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THE INCREASE OF RESISTANCE AT WEAR ON THE SELECTIVE TRANSFER

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Abstract: Seeking for new ways to increase the wear resistance of the machine parts, the examples we found in nature turned out to be of great help. Searching the way of working of the strongly strained friction couples we found out that in nature there are two basic friction couples: open couples and closed couples . The selective transfer can be described as a special molecular interaction and is the result of chemical reactions and physical and chemical processes, as well as of the factors involved in these processes. The selective transfer is characterized by a special molecular interaction and it is the result of some chemical reactions and some physics and chemical processes. These reactions lead to a self – regulation formation in the balance/equilibrium processes, disturbed at the using appearance and also the reduction of the friction force. The formation of a servo wit film is typical of the selective transfer, where a special spreading mechanism is formed. This layer is formed at the beginning of the friction through the selective dissolvent of the anode components in the surface layers of the metal or alloy.

Keywords: selective transfer, friction, wears resistance, experimental approach

INTRODUCTION

Seeking for new ways to increase the wear resistance of the machine parts, the examples we found in nature turned out to be of great help. Searching the way of working of the strongly strained friction couples we found out that in nature there are two basic friction couples:

- open couples;
- closed couples.

In open couples one hard material actuates upon another hard material; for instance, the animals' teeth and hooves. The animals couldn't ruminate a fodder of a hard consistency unless they had teeth of a hard material as well.

In closed friction couples, as for instance the animals' joints, they work on the same principles as with mechanical engineering. A hard bone is covered with soft cartilage in the friction zone. This cartilage is covered with a thin polymer layer, which is very mobile. The friction surface of the opposite body has the same structure, wherefrom we derive that one soft material actuates upon another soft material. These kinds of friction couples are common with animals' und humans'.

The way a friction couple works in case of selective transfer resembles in a certain manner the way joints work with living organisms. In order to achieve a selective transfer the hard steel surface will be covered with a thin layer, which in its turn will be covered by a thin polymer layer. The surface of the opposite body will suffer the same treatment. In this case, too, friction takes place between two identical materials. The aspects revealed allow developing different wear resistance friction couples.

The selective transfer can be described as a special molecular interaction and is the result of chemical reactions and physical and chemical processes, as well as of the factors involved in these processes, such as:

- pressure;
- heating;
- sliding velocity, which causes collisions to the roughness of the friction surface;
- the occurrence of electric charges (the electric particles of different charges attract each other, making up a double electric layer);
- occurrence of different structural defects in metal;
- depolarization effects caused by friction when sliding one surface on the other, which leads to the reduction of autopassivation, to the destruction of the oxide layers und to the acceleration of the corrosion process;
- the effect of emitting exoelectrons, which occurs especially when the friction couple performs an oscillating motion.

These reactions lead to a self-adjustment in the equilibrium processes, which are disturbed by the occurrence of wearing, as well as to the reduction of the friction force.

The selective process represents a complex made up of the following processes:

- reduction of pressure in real contact areas;
- deformation compensation and reduction of the resistance to shearing strain in superficial areas;
- resetting of the particles (which were removed from the friction area) in the contact area;
- the occurrence of a special layer on the friction surface;
- protection of the metal against corrosion;
- the occurrence of a protecting polymer layer.

When is using selective transfer the charge of the construction elements may increase, without causing an increase in weight and dimensions [4]. Typical to selective transfer is the occurrence of a serwit film, in which occurs a special mechanism of diffusion. This layer occurs in the starting phase of the friction strain through the selective dissolution of the anodic components in the superficial layers of the metal or alloy. The servowit layer has the propriety to assure in the deformation processes a sintering agglomeration, in the same way as in annealed metals. This propriety can protect the layer against destruction.

Figure 1 presents the variation of the friction coefficient "f" depending on the pressure for different sliding velocities (0.6 m/s; 1 m/s; 2 m/s) under the conditions of a selective transfer (interior curve) and a friction between the adherent layers (superior curves) [4;5].

Once the layer formed the friction will considerably be reduced on the contact surfaces. The friction force is tightly connected to:

- ≡ *formed structure, in the metallic friction surface areas, following the selective transfer;*
- ≡ *the proprieties of these metallic surface layers.*

The important parameters regarding the physical state of the superficial layers are:

- ≡ *micro voltages;*
- ≡ *its structure und modification on the friction surfaces;*
- ≡ *structure defects (dislocations, punctiform defects);*
- ≡ *the distribution mode of the supplements und the alloy elements.*

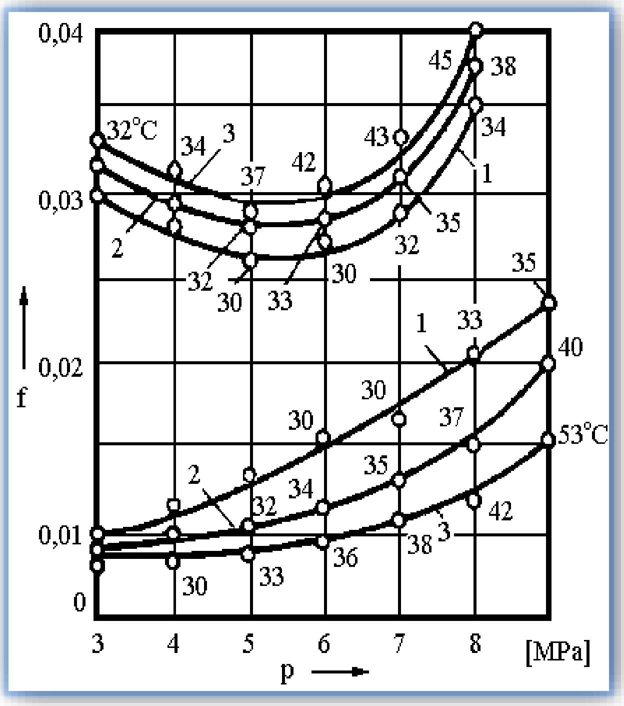

Figure 1. The variation of the friction coefficient "f" depending on the contact pressure "p" for the following sliding velocities: curve 1 at 0.6 m/s; curve 2 at 1 m/s; curve 3 at 2 m/s.

This phenomenon can prove very useful in improving the performance of the hip prothesis.

MEASURING AND TESTING METHODS

To check the transferred layer are used marking methods with informers using radioactive substances or irradiating by accelerated ion beam to cyclotron [7; 9].

During the occurrence of the layer the informers change their form, dimension or leave traces on the tested surfaces in the contact area. In order to make the measurements with informers useful these informers have to comply with certain conditions:

- ≡ *the thickness of the informer layer has to be greater than the highness of the roughness of the tested surface;*
- ≡ *the resistance of the informers has to be smaller than that of the roughness.*

In the case of the marking method by irradiation with accelerated ion beam to cyclotron it is allowed the marking of a thin layer (50 ÷ 700) µm by irradiation at the surface of the part. Depths of (50 µm ÷ 3 mm) can be obtained using protons and deuterons. When irradiating with ion beam a small surface can be marked (3 x 3 mm^2) and at the same time are produced radio isotopes within the same material, which allows to check simultaneously the wear and tear of (2 ÷ 3) surfaces.

As test tool could be used a test tribometer, break shoe on cylinder, preferably Amsler (friction couple third class) or a hip prothesis on a test stand.

The Amsler tribometer [1; 2; 3; 8] can be used to test all motion types: rolling, gliding and sliding. As a standard two collars [8 ÷ 10] of 42 mm in diameter are pressed one against the other. The lateral surfaces of the collar may theoretically be of any geometry. The moment of friction is continuously registered. The wear and tear can be determined by weighing or measuring after the experiment. By means of the eccentric that can be connected the rotation motion can be superposed a pulsating radial load (sudden uplift). A second eccentric allows an axial periodical to and fro pushing of the superior test body. When the superior shaft is standing still a semispherical bearing can be used instead of the cylindrical test body.

Table 1. Parameter of test stand

Number of rotations	25 to 500 1/min
Gliding	0 – 100%
Motor data	1.5 kW, 5.7 A
Load	10 to 2,000 Newton
Temperature	RT
Types of motion	Gliding, rolling, slipping
State of friction	friction in fixed bodies, limit friction, mixed friction
Type of the obtained friction	Elastohydrodynamics
Geometry of contact	Contact – point or line

Table 1 presents the summary of the test stand parameters. Figure 2 shows possible geometries of the tester.

The test stand allows to:

- ≡ *characterize the behavior of materials during friction and wearing;*

≡ *study the over rolling constancy in coatings that reduce friction and wear and tear;*

≡ *to study the material characteristics.*

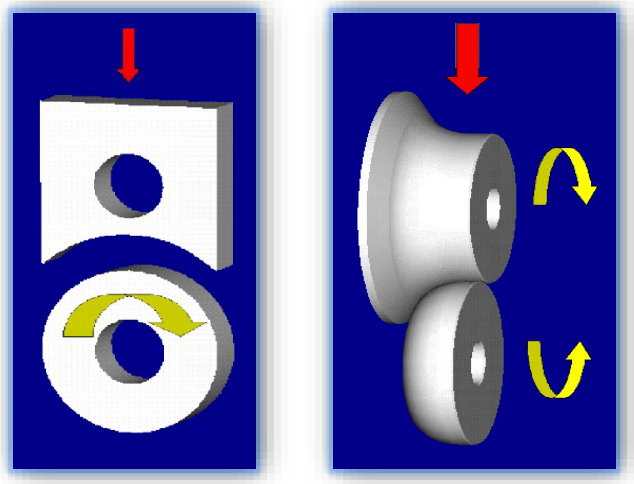

Figure 2. Possible geometries of the tester

CONCLUSION

The selective transfer phenomenon represents a very useful tool in order to obtaining an improved wear resistance of different kind of friction couples.

One of the possible efficient application fields can be the increasing of the hip prosthesis performances, respectively their reliability. One has to underline the well-known fact that by increasing their life-time only with 6 months, one can obtain not only a more competitive biomedical product, but also a significant reduction of the surgical interventions.

Especially for the elder patients, every surgical intervention can represents a great risk of their surviving. By prolongation of the prosthesis's lifetime, this risk will be reduced significantly and also the global intervention's costs will decrease.

Taking into the consideration only the biomedical applications of the selective transfer, one can put in evidence the following incontestable advantages:

≡ *the method allows conceiving and testing of new biocompatible materials (accepted by the surrounding tissues and of the organism as a whole);*

≡ *the selective transfer leads to increasing the durability of prosthesis;*

≡ *the implementation of the selective transfer allows a diminishing of the hip prosthesis' proice.*

In the next period, the author intends to look for some interested companies in improving the actual prosthesis' lifetime by implementation of the selective transfer's advantages.

One other further goal of the author consists of increasing the load-bearing capacity of several great importance bearings by means of the selective transfer.

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