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Oil Additive Testing Equipment

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Abstract. **Automobile industry annually is to reduce harmful emissions into the environment. Anti-friction oil additives in automotive internal combustion engines is one way fight against friction losses which result from fuel economy, which in turn reduces the amount of harmful emissions vehicle exhaust. Assessment of the effectiveness of oil additives need to tribologycal properties for further analysis. For the purpose of this research is carried out in a variety of major friction equipment design studies, evaluating their properties and create an experimental facility with the assistance possible to evaluate changes in oil additives on friction over the existing components and their mutual friction.**

Keywords **– oil additives test, friction surfaces, engine oil, internal combustion engine.**

I INTRODUCTION

World's automobile industry each year are brought ecological requirements for the automotive internal combustion engine harmful emissions, as one of the ways fight against frictional energy losses combustion engine with a friction loss in engine oil by adding a special anti-friction additives, which can reduce friction losses combustion engine component friction pairs, the reduction of fuel consumption and the internal combustion engine the harmful emissions. In relation to this problem is the need for effective oil additive test. To make this possible is designed device (Fig. 1), which provides for sliding friction pairs working of a closer working conditions of an internal combustion engine, the ongoing process of identifying friction pairs.

Fig.1 Oil additive testing machine

Thus be simulated in any of the internal combustion engine sliding friction pairs working conditions of the engine oil through oiling material and anti-friction motor oil with additives, observing the differences with and without anti-friction additives one oil brand. In this way it is possible to determine the oil additive on the friction surfaces without the use of the internal combustion engine, excluding the risks of possible adverse effects of oil additives on the friction surface Simulating the internal combustion engine friction pair working conditions, use of friction pairs in the samples according to materials that are used in internal combustion engines, and can be technologically processed in accordance with the following models: make material compliance, heat treatment, machining, surface hardness, surface roughness. During the experiment, the friction pair ensures a proxy for the ongoing conditions of internal combustion engine, by providing relevant: the contact pressure between the sliding speed, oil temperature. In experimental work, it is planted, and controlled the following specification, oil temperature, friction elements reciprocal downforce, the friction force changes over time (recorded in a computer), the rotating disk rotation speed, the oil supply.

II MATERIALS AND METHODS

Lubricating substance and additives research and testing

In this time there is no generally accepted quantitative indicators that characterize lubricating substances by retarding the wear and anti-friction properties. For this reason, the most common tests are carried out over a given lubricating substances in the benchmark. The benchmark can be chosen for any lubricating substance that is sufficiently tested in practice, and which, by its use and properties are close to the test substance. However, if the oil additive testing, the first test oil without additives, and then added.

Lubricating substance testing has been performed in several successive steps, as listed below.

1. Random testing - short sample tests on the friction devices using the new benchmark and lubricating substances under laboratory conditions.
2. Stand landfill testing - testing simulating long-term mode of operation, the process of making a real mechanical assemblies and machine lubrication of the

test substance. Trials take place on billboards in laboratory or field site and road conditions strictly regulated trial modes.

3. Operational testing - testing of long-term continuous real machine lubrication process, which is the final stage of the testing process for monitoring the lubricating substance material, which has passed all previous tests.

New lubricating substances in the development process is mandatory for all three stages of the trial. In most of the lubricants tested by consumers, it is limited only to the first (random) experimental stage. When lubricating materials testing laboratory should be targeted in order to defined their subsequent properties:

- friction coefficients that are related to sliding speed
- specific pressure and temperature;
- maximum load of to blocking in;
- friction pair ability to operate after the grease exclusion, etc.

Lubricant additive material is to try their using different pairs of different structural materials such as steel steel, steel, bronze, etc.

Lubricating oil additives and material testing general features

In laboratory studies concerning wear resistance of materials, following the aim of shortening the duration of testing, researchers often increases specific pressure and slip speed compared to what is observed in real rubbing node conditions. In these trials, accelerate wear resistance of the material can be determined within a few hours, or even minutes. However, as is indicated in V. Kuznetsov's work [1], accelerated testing over the results may also be wrong. This is due to the fact that the abrasion resistance of the material very strongly influenced by friction surface temperature, but the temperature on the basis of theoretical and experimental research in motion is proportional to the pressure and speed. It follows that the acceleration of the wear process, that is, an accelerated test method is related to the temperature of the friction surfaces, which significantly affects the wear. If the temperature on wear process should be equal for all metals, there is a basis for extrapolation to normal operating conditions.

Lubricating oil additives and materials testing equipment principal operation

To determine the antifrictional characteristics, is available in a lot of equipment, machinery and apparatus. Also, almost every researcher has constructed his own personal, or even multiple machines, which are sometimes quite complex. The literature describes a large amount of friction and device for lubricating materials research laboratory. Trial, samples of some of the described equipment and devices contact point or linear. For example, a four-ball friction machine (see Figure 2.) Oil is tested pyramid, which is composed of four spheres, where the three lower ball rigidly attached cup which is poured into the test oil, but the upper ball rotates vertical center shaft.

Here is a spot by three pins. Hardened steel ball acts on the same analogy.

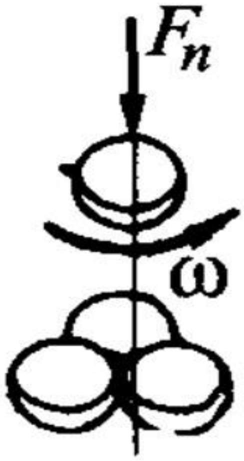

Fig.2. Four-ball test subassemblies principal block diagram

Timken device, which is a common oiling material tests, the test item is selected reel - rolltype conical bearing outer ring and a plane - rectangular model (see Fig.3).

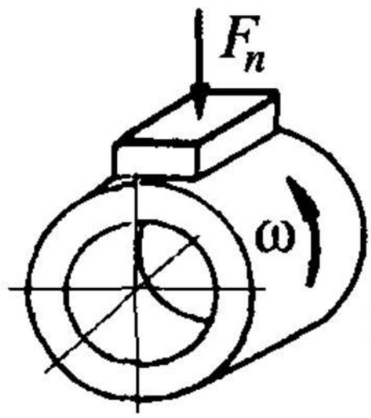

Fig.3 Timken test methods principal scheme

Testing occurs gradually increasing the load on the methodology I = f (P), where I - is the depreciation feet limit, in this case it is a rectangle. One test lasts for 10 minutes. Oil on the appropriate areas of contact load. Timken plant components is linear initial contact. Described friction devices not tested lubricants which implements random transfer of friction, as they tested the samples is a point, or linear contact. As previously described, lubricants, performing random transmission friction, can lead to friction surfaces dissipative structures with certain properties. Overlapping metal grease containing copper, tin, or a combination, greatly reduces friction wear surfaces where there is realized dissipative structure, the lower the wear more than a step.

Dissipative structures can be realized in bronze steel friction pairs, applying lubricant that does not contain copper compounds, but a film of selectively lysed bronze. Dissipative structures distribution surface occurs when there is a specific type of diffusion process, which determines the sample dissolution, lubricants ligands, as well as high deformed surface activation friction. Intensive vacancy formation resulting from dissolving, dislocation changes the direction of motion and speed.

Moving toward the surface, they get there by creating an area where the atoms are free links. In these areas happen chemical reaction between lubricants and active ligand atoms and have a complex connection. Not all alloys are able to create dissipative structures, and for the distribution of alloys which capable produce it, is used in rolling sheaf X-Ray method.

A complex combination of lubricating compositions basis and does lubrication performance as adsorbable surfactant. Partly decomposition friction zone, it re-creates the ligands and metal ions. Inside it there is a limited transformation cycle of grease, this is different from tribodestruction and oxidation processes that occur in limited and unlimited grease friction cases. The described process can be a point or linear contact cases. It is necessary to contact the plane, where the metabolism oiling between the environment and the friction surfaces.

Following on from the above, that the friction device with punctate or linear contact model (four-ball device, Timken equipment, etc.) are irrelevant lubricant testing, which implements random transmission friction. The lubricants testing must be done to such friction equipment, specimens of friction contact with the planes, which is the length and width.

So here it is necessary to note that the academician V. Kuznetsov based on the number of machines tested The analysis has concluded [1] that a simple equipment consisting of a rotating disk, and pressed it to the facility, which is equipped with a friction force measurement device has made a series of very valuable principally important result. No other equipment science has not delivered as certain results, and, in his view, machine designers going the wrong way because of complicated machinery design, complicating the process of wear phenomena.

This device has the advantage that it enables:

1) a wide range of frequency and change the rotation of the load;

2) to measure the friction force, the calculation of the coefficient of friction;

3) to study the dry friction and friction, using lubricants;

4) to study the friction force, rubbing against abrasive wear, or where the metal rubbing against metal;

5) carry out testing of different temperature regimes;

6) to determine the surface temperature of an object scrubbing;

7) The determination of the specific wear, turn the volume or mass with respect to the original.

III RESULTS AND DISCUSSION

For the experiment to be correct and able to judge the oil additive effect on the internal combustion engine friction pairs are properly prepared samples of the materials and the friction pairs used in the automotive internal combustion engine parts suitable materials, for example. pair of crankshaft - plain bearing, uses a rotating disk of material Steel45 (Gost) that the technology worked, produced material sample is tempered obtaining material surface hardness of HRC 51, then surface is sanded obtaining roughness corresponding class 9a roughness (Ra = 0.31... 0.25) [2]. Rotating disk friction pair puts the model in plain bearings suitable material (aluminum or babbit). Components installed on the device providing a degree of interdependence such pressure 5kg/cm^2. Following injection into the oil reservoir 1l, oil is heated to the requisite temperature, which indicates the most similar experiments at 90 ° C [3] [4]. Oil temperature is maintained by a thermostat which is connected to the heating element, the temperature changes is maintained at the set temperature value.

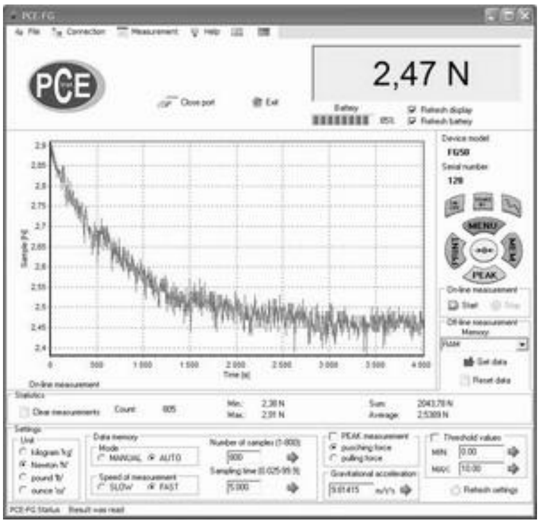

Fig.4. Dynamometer software screenshot

Once the oil is heated on the circulation pump, which provides oil circulation and the supply of fresh oil on the friction surfaces. Are further connected to the dynamometer and the electric motor is switched on, (motor power of 1.5kW nominal 1500RPM). Motor speed can be set with frequency converter and can set the engine speed steady 100-2000RPM within which the disc is rotated. Dynamometer the electronic recording of the friction force on the computer (Fig. 4) with an accuracy of 0.01N range of 0.01-50N, with the ability to record data records with a 1-800 time interval between entries in the 0.1-99.9 seconds.

Equipment description of intervention

The electric motor 2 screwed on facilities housing 1. On electric motor 2 axis 3 is a shift 4 for rotary disc 5 strengthening. At rotating disk 5 with the pendulum 6 is pressed against the test material sample 7, which from the reservoir 8 with the help of pump 9 through a delivery tube 17 is supplied with oil on the 10. Sample 7 downforce disc 5 provides a pendulum 6, which is attached to the pendulum axis 11 and is moving from the linear bearing 12. The pendulum axle end 11 mounted counterweight 13, which provides a certain downforce drive the fifth. The oil temperature to ensure the reservoir 8 mounted heating element 14 and the oil temperature control temperature sensor 15. Friction torque is measured on the dynamometer 16, which is forcing the pendulum 6.

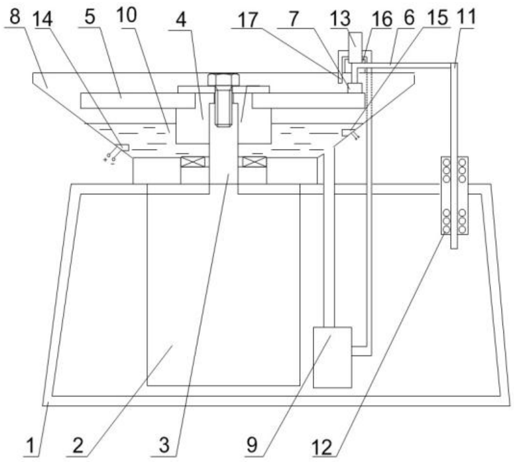

Fig.5. Oil additives tester scheme

IV CONCLUSION

The above-described oil additive test equipment can be an effective additive for oil test sliding friction pairs, which possible to put a variety of materials samples. Facility possible set the several constant parameters, which are zooms in the working conditions similar to existing internal combustion engines. Computer program recorded friction force changes easily processed the data on computer. With the help of such devices in a reasonably short time possible to determine the oil additive on the friction pair justify the the labor-intensive process where oil additive should be used in the engine, which also excludes the risk of damaging the engine if the oil additive negative effect on the friction surface, for example promotes reinforce wear of the friction surfaces.

V REFERENCES

[1] Гаркунов Д. Н. Триботехника (износ и безызносность). – Москва: МСХА, 2001

[2] S.Rumjancevs A.Bodņevs V.Borščovs Automobiļu remounts Zvaigzne Rīga 1984. 229.p

[3] A.Vadiraj G.Manivasagam, K.Kamani V.S. Sreenivasan Effect of Nano Oil Additive Proportions on Friction and Wear Performance of Automotive Materials Tribology in Industry Vol. 34, No 1 (2012) 3-10

[4] Крылов Д. А., Цветков Ю. Н., Кузьмин В. Н. Влияние добавок ультрадисперсного порошка оловянистой бронзы в моторное масло на работу дизельного двигателя Трение, износ, смазка Том 14,N53 2012

[5] Путинцев С.В. Механические потери в поршневых двигателях: специальные главы конструирования, расчета и испытаний. – Москва: МГТУ им. Н.Э. Баумана, 2011

[6] Гаркунов Д. Н. Триботехника (конструирование, изготовление и экспл. машин). – Москва: МСХА, 2002.