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OPERATION AND ECONOMICS

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Abstract

There are very many different mechanical systems in the world (cars, aeroplanes, conveyors, railway transport, ships and so on). These systems have different mobile pairs of friction in their design which during the operation begin to wear and tear. To reduce this negative factor engineers/specialists try to use various lubricants (plastic or liquid). Usually, it increases the term of the reliability operation. Liquid lubricant plays the particular role in this process but herewith such kind of lubricant can lead to the bad effects, namely.

i. It extends the stress into the upper layers of the surface in the place where there is a roughness. As we know, any liquid is practically incompressible medium that's why it doesn't decrease the strain in any material or in a structure.

ii. Moreover, synthetic lubricants can pollute our environment and in this situation much money we are needed to waste.

The main aim of this article is the suggestion of the practical recommendations how to save both the environment using special new organic lubricant and estimate the economics effect from using the new shape and structure of this lubricant or for another potential product.

Key words: New type of lubricant, wear, calculations, economics examples, reliability.

Introduction

Many specialists know very well both the positive and negative properties/characteristics of liquid and plastic lubricants. General aim: to show the ways to improve the positive role of lubricants for the mobile junctions, namely, for pairs of friction. At the same time, and the new very important effect with the organic lubricant was discovered and now will be demonstrated. It is the electro-magnet property which helps to keep organic lubricant in a zone of friction constantly and essentially diminish the wear during the operation process. It is commonly known the different lubricants (liquid and plastic) play various role when they are applied usually in the mobile junctions of mechanisms or machines. This role can be both positive and negative [1-5]. In the first case, all lubricants decrease wear and tear, temperature in zone of friction, noise, forces of movement/rotation and separate the surfaces of the pair of friction. But quite the contrary, we obtain (rather not seldom) the negative processes, namely: the temperature can be very high if there is too much lubricant inside the box or in the roller bearing, or if it is not proper for the certain junctions at all, or if the strains in the roughness increase essentially (especially, if the liquid lubricant was applied when the liquid medium can reach the bottom of the irregularity). There were investigated many factors and the new ways to increase the positive role of lubricant which can enhance the reliability in operation for the main parts of the technical systems [1-3].

Text 1

Some information about the new organic lubricant now. Usually, to produce an organic lubricant, we are cultivating plants or trees with fruits or gather fruits and vegetables from the wild nature. They must be treated for a long period of time, for many hours or even days to obtain liquid or plastic lubricant with various elasticity, flash point, etc. But here we paid attention to the hair. As usual, they are oily, and people wash heads with shampoo or with a soap. And moreover, a man often cuts/clips and shaves faces, for example, beard and moustache. Using this action in dry way with electrical safety razor any man can get many small parts of hair. Small hair particles, regarding that they are the organic lubricants, were collected in a small glass cups. There were many small organic elements of this lubricant (in powder-like) on the surface of friction after the experiment test. And, suddenly, it was revealed that this powder acquired the property similar to electric magnet. This organic lubricant literally adhered to the surface of friction. For the process of wear and it is very positive and important new factor. The calculation equations for wear (mm) with a hair as a lubricant are given below (Fig.1) using computer programme MathCad-15 [6-9]:

$j := 1 .. 2 \quad i := 1 .. 8$

$z_j :=$	$t_j :=$	$t1_i :=$	$t2_i :=$	$s_i :=$	$t3_i :=$
0.5	0	0.5	3	0	0
0.5	3	0.8	4	0.8	3
		0.95	5	0.97	4
		1.1	6	1.2	5
		1.3	7	1.34	6
		1.4	8	1.5	7
		1.6	9	1.8	8
		1.7	10	2.0	10

$n := 8 \qquad h := 1 \qquad k := 1 .. 8$

$d_1 := 0 \qquad d_n := 9.2$

$p0_k :=$	$x_k :=$
0.7	0
1	1.3
1.4	2.6
2	3.9
2.4	5.2
2.6	6.5
2.8	7.8
3.1	9.2

$$d_0 := \frac{d_1 + d_n}{2} \qquad d_0 = 4.6$$

$$r_0 := \sum_k \frac{r\cdots k}{n} \qquad r_0 = 2$$

$$H1 := n\cdot\frac{n^2-1}{12} \quad H2 := n\cdot(n^2-1)\cdot\frac{n^2-4}{180} \qquad H1 = 42 \quad H2 = 168$$

$$a1 := \frac{1}{12\cdot H2}\cdot\left[3\cdot\left[\sum_k\left[p0_k\cdot(2\cdot k-n-1)^2\right]\right]-(n^2-1)\cdot\left(\sum_k p0_k\right)\right]$$

$$b1 := \frac{1}{2\cdot H1}\cdot\left[\sum_k\left[p0_k\cdot(2\cdot k-n-1)\right]\right] \qquad c1 := r_0 - \frac{H1\cdot a1}{n}$$

$$Z0_k := a1\cdot\frac{(x_k-d_0)^2}{h^2} + b1\cdot\frac{x_k-d_0}{h} + c1 \qquad a1 = -0.021 \quad c1 = 2.112$$

$b1 = 0.355$

$Z0_k =$

0.027
0.708
1.317
1.854
2.318
2.709
3.028
3.291

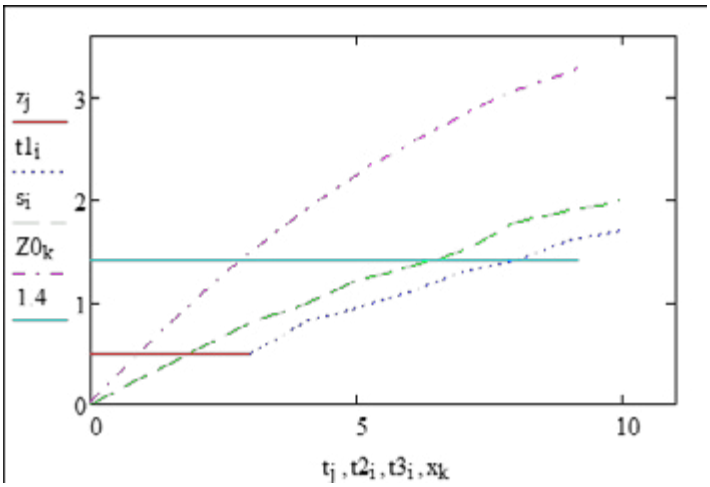

Figure 1: Results of calculations and constructions

Symbols and elucidations. Here they are: z_j – running in period for the pair of friction with hair lubricant; t1i – wear and tear *(mm)* if the lubricant is made from the hair; s_i – deterioration *(mm)* if the liquid oil was used; $Z0_k$ – wear *(mm)* if the surfaces of friction are dry (without any lubricant at all); 1.4 – the level (mm) for the permissible limit of wear; t_j – time (hours) if the deterioration is practically absent; $t2_i$ – time of operation (hours); $t3_i$ – the all period (hours) of testing control; $p0_k$ and x_k – statistical data about deterioration *(mm)* for the pairs of friction with hair lubricant and without one correspondingly; d_0 and r_0 – average meanings *(mm)* for the statistical data connected with wear; H1 and H2 – constants; a1, b1, c1 – parameters for the theoretical equation; $Z0_k$ – nonlinear parabola approximation for the process of the deterioration development *(mm)*.

As it can be seen in the figure 1 the application of the hair lubricant gives the more term of the reliable operation for the mobile pair of friction (approximately: 2.5; 6.2 and 7.1 for three curves lines accordingly and the last is correlated with the term of operation using organic lubricant).

Text 2. About economic effect

Here they are the next typical situations connected with two positions, namely, "demand – supply" and several examples.

A. The first step is the case if the link between "demand – supply" has the nonlinear shape

(Fig. 2) with the computer programme written in MathCad-15.

$i := 1 .. 8$

$x_i :=$ $y1_i := 0.3\cdot(x_i)^2 + 0.1\cdot x_i + 0.05$ $y2_i := -0.4\cdot(x_i)^2 + 0.5\cdot x_i + 5$

x_i	$y1_i$ =	$y2_i$ =
0.5	0.175	5.15
1	0.45	5.1
1.5	0.875	4.85
2	1.45	4.4
2.5	2.175	3.75
3	3.05	2.9
3.5	4.075	1.85
4	5.25	0.6

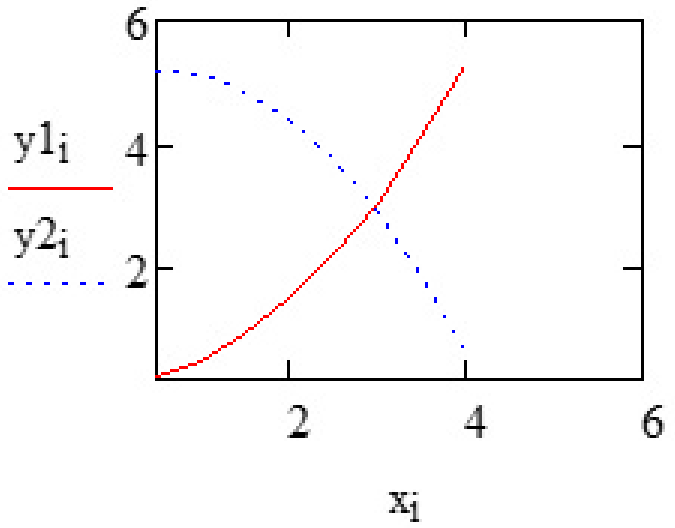

Figure 2: Mutual link between of the two factors: "demand – supply"

$\left[0.3\cdot(x)^2 + 0.1\cdot x + 0.05\right] - \left[-0.4\cdot(x)^2 + 0.5\cdot x + 5\right] = 0$

$\text{Find}(x) \rightarrow (-2.3888064609784364131 \quad 2.9602350324070078417)$

Explanations. Equation for y1i is the curve for the supply for the new organic lubricant (for example, and the parabola curve/branch goes up in here). Function y2i is the function of the demand. The point of their intersection is the point of balance for the correlation of prices. The negative meaning for the radical//root we must not take into account. The substitution of the positive meaning for the radical x=2.96 into the both equations gives the answer 2.97.

Let's make this verification to get the optimum result of calculation:

$$0.3\cdot 2.96^2 + 0.1\cdot 2.96 + 0.05 = 2.974$$

$$-0.4\cdot 2.96^2 + 0.5\cdot 2.96 + 5 = 2.975$$

B. Version of task (Fig. 3) if there is the linear function for the demand D(Q) and for the nonlinear function of supply for the product (organic lubricant) S(Q):

$D(Q) := -5\cdot Q + 150$ $S(Q) := \frac{(Q)^2}{4} + \frac{Q}{2} + 70$

Given

$\left[\frac{(Q)^2}{4} + \frac{Q}{2} + 70\right] - (-5\cdot Q + 150) = 0$ $\text{Find}(Q) \rightarrow (10 \quad -32)$

$P := D(10)$ $P = 100$

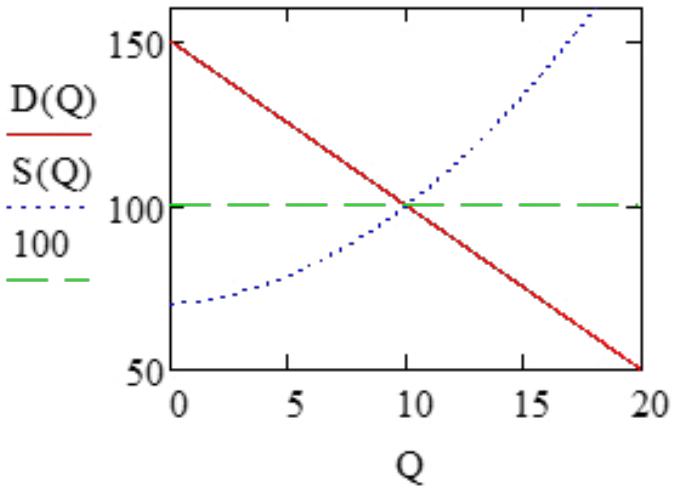

Figure 3: Function of the demand is shown as the dependence for the demand D on the product in accordance with the price P of the definite product

Maximum profit will be if P=100 in the point of the intersection for the two lines, namely, curve and the straight line.

C. In this case both the functions of demand and the supply have the straight lines (Fig. 4).

In the procedure of calculations, we take the method suggested by R. Tornqvist.

Let's suppose that y1(x) is a function as a demand and y2(x) is a function as a supply. Subtracting from function supply to another function demand represents the result using the symbol imprint with function Given in MathCad-15.

$y1(X) := 0.5\cdot X$ $y2(X) := -0.5\cdot X + 3$

Given

$P := y1(3)$ $P = 1.5$ $P2 := y2(3)$ $P2 = 1.5$

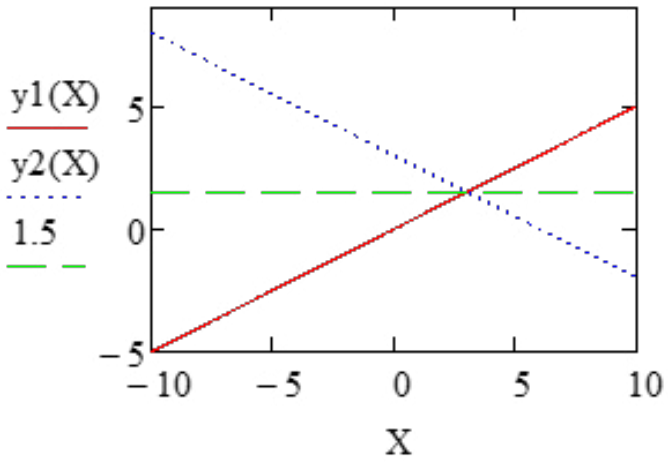

Figure 4: The point of the intersection for two lines is the point of balance for the correlation of prices for the demand and for the supply giving the optimal profit

The point of intersection for lines demand-supply is named as the point of equilibrium. And the appropriate price is the equilibrium price. The intersection as P=100 shows that with this price the all product/lubricant will be used in full and both the demand and the supply agree. If the profit P<100, then the demand exceeds the supply. In this case there is a deficit of the product. In that case we can raise the price to the equilibrium level [14].

So, the decrease in the rate of wear in pairs of friction will be if use this new organic lubricant. This lubricant can be practically produced very easy in any hairdressing salon. According to this estimate, the cost of about 1 kg of such organic lubricant will be not more than 5 roubles. But, if we apply the traditional organic lubricant, the cost will be approximately 1000 roubles. Moreover, the additional effect can be achieved for many steel pairs of friction (or for another material if they acquire the property like electro-magnet holding this organic lubricant) during the operation [10-13, 15, 16]. In this case, a man must not raise sunflower (for example), fertilize (ground), plough, sow, water, weed, harvest, etc. The costs maybe too high in this case. As it was shown above, the term of real operation for the different pairs of friction will be longer as well. Using this new organic lubricant we additionally enhance the general reliability for many mechanical systems.

Conclusion

1. Very important result was got if the organic lubricant was made from the hair which is between of the mobile surfaces in the pair of friction constantly having the magnet property.
2. The term of the reliable operation against the deterioration was very high if the new organic lubricant was used (the common result was better than with the typical lubricant and especially as the friction was without any lubricant).
3. The applied new organic lubricant is the cheapest among the other organic lubricants in the world. It ensures the decrease in the rate of deterioration potentially for many moving parts of mechanisms, machines and devices.
4. The new and very important effect of the organic lubricant was discovered, that is electro-magnet property which helps to keep organic lubricant in a zone of friction practically constantly during the whole period of operation.
5. Three practical examples with computer programme connected with the calculation of the profit and with the rational link between demand – supply are demonstrated as well.

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