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# PRELIMINARY RESEARCH ABOUT INFLUENCE OF BASIC GRINDING PARAMETERES ON TEMPERATURE OF TITANIUM ALLOYS CUTTING

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## ABSTRACT
*Generated thermal energy located in relative small cutting area brings to the high temperature that causes different physical and chemical changes in the cutting area. High temperature of the titanium alloys grinding process, that as a characterization have current achievement of maximum value with short duration, have extremely nuisance on characteristics of the quality of the treated exampler area and the conditon of the desktop of that device. We must add and the dimensional mistakes to that, and all that can decrease features of exploatation of the made part significantly.*
Key words : heating energy, titanium, grinding, stress

## 1. INTRODUCTION
Grinding temperature is a temodynamic size of a heating condition of grinding process, which defines heating degree of few points, in a contact zone of a grind and working area (obradak). Generally speaking, grinding temperature $\theta$ is a function of strength of a heating source *t*, based on physically heating characteristics of elements in a working system λρc, and space coordinates x, y, z, meaning :

$$\theta = f(q,\, t,\, \lambda\rho c,\, x,\, y,\, z)$$

the temperature values of all points in a contact zone, between the grinding contact with working area in a given moment, define temperature field of cutting zone, isoterm surface and temperature gradient. The isoterm surface is made by all points with the same temperature, while the gradient is the biggest change of temperature in a normal direction for isoterm surface. Large quantity of heating energy, which goes into the work from the cutting zone, can cause a list of unwanted termic defects on the surface layer of high temperatures, with high speed of heating and cooling. On a working surface are appearing : microstructure change, microhardness, missing voltage, microfissures and in places burned surfaces. In order to define a temperature field on a surface layer of working material, temperatures are measured for different distance of a measuring points in worked areas, from contact surface of grind and working area. Together with temparature, it is recommended to measure a grinding forces, so that the exact position of temperature change could be determined, in a relation with a contact area. By using temprature diagrams and grinding forces, obtained in this way, and by theirs systematisation, we get temperature change in a contact zone, with time for different distance of measuring point from working surface. The change of temperatures in a zone of contact with time, measured on a different spot inside of surface area of work, illustrate the appearance of a temperature field of cutting zone. Concerning grinds enterance in a operation, dimensions and moving speed of working area, it can modify the temperature field of cutting zone by using the time change of temperature. Resulting codes of temperature change, over the depth of surface area of working material, confirm the characteristics of heating sources parameters, meaning, the influence of working regime on a temperature of grinding. It is seen that the deeper depth of cutting, primarily because of increased strength of heating source, increases contact temperature of grinding, and the depth of heating tension of surface layer of working area. On the contrary, higher speed of working, because of less time of action of a total heating source on a working material, decreases the grinding contact temperature, and equals the heating load of the surface layer of working area.

## 2. DEFINING PARAMETERS OF GRINDING TITANIUM

### 2.1. The object of work

For grinding temperature definition it is used titanium alloy TA6V, which is more and more commercially used, because of :

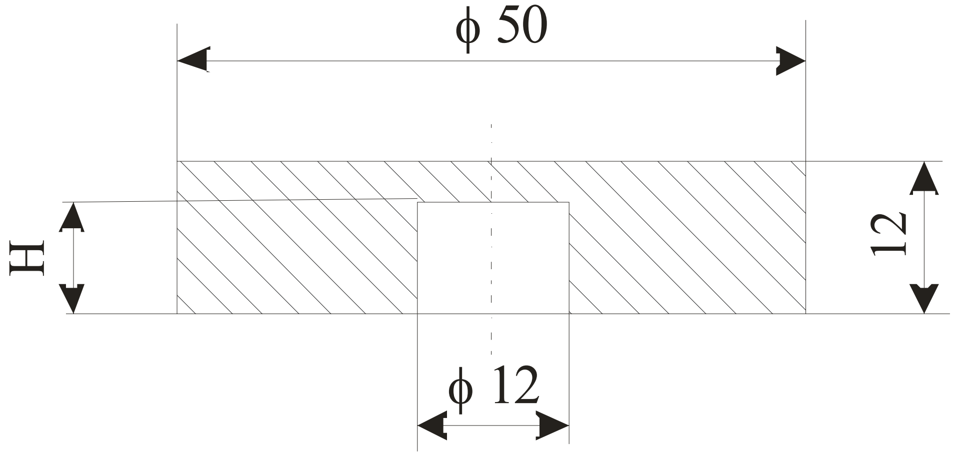
- small specific weight (between aluminium and steel)
- great mechanical resistance, especially for alloys, joined with good characteristics during fatigue
- resistance to corrosy in a big number of mediums, etc.

Plate 1.

| Mechanical and phsycal characteristics | | |
|---|---|---|
| Displacement $\sigma_{0,2}$ (daN/mm$^2$) | Displacement $\sigma_{max}$ (daN/mm$^2$) | Density $\rho$ (g/cm$^3$) |
| 92 | 105 | 4,505 |

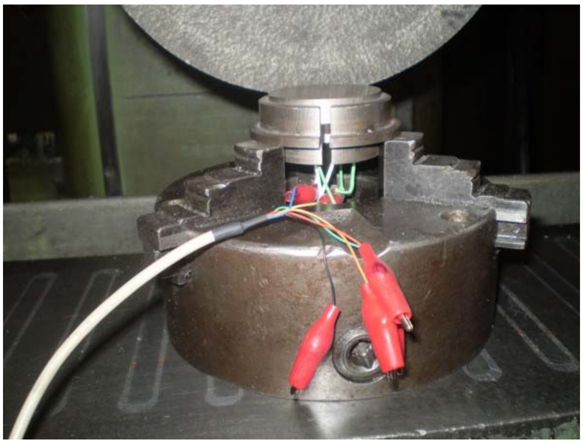
Plate 2.

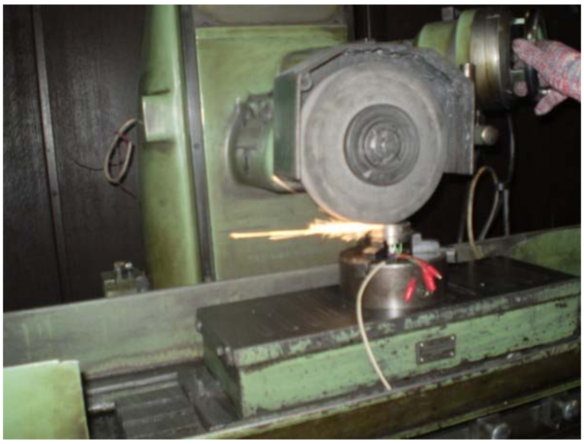
| Chemical content TA6V | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| % | C | Fe | Al | V | H | N | O | Ti |
| From | | | 5,5 | 3,5 | | | | |
| To | 0,08 | 0,25 | 7 | 4,5 | 0,01 | 0,07 | 0,2 | From - until the rest of |




*Picture 1. The appearance of test tube*

**2.2. Working spot (picture 2 and 3)**





Test are done on a machine for a flat grinding :

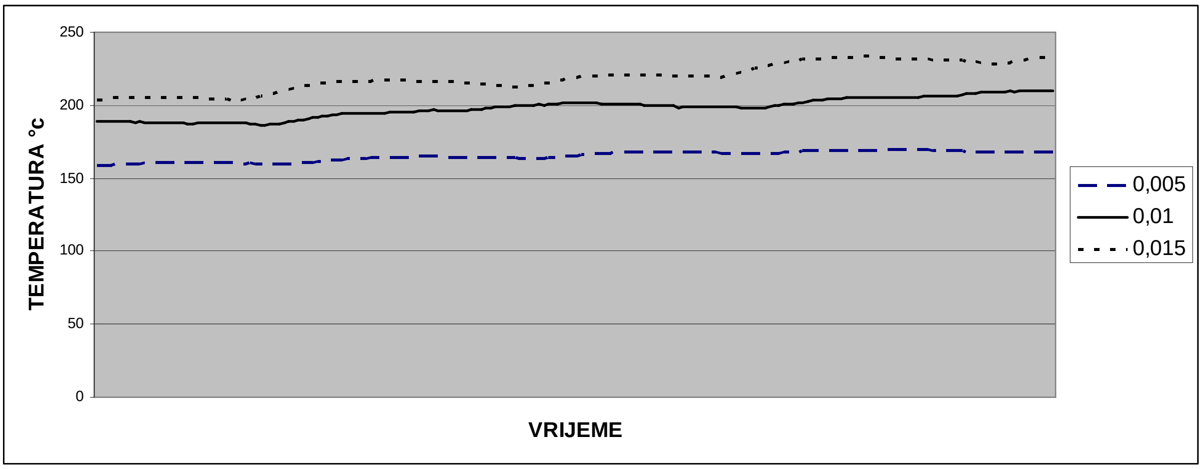
- working voltage .................................................................................220/380 $[V]$,
- maximum speed of a table .......................................................... $v_R = 18\left[\frac{m}{\min}\right]$,
- the grind diameter .......................................................................... $D = 250\ [mm]$
- the number of grind rotations............................................................ $3000\left[\frac{o}{\min}\right]$,
- the strength of electroengines ............................................................... 2,2 $[kW]$,
- transmission of supporting movement - ................................................ hydraulic.

The tool used in the test is round grind, produced by «Swaty» Maribor, the grind measurements are 250x76x35, B46J6V quality.

**3. TESTING RESULTS**

| | of test tubes br. 5 δ=0,005 mm | of test tubes br. 9 δ=0,01 mm | of test tubes br. 3 δ=0,015 mm |
|---|---|---|---|
| | Temperature °C | | |
| 1. | 169,5286 | 205,1981 | 231,6636 |
| 2. | 169,5286 | 205,1981 | 231,6636 |
| 3. | 169,5286 | 206,0985 | 231,5534 |
| 4. | 169,3301 | 206,2986 | 231,333 |
| 5. | 169,0324 | 206,0985 | 231,1127 |
| 6. | 168,834 | 206,0985 | 231,1127 |
| 7. | 168,7348 | 206,1985 | 231,1127 |
| 8. | 168,6355 | 206,2986 | 231,0026 |
| 9. | 168,6355 | 206,2986 | 230,8924 |
| 10. | 168,5363 | 206,3987 | 230,6721 |
| 11. | 168,4371 | 206,899 | 230,4518 |
| 12. | 168,2387 | 207,5996 | 230,2315 |
| 13. | 168,2387 | 207,9999 | 230,2315 |
| 14. | 168,2387 | 208,4003 | 229,5707 |
| 15. | 168,2387 | 208,5005 | 228,91 |
| 16. | 168,0403 | 208,8008 | 228,5797 |
| 17. | 167,9411 | 208,9009 | 228,3595 |
| 18. | 167,8419 | 209,2013 | 228,2494 |
| 19. | 167,8419 | 209,3014 | 228,4696 |
| 20. | 167,8419 | 209,3014 | 228,7999 |
| 21. | 167,7427 | 209,6018 | 229,0201 |
| 22. | 167,7427 | 209,3014 | 229,5707 |
| 23. | 167,7427 | 209,6018 | 230,3417 |
| 24. | 167,7427 | 209,4015 | 230,8924 |
| 25. | 167,7427 | 209,7019 | 231,333 |
| 26. | 167,7427 | 210,0023 | 231,9941 |
| 27. | 167,6435 | 210,2026 | 232,7654 |
| 28. | 167,6435 | 210,1025 | 233,096 |
| 29. | 167,6435 | 210,2026 | 233,647 |
| 30. | 167,6435 | 210,3028 | 233,9777 |

$$H = 9\ [mm];\ v_R = 3\left[\frac{m}{\min}\right]$$




*Picture 4. Value notes of temperatures for* $H = 9\ [mm];\ v_R = 3\left[\frac{m}{\min}\right]$

## 4. CONCLUSION

● The grinding work of titanium alloy is hardened because of bad heating flow, just as relatively large ductility (titanium is soft, gluable on a grind working surface), and because of hard oxydant layer, which appears while staying long on the open air.

● The change of temperature in a time contact zone, measured on different areas inside surface layer of working area, are illustrating the appearance of temperature field of cutting zone. Concerning the moment of action grind entrance, dimensions and speed of working area, temperature field of cutting zone can be modified through temperature time change.

● During titanium grinding under larger depths, and relatively low speed of working objects, burned areas are seen (explained by bad heating flow of titanium) . The use of softer grinds would probably give a better results.

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