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Novelties Connected With Lubricants

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***Abstract*—In this paper we describe many important aspects connected with lubricants, namely: the cheapest organic lubricant in the word, how effectively save lubricant between pairs of friction, what kind of rational shapes for the lubricant must be, what it will be connected with wear and tear using the new organic lubricant (for this purpose formulas and curves are shown in computer program MathCad with calculation). Moreover, there are two new devices which help to get and estimate both the adhesion and the quality for plastic and liquid lubricants. In conclusion, some recommendations will be given to realize them into the practice during the operation for the different mechanisms/machines.**

Keywords—lubrication, new organic lubricant, plastic and liquid, MathCad calculation, test bench, devices, experiments.

1. Introduction

It is common knowledge, that all lubricants have both positive and negative aspects. Firstly, we'll mark the first one:

- they decrease, as usually, the deterioration in pairs of friction (gear wheels, bearings, guides, cam mechanisms and so on);
- they essentially extinguish vibrations and oscillations;
- they decrease forces of friction and rotary moment;
- they reduce temperature in a zone of friction mobile contact;
- they partly help to smooth the surface roughness and protect it against the destruction.

All of them (aforesaid) play usually good role in various mechanical joints. But now (secondly) here they are the negative moments connected with lubricants which have some negative aspects:

✓ liquid lubricant increases strain in the upper layers of surfaces for different parts in the mobile pairs of friction because of the deep penetration into each pits which every time there are in roughness. *Reminding*: from physics we know that liquid is an incompressible medium. By this reason, it passes the all load on the walls of pits and tries to broaden and to tear these pits. It's not good for the resistance to wear;

✓ if we try to utilize natural oil (as, for example, from sunflower) then the whole complex procedures must be done beforehand, namely: plough, plant, cultivate, fertilize, pour, weed, gather the harvest, to work the harvest, to get oil at the works and so forth;

moreover, this product cannot be saved too long in a good state in accordance with its qualities;

✓ the good properties of the natural oil cannot be excellent for the long time because of ageing;

✓ some useful components can be disappeared / evaporated unfortunately if the packing was opened or was not closed hermetically;

✓ sometimes different lubricants smell badly and even harmful to persons (or annoying);

✓ practically all lubricants are the dangerous and they can be on fire and excrete the perilous gases and evaporations for our life and for the environment too;

✓ we have to guard such oil against the possible misappropriation in a special premise;

✓ it is needed the special conditions into the shops where this oil must remain;

✓ this definite kind of lubricant we usually cannot mix with the other type of lubricant;

✓ the empty packaging from under the definite oil must be cleaned carefully before the next process of packing filling will be for lubricant;

✓ at last, all plastic lubricants vanish from the tight contact between two mobile surfaces very quickly because of press one body on the other one (for example, in gear wheels, in cams and so on).

As it will be shown below, many of enumerated negative aspects will be deleted at all by means of our novelties and recommendations. Moreover, both gases and lubricants can bring the definite harmful for our environmental [1-5, 10-16].

2. Materials and Methods for the first suggestion

Evidently, to diminish press from the liquid oil into the pit of roughness we must exchange the structure and shape of oil, for example: as elastic ball (hollow or complete), short and small macaroni, boublik or roller. To prove this fact several experiments were made using physical macro-model as inverted pyramid on

the one lateral side (on the outside) five transducers were fixed (Fig. 1).

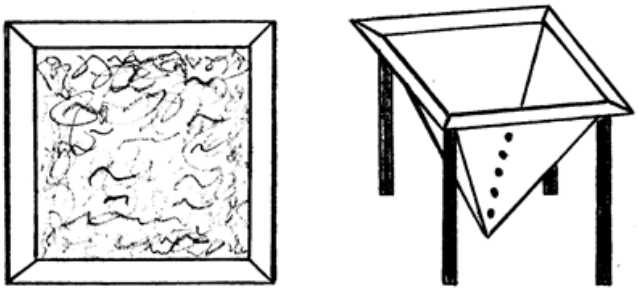

Figure 1. The physical macro-model with transducers to investigate the stress on the lateral side according to height: left view is the model with the definite media (water, oil, grease and so on including the new special suggested lubricant); right view is the pyramid with five transducers

Such forms don't permit this lubricant penetrate too deeply into the pit, not to bottom. Moreover, it is well known that to decrease the coefficient of friction we often use balls and/or rollers. In this case this effect will be obtained immediately. Different lubricants (and even water) were put into this model in turn of course. Applying suggested new lubricant, we managed to decrease the stress on the lateral side of pyramid from 30 % to 10 times! It's the brilliant result. Such new shape of lubricant can essentially facilitate the work for the upper layers of all surfaces of friction during operation period. So, the first problem is solved in full.

3. Materials and Methods for the second task connected with the previous one

The question is – How can we quickly get such new shape of lubricant? Really, it's mighty easy. Let's use the electrical safety razor to cut hair from face (cheeks, chin and moustaches hair). In this case we get small elastic and fatty parts at once. Consequently, we've managed without many actions, namely: plough, plant, cultivate, fertilize, pour, weed, gather the harvest and so on to get good and the very cheapest organic lubricant. Besides, we save much money because we have just spent too small amount of electricity. But we can use even for this aim only small storage battery as well (without electricity at all)! Heir must be cut in dry way without any soap, foam/soapsuds or shampoo. All species were placed into the small cupping-glasses (Fig. 2, left). Then several spacers were made (Fig. 2, right) with special grooves (Fig. 3, left) to catch species of hair energetically. It helps to save maximum species of hair in the zone of friction between of the two spacers. One of these spacers had the tail which we put into the spindle in the electrical hand-drill.

Figure 2. Cupping-glass (left) for hair and several spacers (right)

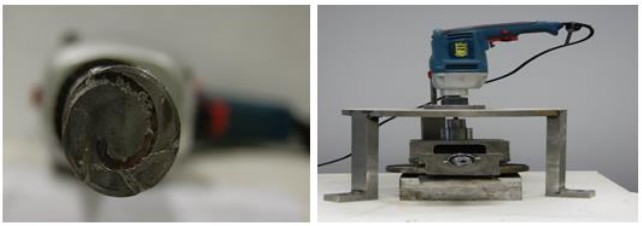

Figure 3. One spacer with grooves and hair lubricant in them (left) and installation to investigate the wear process for spacers using our new organic lubricant (right)

To rotate upper specimen (spacer) we can use both boring machine and electrical hand-drill FINCH Industrial Tools FIT™ Serial NO: ID 04 1 0298 having the speed of revolutions per minute from 0 to 1410. At the same time the lower spacer must be fastened firmly in the vice.

During the tests connected with wear and tear some of metal specimens were covered with hair to determine the possibility of appearance for any corrosion. This experiment had the period in three months. Moreover, in this case corrosion was absent.

Furthermore, the investigation showed that this new lubricant hasn't harmful components.

The comparative curves of deterioration are given in Fig. 4 (upper curves are without lubricants – with theoretical approximation in computer program MathCad and with the statistical data) [6-9]. Beneath there are two curves of wear, if the surfaces of friction were with the new organic lubricant.

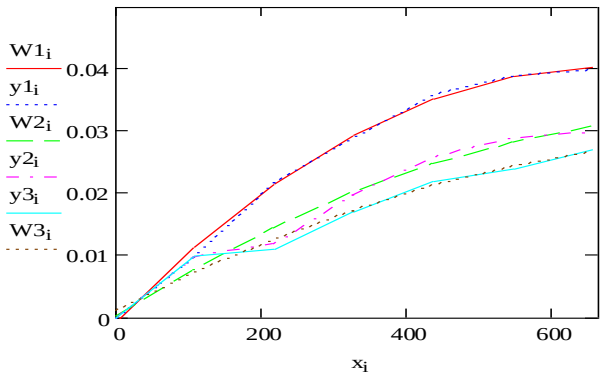

Figure 4. Results of deterioration for three steel specimens

The dimension on the horizontal axis is minute but for ordinate one is millimeter.

Theoretical equations which describe the wear (W) in these experiments are the next:

$$W1 = -1{,}071\cdot10^{-3}\cdot (x_i - x_0)^2 / h^2 + 6{,}857\cdot10^{-3}\cdot (x_i - x_0) / h + 0{,}029; \quad (1)$$

$$W2 = -5{,}238\cdot10^{-4}\cdot (x_i - x_0)^2 / h^2 + 5{,}071\cdot10^{-3}\cdot (x_i - x_0) / h + 0{,}020; \quad (2)$$

$$W3 = -3{,}81\cdot10^{-4}\cdot (x_i - x_0)^2 / h^2 + 4{,}286\cdot10^{-3}\cdot (x_i - x_0) / h + 0{,}017. \quad (3)$$

Designations and elucidations: Здесь h = 110 min. (the step of observation the wear process); x = 660 minutes (common time of trial); the number of points for measurements including the initial dot are seven n=7 where the deterioration is zero; x_0 – average meaning for the time of test. Broken lines in the chart correspond to the statistical data about deterioration but the smooth curves are the result of the theoretical approximation by parabola formula. Moreover, using well-known criteria written and suggested by professor V.I. Romanovsky we tried to find the unusual value in our statistical information.

Reckoning up the grand total connected with this investigation we can ascertain that hair can be effectively applied in practice to essentially decrease the wear in many pairs of friction.

Note: as any organic material hair cannot work if the temperature is too high. But, as we usually know, the negative temperature (approximately +65 ^{o}C) is not obstacle for hair to use it.

1. Materials and Methods for the third task connected with the plastic lubricant

It is common knowledge, that plastic lubricant disappear very quickly from the thick/dense contact in the mobile junctions for pairs of friction (in rack-wheel, in cams, in guides and so forth). In these cases, the plastic lubricant disappears practically very quickly from the contact zone. We've managed to solve this negative problem too by means of the simplest method. We applied the resilient rings which were tightly fastened to the definite places in mechanisms (Fig. 5). For example, They are installed on the both sides of the rack-wheel. The exterior diameter of our ring must be more than the outer diameter of the cogs peak (on 4 mm approximately). If the pair of the rack-wheels are mounted in a vertical position, the small capacity must be placed under the lower rack-wheel between of the two resilient rings. This capacity will save some amount plastic lubricant which can fall downwards during the revolution of rack-wheels. This lubricant will be used automatically because of contact between cogs and lubricant which is into the capacity in this case.

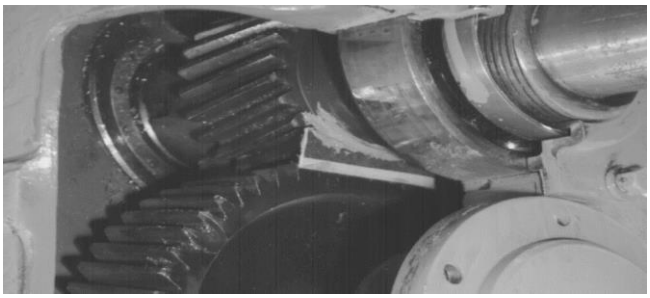

Figure 5. Fragment position if the part of the resilient ring was bonded to the rack-wheel

The analogous method was applied with the cam mechanism (Fig. 6).

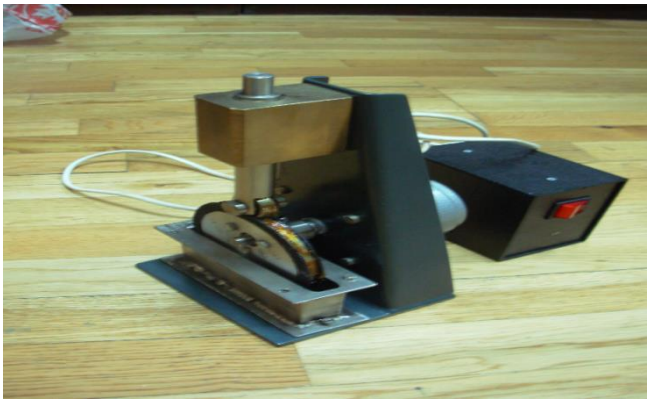

Figure 6. Design version how to save lubricant constantly between zone of contact cam-disc

Any deterioration in these described cases was essentially less than in a traditional design because of stable lubrication during the operation.

2. Methods how to make a control for adhesion and quality for different lubricant

Two effective examples are given below to control the main characteristics of lubricants (Fig. 7 and Fig. 8).

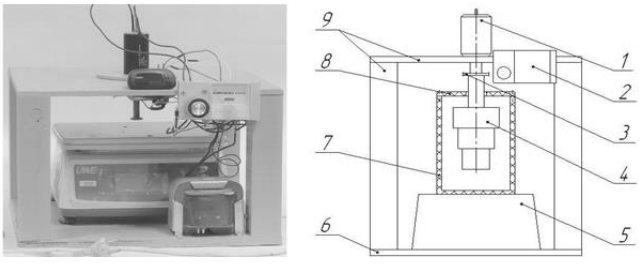

Figure 7. Common view of device to control plastic lubricant (left) and its composition elements (right): *1*- motor which has the very high velocity during rotation; *2*– transducer of speed; *3* – connection coupling; *4* – step shaft/pattern/specimen; *5* – electron balance; *6* – base; *7* – transparent glass; *8* – lid; *9* – mainframe

In here we have used the effect connected with the centrifugal acceleration for plastic lubricant. Firstly, the balance shows only the weight which the empty glass has. When (during the rotation) our lubricant

begins to tear off the specimen, it will be either on the bottom of the glass or on the wall. At this moment the balance shows immediately another meaning of weight and at the same time we can see the level of the sped rotation. Smoothly increasing the speed of revolution we stop this act if all lubricant will be absent on the surface of step shaft. Knowing this information, it is not difficult to determine the next fact: does this lubricant suitable for our mechanism/machine or not.

Using the way which we have just described the new device for the liquid lubricant will be done below.

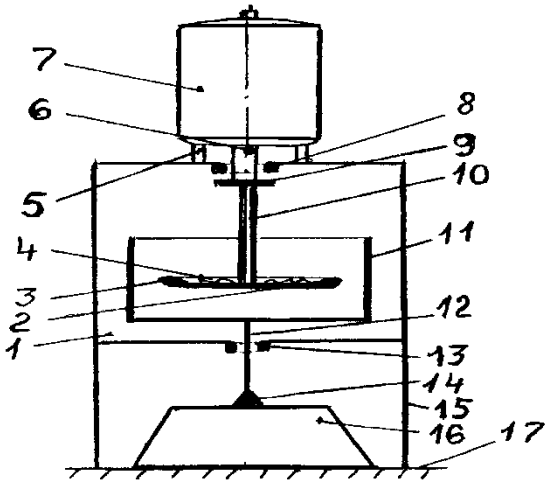

Figure 8. Device to test adhesion and the quality for the liquid lubricants

Applied symbols: *1* –temperature block; *2* – plate for the liquid lubricant; *3* – plate fender (circular); *4* – liquid lubricant; *5* – supports for the motor; *6* – motor shaft; *7* – motor (electrical drive); *8* – upper bush; *9* – connection coupling; *10* – connective shaft; *11* – glass; *12* – supporting pivot; *13* – lower bush; *14* – the end of the pivot; *15* – support wall; *16* – electron balance; *17* – ground.

The horizontal plate has a very small fender (not more than 2 mm). Moreover, the fender wall has the smooth surface with about 10^{o} to the horizontal line. We will not depict once again the principle of testing the adhesion and the quality for the liquid lubricant because of it is the same for the method which has just described above in detail.

At last, we can make the control of evaporation from different lubricant during the process of testing.

1. Results and Conclusion

In this paper many new peculiarities are demonstrated and depicted as the progressive ways, namely:

- to use new organic lubricant which showed the unique properties in pair of friction;
- how to save plastic lubricant in a mobile zone of the thick contact between of two parts in different mechanisms;
- how to test adhesion and quality for different lubricants (plastic and liquid) quickly, correctly and exactly.

2. Short discussion

During our work we attentively looked through many information (papers, patents, Internet, technical books and so on), linked with the items/problems which are given above. It seems to us, that our technical novelties have the definite indisputable advantages to be realized widely in practice. There are no publication made another authors in their investigations connected with plastic lubricants which have different shapes.

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In Saint-Petersburg our University ITMO politely left to us laboratory, devices and subsidiary apparatus to make many different investigations. We could work practically at any time during one year and a half. Thanks a lot for this possibility and help.

Conflicts of Interest

The authors declare no conflict of interest.

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