MEASUREMENT OF THE QUALITY OF LUBRICANTS FOR MECHANICAL SYSTEMS

Kirill VOYNOV*, Helena SAMOYLOVA*

* State Transport University, Mechanical Faculty, Saint-Petersburg, 190031, Moskovsky av., 9, Russia

forstar@mail.ru, ktmrs@pgups.edu

Abstract: One of the basic factors which plays the dominant role in different machines and mechanisms (and in robots too) is a lubricant (oil, grease, fat, plastic lubricant, organic or synthetic lubricant etc.). In the paper the new effective method of quality test for different lubricants is represented, because a bad lubricant may be a reason of any mechanical system damage.

1. INTRODUCTION

The new device to investigate the main properties of lubricants was created which helps to determine very quickly and exactly both the viscous properties of the lubricant and its adhesion to lubricated faces (Fig. 1). In a capacity of sample the cylindrical element was used. Before experiment a small amount of definite lubricant was smeared on the surface of this sample. The sample in the form of the shaft was connected with the engine which can realize smoothly the rotation from zero to 25,000 revolutions per minute. At the definite moment the lubricant begins to get away from the shaft because of the centrifugal acceleration. To observe this effect and catch disconnected from the shaft amount of lubricant the sample was put into the transparent glass before experiment.

So, the researcher can determine the moment when the first quantity of the lubricant will appear on the inner wall of the glass.

2. EXPERIMENTAL

Below four results of these experiments are presented.

1. Unirex №3 ISO L-XADHB 3 DIN 51825 – K 3 N-10 NLGI 3 (Esso Lubricants): the first small part of the lubricant was appeared on the wall of the glass when the cylindrical sample reached 3,280 revolutions per minute (RPM). This kind of lubricant can be applied for hinges and bearings if the temperature value is from the range of about -40 to + 135 ^{0}C.
2. Russian lubricant «ВНИИНП-207Е»: the beginning of the appearance of a small amount of this lubricant on the inner wall of the glass was at about 2,480 RPM. This lubricant can be used for bearings, hinges, ropes and so on. The work temperature is from the range of about -40 to + 140 ^{0}C.
3. Lubricant "Litol-24": the beginning of the appearance of a small amount of this lubricant on the inner wall of the glass was at about 1,610 RPM. It is the multifunctional anti-wear lubricant which can be used for bearings, hinges and so on. The work temperature is from the range of about -35 to + 120 ^{0}C.
4. The last investigated lubricant was «ШРУС, Супер-4МЛ»: the first small amount of the lubricant appeared on the wall of the glass when the cylindrical sample reached 1,430 RPM.

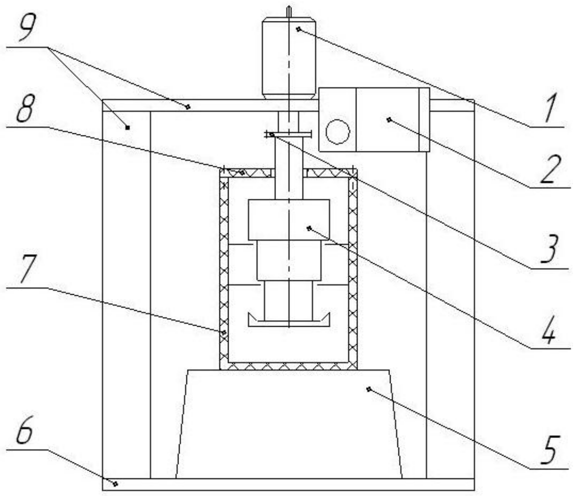


Fig. 1. The outline of the new device to express – control for different lubricants: 1 – high-speed electromotor; 2 – transducer of a velocity; 3 – joint; 4 – shaft / specimen having three various diameters to put on them lubricant; 5 – electronic balance; 6 – ground; 7 – transparent plastic glass; 8 – lid; 9 – support

The process of test is the next: bring a definite quantity of lubricant on the definite part of cylindrical diameter of a specimen; smoothly start rotation of our shaft using electromotor. At the definite speed of rotation some amount of lubricant we can see on the wall of the glass. At the same time the electronic balance begins to show that the weight of the empty plastic glass started to grow too. The limit velocity of rotation for our shaft with a lubricant gives a signal by electronic balance that all amount of grease is come off.

$j := 1 .. 34$ $\quad$ $bin := 7$

$v_j :=$

13.10
15.20
14.45
14.38
13.25
13.20
13.66
13.70
14.20
14.05
14.00
13.80
13.20
12.98
12.84
13.14
14.66
14.70
14.32
14.29
14.55
13.97
13.83
13.86
14.33
14.43
14.46
14.06
14.00
14.05
13.82
13.52
13.31
13.10

$n := length(v)$ $\quad$ $n = 35$ $\quad$ $m := mean(v)$ $\quad$ $m = 13.497$

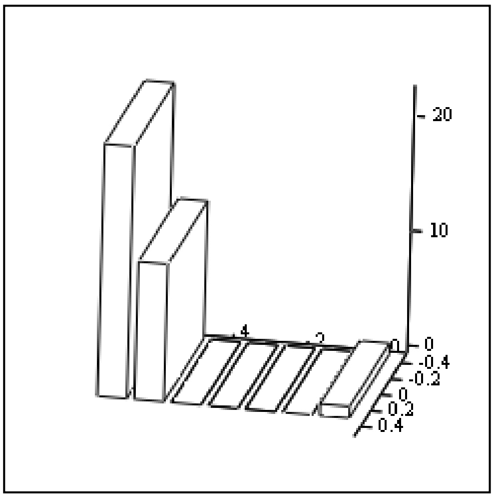
$s := stdev(v)\cdot\sqrt{\frac{n}{n-1}}$ $\quad$ $s = 2.416$ $\quad$ $median(v) = 13.97$

$upper := ceil(max(v))$ $\quad$ $upper = 16$ $\quad$ $lower := floor(min(v))$

$h := \frac{upper - lower}{bin}$ $\quad$ $h = 2.286$ $\quad$ $i := 0 .. bin$

$int_i := lower + h\cdot i$ $\quad$ $f := hist(int, v)$ $\quad$ $F(x) := n\cdot h\cdot dnorm(x, m, s)$

$intx_i := int + 0.5\cdot h$



f

$int_i =$

0
2.286
4.571
6.857
9.143
11.429
13.714
16

Fig. 2. The distribution of the velocity vj (x100) during rotation of the cylindrical sample with lubricant «Шрус» (Luxoil) smeared on

This method helps us to determine very quickly not only the quality of lubricants but the force of adhesion as well.

$j := 1 .. 26$

$bin := 7$

$t_j :=$

15.20
16.34
17.00
15.25
16.05
15.80
15.52
16.90
16.44
15.64
15.79
16.66
16.32
16.21
16.02
15.97
15.63
15.55
15.62
15.71
16.10
16.39
16.61
16.49
16.26
15.99

$n := length(t) \quad n = 27 \quad m := mean(t) \quad m = 15.461$

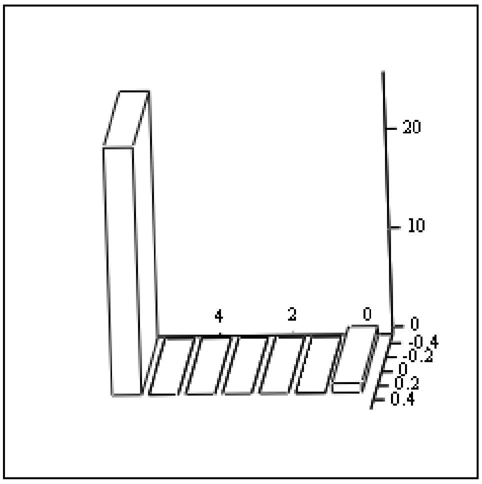
$s := stdev(t) \cdot \sqrt{\frac{n}{n-1}} \quad s = 3.125 \quad median(t) = 16.02$

$lower := floor(min(t)) \quad upper := ceil(max(t)) \quad upper = 17$

$h := \frac{upper - lower}{bin} \quad h = 2.429 \quad i := 0 .. bin$

$int_i := lower + h \cdot i \quad f := hist(int, t)$

$F(x) := n \cdot h \cdot dnorm(x, m, s)$



$int_i =$

0
2.429
4.857
7.286
9.714
12.143
14.571
17

f

Fig. 3. The distribution of the velocity tj (x100) during rotation of the cylindrical sample with lubricant "Litol-24" smeared on

3. CONCLUSIONS

In a result of carried out investigations the following conclusions can be formulated:

1. The lower viscosity of a lubricant the lower rotational speed at which the lubricant begins to separate from the sample (shaft).
2. Proposed examination method enables quick and effective evaluation of lubricant properties.

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