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Stockpiling of Wear Products of Parts in the Oil of the Power Unit during the Operation of Machines

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ABSTRACT: The article discusses the stockpiling of products of wear parts in the oil of the power unit during operation of the machines. Rolling products wear products fall into the oil of the unit from the inner and outer rings, rolling elements (balls or rollers) and the separator. The amount of wear products on the bearing elements is distributed as follows. In the inner ring - 33%, in the outer ring - 25%, to the rolling elements - 25% and in the separator - 17%. In our studies, the total concentration of oil pollutants was determined using a centrifuge at angular speeds of its rotor 1000-8000 rpm. For the experiments, the container with oil was heated in a SNOL-2.5 M oven to a temperature of 50-60 °C. At this temperature, it was kept in an oven for 20–30 minutes in order to reduce viscosity and improve the mixing of pollutants throughout its volume of oil. After thorough mixing for 5-10 minutes, the oil was immediately poured into a test tube, the mass of which was pre-determined.

KEY WORDS: Oils, Wear, Assembly, Parts, Bearing.

I.INTRODUCTION

During the operation of machines from the housing of the power unit, its covers in the oil of the unit does not fall out of wear products, as in the power transmission unit there are no parts that have relative movement of these parts. For this case, consider the process of accumulation of wear products from gears, rolling bearings and their glasses, gear couplings and shaft assemblies.

Conducted theoretical and experimental studies show that in the gears of the power transmission the tooth head is 8.6-8.8% more worn out than the leg of the tooth. The amount of wear of the engagement pole is 6.3-7.0% of the tooth head. Analysis of the results of experimental studies showed that the change in the degree of slippage between the teeth of the leading and driven gears along the height of the gear teeth occurs according to a linear pattern and the change in the wear value along the height of the teeth also has a linear character.

Due to the lack of relative displacement in height of the teeth and a slight displacement along the length of the teeth between the gear coupling and gear, the amount of wear of the coupling teeth in thickness is small. They fail mainly due to the collapse of the side surfaces of the teeth. At the same time, the amount of wear products falling out of the oil from each coupling is 0.2-0.4% of the wear products of all gear wheels in the unit.

In most cases, the shafts of the units are installed in the hub using the slot. They have a relative displacement equal to the gap between the teeth of the shaft and hub slot. Therefore, parts fail as a result of wear and collapse of splined joints and their lateral impact. Here, the wear value corresponding to 10 mm of the slot length is 0.05-0.08% of the total amount of wear products falling from the gear wheels. The inner ring of the bearing is mounted on the shaft without relative movement, therefore, from this compound, no wear products fall out of the unit's oil.

The concentration of wear products falling out of the gears depends on the engagement module. With the increase of the gearing engagement module, the share of wear products of the aggregate falling out of oil from the rolling bearings decreases. If in gears the gearing module increases from 1 mm to 10 mm with a gear ratio, then the share of wear products per bearing is reduced from 5% to 3%.

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Rolling products wear products fall into the oil of the unit from the inner and outer rings, rolling elements (balls or rollers) and the separator. The amount of wear products on the bearing elements is distributed as follows. In the inner ring - 33%, in the outer ring - 25%, to the rolling elements - 25% and in the separator - 17%. The rolling elements of the bearing on the rolling surface wear evenly, the greatest wear of the inner and outer rings occurs at the edges of the grooves of the rings, the amount of wear of the bottom of the grooves is 19-21% of the wear of their edges. The amount of wear of the separators depends on the type of bearing. In ball bearings, the greatest wear of the separator occurs on the surface of friction of average cross-section along the height of the bearing. The lowest wear of the separator is observed in the middle part, where rolling elements are installed. The smallest wear rate of a separator is 27-32% of its largest wear value.

Wear of the bearing cup occurs at the place of landing of the bearing, the amount of wear products falling out of them is 0.02-0.03% of the wear of all gears in the unit. Traces of wear are evenly distributed around the perimeter of the glass.

II. DETERMINATION OF QUANTITATIVE AND QUALITATIVE INDICATORS OF THE CONTAMINANTS OF THE OIL AGGREGATES OF MACHINES

Oil contaminants consist of soil dust penetrating into the machine aggregates from the environment, as well as from wear products falling out of the oil of the machine aggregates during wear of parts materials and insoluble oil deposits.

To determine the total concentration of transmission oil pollutants depending on the duration of the cotton version of the TTZ 100K 11 tractor, tests were conducted at the test site of the Uzbek Machine Testing Station (UzMIS) at an additional final gear.

In order to remove residues of pollutants in the crankcase, they were thoroughly cleaned, washed with diesel fuel, blown with compressed air, after which they were refilled with Thad-17 transmission oil. The tests were carried out in an additional final gear for 1000 motohours after the end of the operation to clean the crankcase of the unit.

In order to check the cleanliness of the crankcase after changing the oil in the unit and determining the degree of tightness of the crankcase of the unit, the first sample was removed after 8-10 hours of tractor operation. In this case, the oil contaminants in the unit must be mixed until a homogeneous mass is obtained, preventing them from settling. Subsequent samples were taken every 100 motohours. The mass of samples taken was 300-400 g, after removal of the samples, the units were added with oil in an amount equal to the volume of the sample taken.

The amount of oil contaminants of the machine units according to the NATI method is determined by filtering the oil through a deashed filter [1]. The disadvantage of this technique is that when filtering on the filter, in addition to solid particles of soil origin and wear products, there are also organic substances formed as a result of oil oxidation during long-term operation of machines, which significantly affects the accuracy of the results [2-3].

In our studies, the total concentration of oil pollutants was determined using a centrifuge at angular speeds of its rotor 1000-8000 rpm. For the experiments, the container with oil was heated in a SNOL-2.5 M oven to a temperature of 50-60 °C. At this temperature, it was kept in an oven for 20–30 minutes in order to reduce viscosity and improve the mixing of pollutants throughout its volume of oil. After thorough mixing for 5-10 minutes, the oil was immediately poured into a test tube, the mass of which was pre-determined. The test tube with oil was weighed on an analytical balance and the mass of oil in it was determined. To ensure balancing of the centrifuge rotor during its rotation, the difference in the masses of the tubes installed in the rotor socket did not exceed 0.5 g. The gasoline oil was thoroughly mixed with a glass rod in order for the contaminants to be washed and the oil products dissolved. Test tubes with transmission oil dissolved in gasoline were installed in the centrifuge rotor socket. After that, the centrifuge rotor closes the cap. At the beginning, the rotor rotates at an angular speed of 1000 rpm, the angular speed of the rotor was subsequently increased to 8000 rpm. At this speed, the centrifuge worked for 35-40 minutes. Under the influence of centrifugal force generated from the rotation of the rotor, the heavy fractions of pollutants in the oil adhered to the lower side of the tubes. Then the centrifuge rotor stopped and the solution in the tubes poured out. Pure gasoline B-70 was poured into the test tube with sediment, then the mixture was shaken until the adherent sediment was completely destroyed and transferred to gasoline. In order to wash the contaminants in the oil, the tube was again placed on the

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centrifuge rotor. The process of washing the oil pollutants was repeated until the color of the gasoline poured into the tube with the pollutants changed. The washed contaminants were dried in test tubes in an electric oven at a temperature of 100-120 °C, then cooled in a desiccator to room temperature and weighed. The amount of contaminants in the oil was determined by the mass difference between the clean test tube and the test tube with contaminants.

The content of non-combustible components of pollutants was determined by the method of US, i.e. the total content of pollutants was calculated, and then these impurities in the test tube were heated in a muffle furnace at a temperature of 600–50 ° C. Burning was done gradually, i.e. the test tubes with impurities were placed in a cold oven and, turning it on, heated to a temperature of 600 ° C, after which the oven was turned off and left to cool completely. Then the tubes were further cooled in air for 5 minutes and in a desiccator (for 30 minutes) and weighed to the accuracy of 0.0002 g.

To determine the sizes of the constituent parts of the pollutants, 100 ml of B-70 gasoline was poured into the flask, which was poured into a tube with pollutants with a pipette, the mixture was shaken and poured into the flask with pure gasoline. This process was repeated 4-5 times to rinse the tubes and transfer pollutants to the flask with gasoline. The contents of the flask were shaken and poured into a red ribbon filter funnel with a dropout rate of up to 2 microns. After filtration, the filter with sediments was removed from the funnel, dried for 30–35 min at room temperature and examined under a biological microscope of the brand MBR-3. Particles with a size of 4 microns and more were divided into size groups: 4-8; 9-12; 13-16; 17-20; 21-25 and 26-40 microns. In this case, the total number of scanned particles in each sample was at least 500 pieces.

The concentration of iron in the oil characterizes the amount of wear of the parts in the unit. Silicon and aluminum are the main components of abrasive particles in the oil of the unit. Determination of the chemical composition of waste transmission oil was carried out on the installation of MFS-3 by the method of spectral analysis.

The method of determining the content of the constituent elements of mechanical impurities was as follows. Samples of the oil, after thorough mixing in a mixer with a rotational speed of 0.33 s-1, were poured into the installation bath, which was placed under the bottom electrode on the stand. The oil level in the bath was adjusted so that in the working position the disk electrode touched the surface of the oil. Then included the mechanism of rotation of the electrode. After making the electrode about one turn, the electric arc worked and the photovoltaic unit turned on.

The C-3-6X200 electrodes were used as the upper ones, the lower disk electrodes were manufactured by the Electrougol plant according to the drawings of the Central Research Institute of the Ministry of Railways.

The characteristics of the equipment of the installation of the brand MFS-3 with a rotating electrode and its mode of operation are the following:

- diameter of the upper electrode - 6 mm;
- diameter of the rotating carbon disk electrode - 13.5 mm;
- disc electrode thickness - 3 mm;
- speed of rotation of the disk electrode - 0.1 s-1;
- the volume of the oil bath - 6 cm3;
- immersion depth of the electrode in the oil - 0.1-0.2 mm;
- discharge in a tripod - 50-100 MPa;
- diameter of the nozzle inlet section - 16 mm;
- roasting time of electrodes - 90 s;
- width of the entrance micrometric slit - 100 microns;
- width of exit slits - 200 microns;
- current strength - 6A.

III. CONCLUSION

The control over the process of roasting used oil and the exposure during spectral analysis, as well as switching on the device, was performed automatically. To improve the stability, sensitivity, and reliability of spectral analysis, samples were burned in an air stream. Channels were polled manually by connecting them to a recording device with appropriate toggle switches. The concentration of the elements was determined according to a predefined reference

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chart.The standard deviation of the analysis results was as follows: for iron - no more than 5, for silicon and aluminum - up to 10%.

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