CONSIDERATIONS ABOUT THE SURFACE ROUGHNESS IN FLAT LAPPING

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Lapping consists in the final smoothing of previously grinding surfaces. This is done by means of certain fine abrasive particles impressed on the lap or freely interposed between the piece to be processed and the lap. Abrasive pastes applied on the tool may also be used. Through the relative motion of the lap compound to the piece, in the presence of abrasive grains, particles from the processed material are removed.

The abrasive and the material out of which the lap is made are chosen according to the lapping procedure, which can be classified as follows:

Free, impenetrable abrasive lapping. This procedure uses a soft material: Vienna lime, chromium oxide, which, during the process, penetrate neither the surfaces of the lap nor that of the permanently free actioning part. The lap is made of a material characterized by a high degree of hardness, lg. quenched steel. The liquid containing suspended abrasive grains is a mixture of machine oil and gasoline or petroleum.

Lapping with abrasives previously penetrated in the surface of the lap. In this situation, the lap is made of soft material: copper, lead, soft allots, capable of retaining the abrasive grains under good conditions. The abrasive used can be: diamond dust, carborundum, electrocorundum, boron carbide. The abrasive grains should be impressed on the surface of the lap without being dulled.

Abrasive paste lapping. This method uses abrasive pastes which exert not only a mechanical influence, but also a chemical one on the working surface (they oxidize the surface). The oxide film which is being formed can be easily removed from the lap. The pastes can have various compositions: grains of chromium oxide and oleic or stearic acid as a binder. the paste is diluted by adding petroleum in the case of cast iron and machine oil in the case of steel laps.

In lapping, the tooling allowance is minimum and it overtops only a little the height of the roughness resulting from previous grinding. That is why mechanical lapping should be accompanied by the selfcentring of the parts or of the tool and it cannot correct the geometrical shape obtained as a result of the previous operation.

Lapping is necessary to obtain only special smoothness of the surface or to obtain extremely high dimensional precision together with special smoothness of the surface.

Experimental research made use of the lapping machine whose kinematics diagram is presented in figure 1.

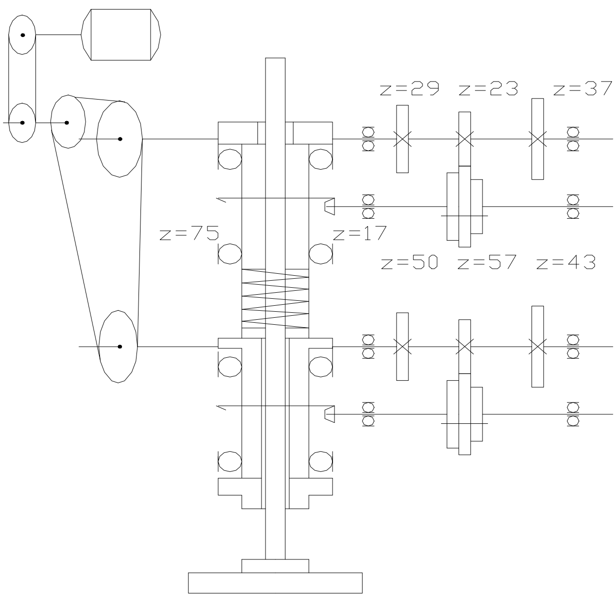

Figure 1. Kinematics diagram of lapping

Several types of materials have been processed, starting with 40Cr10 and RUL 1. The processed pieces are cylindrical in shape, with 20

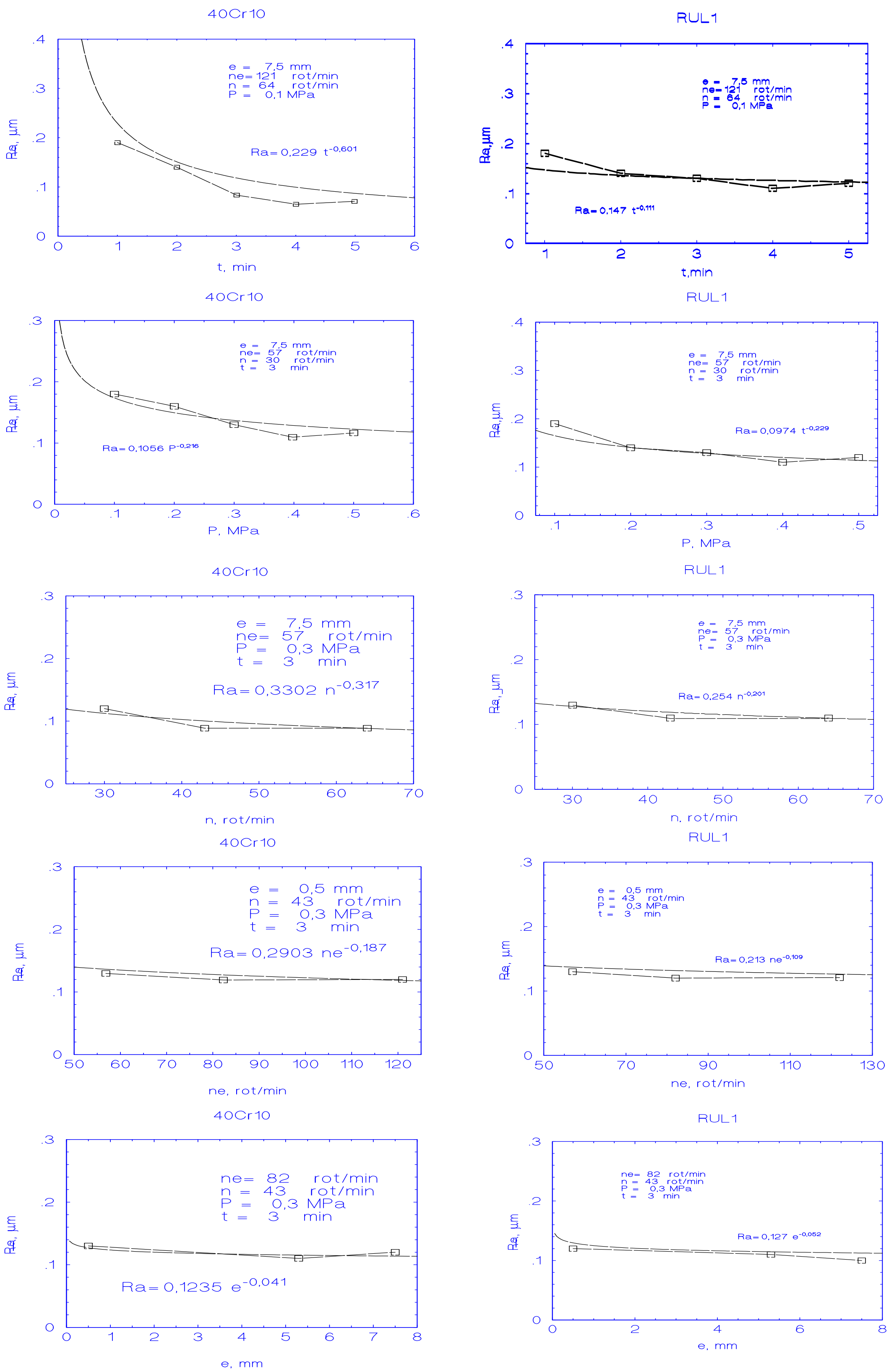

Figure 2.

mm in diameter and 10 mm in height. The front surfaces have been processed :

√ initial roughness was measured, parameter $\boldsymbol{R_a}$;

√ the pieces were then placed in the slats of the lapping device, mounted on the machine table;

√ the lapping device was adjusted that the front surfaces of the from simultaneously processed pieces might be on the same plane;

√ the working parameters were adjusted as follows:

1. the eccentricity in the three positions (0.5 mm; 5.3 mm; 7.5 mm);

2. the number of rotations of the eccentric. The following three values were obtained: 57 rot/min, 82 rot/min and 121 rot/min;

3. the number of rotations of the main axle. The following three values were obtained: 30 rot/min, 43 rot/min and 64 rot/min;

4. the working pressure through the compression of the spring while smoothly moving the machine down the column. The following five values were obtained: 0.1 MPa; 0.2 MPa; 0.3 MPa; 0.4 MPa and 0.5 MPa;

5. the operating time was measured by means of a clock. The process lasted for 1 min, 2min, 3min, 4min and 5 min.

√ the abrasive used was a paste obtained by mixing chromium oxide and machine oil. This was applied on the lapping disc before each processing. Chromium oxide (Cr_2O_3) is a bright green abrasive powder having 7.2 in hardness (MOSH scale).

√ for each combination of the working parameters from pieces were processed. For each piece three measurements of roughness R_a were made, followed by their arithmetic mean. For each point on the graph of the variable R_a the arithmetic mean of the roughness R_a of the four simultaneously processed pieces was marked.

Research has experimentally demonstrated the dependence of roughness R_a on variables ***e*** (eccentric), ***ne*** (number of rotations of the eccentric), ***n*** (number of rotations of the main axle), ***P*** (working pressure) and ***t*** (operating time). The problem is to find a relation of the type:

$$R_a = f\,(e, ne, n, P, t)$$

In order to solve this problem, a function searching program was used, meant to find a function for representing experimental data, obtained as multidimensional series. After introducing the experimental data, the following functions were obtained for the tow types of processed materials:

for 40Cr10

$$R_a = 1.384\, e^{-0.041}\, ne^{-0.187}\, n^{-0.317}\, P^{-0.216}\, t^{-0.601}$$

2. for RUL1

$$R_a = 0.376\, e^{-0.052}\, ne^{-0.109}\, n^{-0.201}\, P^{-0.229}\, t^{-0.111}$$

Figure 2 presents the curves of the type ***Ra=f(t), Ra=f(P), Ra=f(n), Ra=f(ne), Ra=f(e),*** for the two materials, 40Cr10 and RUL1, while keeping the other variables at constant values.

The values of these constant factors were presented on each graph together with the expression of the particularized function.

These curves evince a tendency to going down, so that the higher the value of the respective parameter, the lower roughness R_a. As can be sun from the respective graphs, the curves corresponding to the functions for 40Cr10 display a more prominent tendency to going than that corresponding to RUL1. Therefore material 40Cr10 may be said to lend itself better to being processed. The curves traced through the experimentally obtained points deviate from the curves of the particularized function with at most 10% of the maximum value of roughness R_a measured in the respective situations.

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