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STUDY OF WEAR OF FRICTION LINING OF BRAKE SHOE

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***Abstract**: The paper represents a part from the researches referring to the tribologycal aspects ale of the brakes of the mining hoisting machines in the mining basin Baia Mare. Is presented an assessment method for the thickness of the layer of material worn-out lining of friction brake shoes correlating the theoretical methods with the experimental methods.*

***Key word**: wear, brake shoe, rim, roughness*

1. The theoretical determination of linear intensity of wear

In the process of braking, due to friction among the surfaces of friction couple (brake shoe and rim), the zones of contacts are destroyed to one or else many cycles of braking, resulting the particles of wear. The elements couple fricative have decreases the sizes in the normal direction to the friction surface.

Wear Equation for Friction Materials [10]

$$V = K \cdot p^a \cdot v^b \cdot T^c \tag{1}$$

where:

- V-Wear volume
- v - sliding velocity
- T - time of sliding
- P- load
- K- proportionality constant

The exponents, a, b and c depend upon thematerial combinations and sliding conditions.

The volume of material far-off from the surface of friction lining under the form of the particles of wear (Δv) is proportionate with the area of contact [7]:

$$\Delta v = \Delta h \cdot l_f \cdot b \ , \tag{2}$$

where:

- Δv is the volume of material worn-out for an alone crossing (for an alone rotation of rim);
- Δh - the average far-off thickness through wear process, for an alone crossing(for a circumrotation of rim);
- l_f - the friction length for a circumrotation of rim;
- b - the width shoe.

At those conditions for a braking cycle the volume of material worn-out he is:

$$\Delta V_0 = n \cdot \Delta h \cdot l_f \cdot b \, , \tag{3}$$

where n is the number of rotation of rim for a braking cycle.

Thus, if is known the thickness maxim admitted of material worn-out for friction lining (for the hosting machine is specified in documentation), we can calculate the number of braking cycles:

$$N = \frac{\Delta H}{n \cdot \Delta h} . \tag{4}$$

Below another appearance, hereupon the friction length L_f, on the duration of operate of the friction lining, he took off in the shape of wear the thickness ΔH. In thus conditions the intensity of linear effeteness is expressed:

$$I_h = \frac{\Delta H}{L_f} = \frac{n \cdot N \cdot \Delta h}{L_f} . \tag{5}$$

2. The experimental research of wear of friction lining of brake shoes

The theoretical and experimental researches demonstrated the fact that in the case of friction couples metal and friction material, the relative speed of the surfaces, the bearing load, the roughness of metallic surface and the temperature of friction surface influences the process of wear. [1][2][3][5]

In this context, after the research and analyze of tribo-system brake shoe- rim of the hoisting mining machines were considered as be exhibitive for the process of wear of friction surfaces the parameters: roughness surface of rim, bearing load and the relative speed of surfaces. [4][6][8][10]

The determinations of wear are achieved, as by the scheme represented in the figure 1.

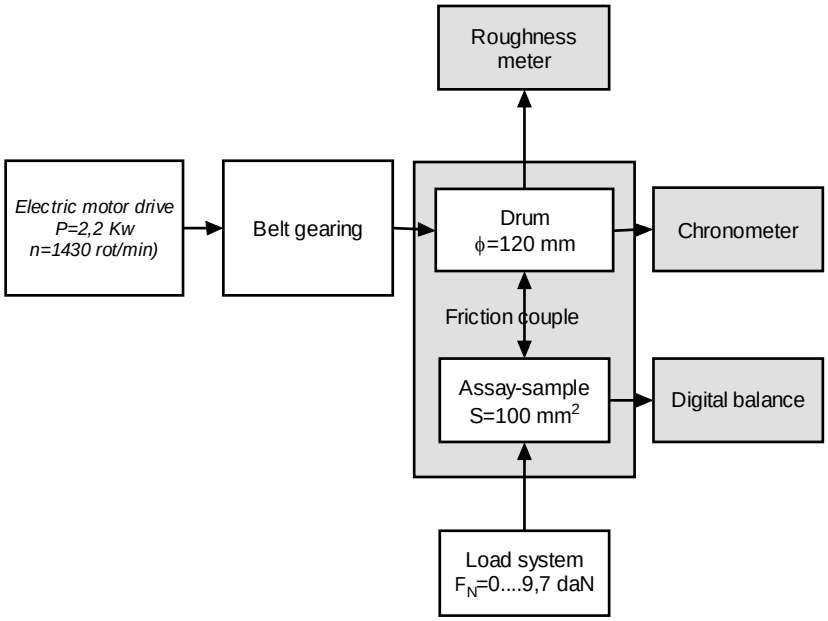

Fig. 1 *Schema for the wear attempts*

The experiments were made with a help an existing device in the Laboratory of machines elements from the framework of North University of Baia Mare. At this device we maiden some modifications and completions so that to represent friction couple brake shoe-rim of the hoisting mining machines used-up in the mining basin Baia Mare. [8][9][10]. The drum was made from OL-37, and the assay-sample representing the brake shoe from friction material named samexfagron. On drum was realized, through processing mechanic procedures three bands of different roughness. The bearing loads they achieved with of a help a etalon weights. Each try was made for a friction space equal with a kilometer, this be caused through time for each speed of attempt (for each revolution). The tries was made for three relative speeds ale surfaces of friction couple (5, 5m/s, 8 m/s, 10, 5 m/s), for five values ale the bearing load (2, 9daN/cm^2; 3, 5daN/cm^2; 5daN/cm^2, 9, 7 daN/cm^2; 12daN/cm^2) and three values ale roughness of the drum (0, 871; 1, 969; 7, 061). After each experiment was determined the material worn-out, the assay-sample was weighted forward and after the experiment with of a help of digital balance type GR-202. Knowing the wear volume and the material density of assay-sample it's possible to calculated the volume of material worn-out (the volumetrically wear) and the average thickness of the layer of material worn-out (the

linear wear). For all condition of operation, presenting the combination of the three parameters was made twelve determinations. After processing of experimental data have result three charts (fig. 2, fig. 3, fig. 4), representing the intensity of wear depending on three parameters.

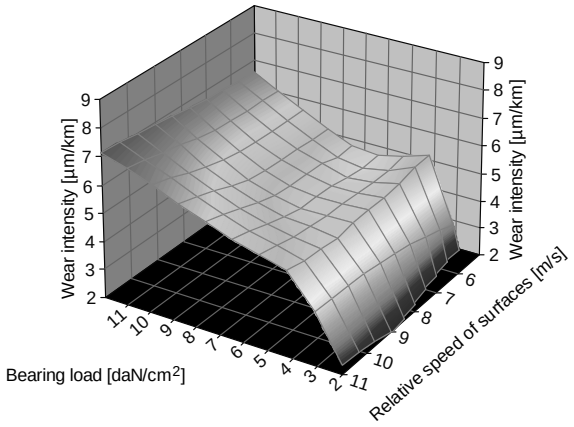

Fig. 2. *Wear intensity at roughness R_a=0,871 (experimental data)*

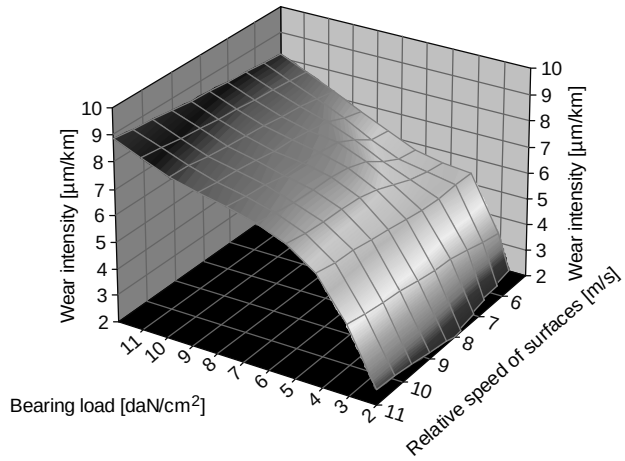

Fig. 3. *Wear intensity at roughness R_a=1.969 (experimental data)*

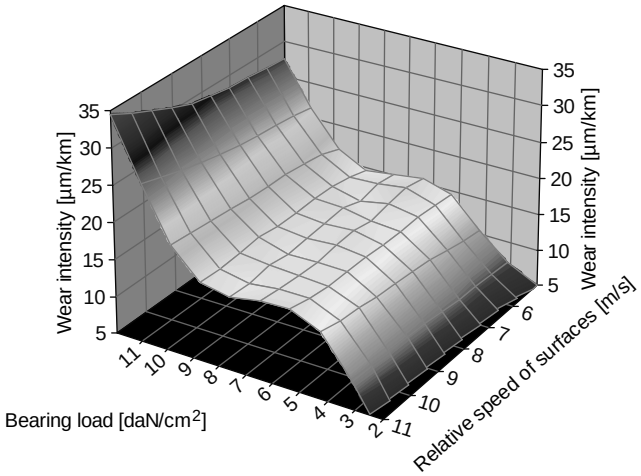

Fig. 4. *Wear intensity at roughness R_a=7,061 (experimental data)*

The charts from the figures: 5, 6 and 7 he represents the intensity of wear after the determination of theoretical depictive equations of phenomenon (curve determinate on the base of gived data and on the base of particular considerations).

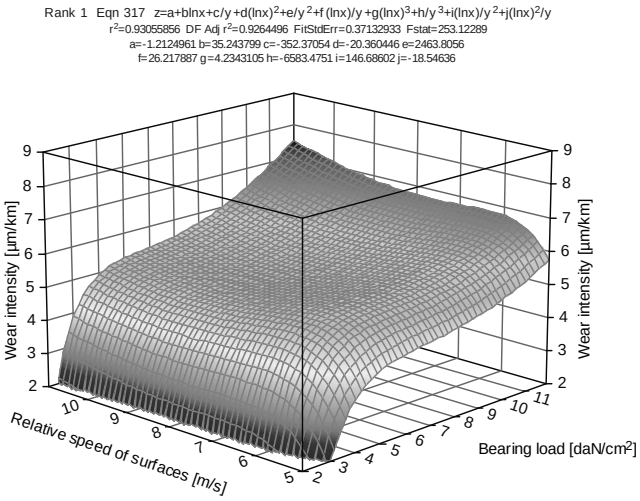

Fig. 5. *Wear intensity at roughness R_a=0,871 (theoretical curve)*

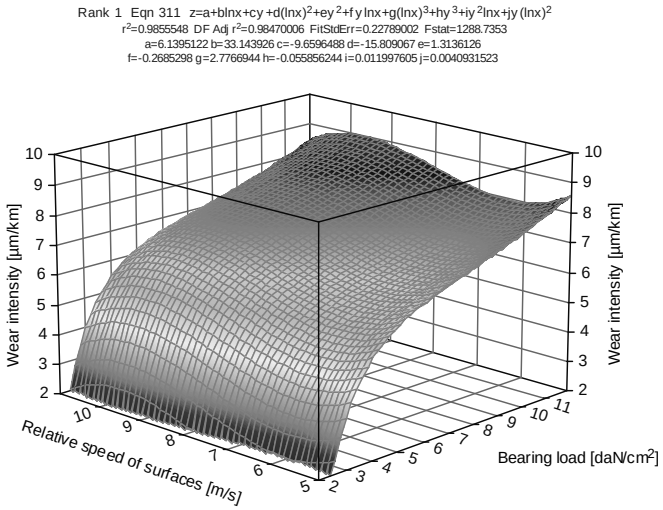

Fig. 6. *Wear intensity at roughness R_a=1,969 (theoretical curve)*

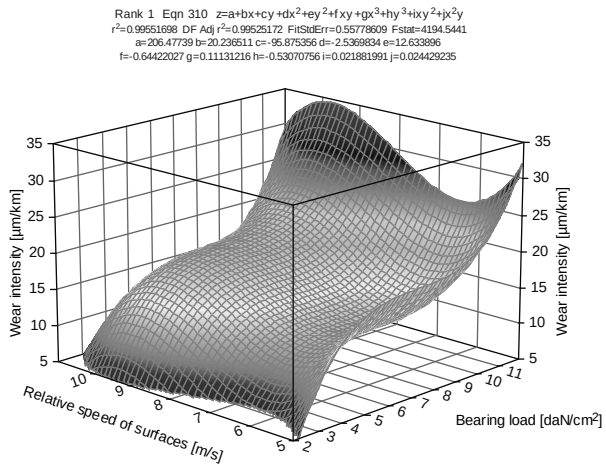

Fig. 7. *Wear intensity at roughness R_a=7,061 (theoretical curve)*

3. Conclusions

- The linear wear intensity presents a marked growth in report with the growth of roughness of rim and the pressure of contact;
- The wear intensity presents an easy growth in report with the growth of relative speed of the surfaces of couple;
- Is noticed the fact that the intensity of wear diminishes of five times in the case minimum roughness against the maxim roughness.

The analyses, the measurements and the experiments can be improved and completed. In this context we propose:

- Particular analyze for the friction tribo-system elements (brake shoe-rim) for the many maul cases;
- The effectuation of wear determinations for the many maul types of material ale couple and for the many maul conditions of operation, with the target to choose friction couple proper for the respective conditions, so that the friction coefficient to be big and stable and the wear intensity of the friction lining to be minimum.

4. Bibliography

[1] **Balekics, M.,** Tribologie, Editura Todesco, Cluj Napoca 2000.
[2] **Belobrov,V. I.,** Dinamika, nagrev i iznos tormozov şahtnâh podbemnâh maşin, Naukova dumka, Kiev, 1981.
[3] **Czichos, H., s.a.** Tribologie-Handbuch (Reibung und Verschleiss) Vieweg & Sohn Verlagsgeselschaft mbH braunschweig 1992.
[4] **Iliaş, N., Magyari A., Adam D.,** Studiu privind cinematica şi dinamica instalaţiilor de extracţie multicablu în vederea reducerii puterii de acţionare a motoarelor electrice, Contract de cercetare nr. 3-B2-1997, Petroşani, 1997.
[5] **Ivanovici, Fr.,** Contribuţii la studiul materialelor plastice în condiţiile frecării uscate cu aplicaţii la segmenţii de frână, Editura Tehnică, Bucureşti,1973.
[6] **Pay, E.** Creşterea fiabilităţii troliilor pneumatice, Contract de cercetare nr.352/1986, Institutul Politehnic Cluj-Napoca, 1986.
[7] **Tudor, A.,** Contactul real al suprafeţelor de frecare, Editura Academiei Române, Bucureşti, 1990.
[8] **Ungureanu Miorița**, Contribuţii privind unele aspecte tribologice apărute în funcţionarea instalaţiilor de extracţie miniere, Teză de doctorat, Baia Mare 2004.
[9] * * * Echiparea puţurilor de mină de la obiectivele miniere existente, noi sau în curs de dezvoltare cu maşini de extracţie de fabricaţie românească, I.C.P.M.N. Baia Mare, 1983.
[10] * * * www.sae.org/events/bce/tutorial-bahadur