces state measurements of the parts and then processed by means of the Pedhometer. The part mass determinate after each trial was done on an electronic balance. The loss in weight that taken place was very small (of10^{-3}g order) so that it was related to the thickness variation of the parts (Δh).

In figures 3, 4 and 5 the surface characteristics of the parts in row state are shown (Fig. 3), after lapping for 30 minutes with PWB 30 (see fig.4) and after lapping with PWB 7 for the last 10 minutes (see fig. 5).

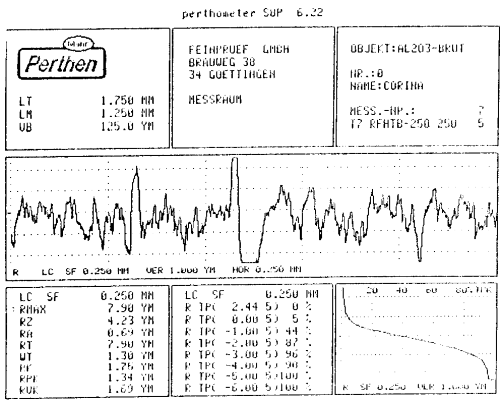

Figure 3

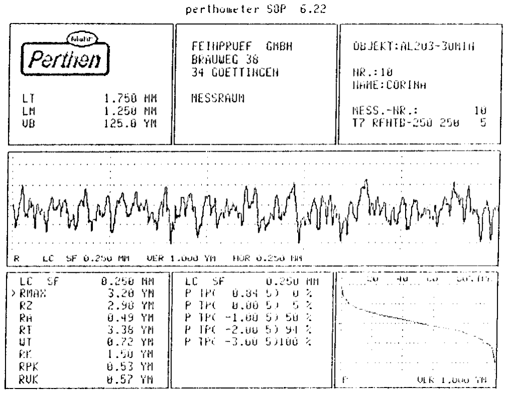

Figure 4

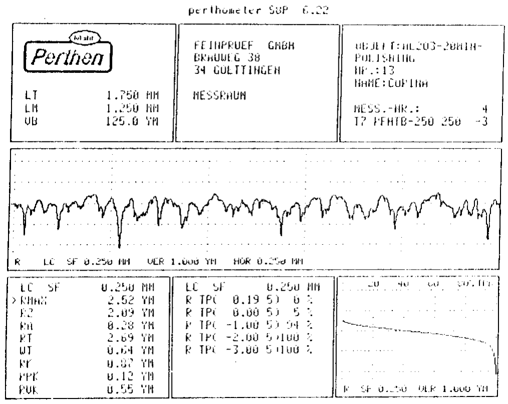

Figure 5

4.CONCLUSIONS

We may conclude that the lapping process of technical ceramics parts of the Al203 type is a process of extrafinishing by microshaving - a process influenced by the parameters of shaving, respectively by the magnitude of the normal load, the r.p.m. of lapping machine, the state and size of the contact surface and last but not least by the granules size of the lapping medium.

5. REFERENCES

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USLOVI KOJI OPREDELJUJU TAČNOST KERAMIČKE POVRŠINE PRI POVRŠINSKOM LEPOVANJU

Corina Barleanu

Ovaj rad ima za cilj pronalaženje najpovoljnijeg medijuma za lepovanje savremenih keramičkih materijala i to variranjem normalnog opterećenja, brzine i krupnoće (granulacije) medijuma za lepovanje. Eksperimentalna ispitivanja su vršena na uzorcima od Al_2O_3*-99.7%-RK38.*