APPLICATION OF HYDRODYNAMIC DISPERSES
FOR IMPROVEMENT OF MOTOR OIL SERVICE
PROPERTIES

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A general demand made of modern engines is that power must be maximized while minimizing weight and providing the ultimate in economy and reliability in service. How well these demands are met will depend to a considerable degree on the improvement of lubricating materials and methods of application.

During engine operation, solid contaminants of organic and inorganic origin are formed in the oil, and this process is important in determining the antiwear and antifriction properties of the oil.

From [1] it follows that small particles of contaminant (below 5 μm), having a large specific surface, will adsorb various oil oxidation products, thus giving a substantial improvement in the antifriction properties of the oil. A number of detergent additives act by retarding the coagulation of oil oxidation products. In this case, the varnish-forming particles remain in suspension and do not form varnish or other deposits [2, 3]. An increase in particle size above 2 μm is a sign that a detergent additive is no longer working [4].

It is natural to assume that a premeditated dispersal of large particles of solid contaminants will make it possible not only to improve the antifriction and antiseize properties of an oil, but also to reinforce the action of detergent additives.

We have developed and fabricated a hydrodynamic disperser for solid contaminants. The operating principle of this disperser is as follows (Fig. 1): Pressurized oil enters the housing 1, from which an oil jet flows out of the conical nozzle 2 at high velocity and impinges on the end plate of the cap 3, which is screwed onto the housing. Impingement of the jet breaks up the solid contaminants that are present in the oil, and the oil passes out through slots in the cap and thence into the crankcase of the engine.

The position of the cap is set by means of the lock nut 4. The spacing between the end of the nozzle and the end-piece of the cap is adjusted by screwing the cap on or off the housing.

In order to increase the dispersion efficiency, the oil jet should be nonflooded, i.e., it should exist in an air medium.

Fig. 1. Hydrodynamic disperser: 1) housing; 2) nozzle; 3) cap; 4) lock nut.

Fig. 2. Test stand for hydrodynamic disperser: 1) oil tank; 2) pump; 3) flexible hose; 4) disperser; 5) bypass valve; 6) gage; 7) heater unit; 8) thermometer; 9) oil level.
TABLE 1

<table>
<thead>
<tr>
<th>Oil</th>
<th>&quot;Mileage,&quot;</th>
<th>Acid No.</th>
<th>Alkalinity</th>
<th>Solid contaminants, %</th>
<th>Viscosity at 100°C, cS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000 km</td>
<td>mg KOH/g</td>
<td>mg KOH/g</td>
<td>organic origin</td>
<td>inorganic origin</td>
</tr>
<tr>
<td>M12B from 10D100 locomotive engine</td>
<td>16</td>
<td>0.73</td>
<td>0.88</td>
<td>0.32</td>
<td>0.08</td>
</tr>
<tr>
<td>M14V from 10D100 locomotive engine</td>
<td>67</td>
<td>0.56</td>
<td>0.59</td>
<td>0.79</td>
<td>0.15</td>
</tr>
<tr>
<td>DPll from YaMZ 236 automotive engine</td>
<td>52</td>
<td>0.63</td>
<td>0.75</td>
<td>1.10</td>
<td>0.25</td>
</tr>
<tr>
<td>AS 8 from GAZ-53 automotive engine</td>
<td>8</td>
<td>1.25</td>
<td>0.56</td>
<td>0.21</td>
<td>0.17</td>
</tr>
</tbody>
</table>

This disperser is mounted in parallel with the main oil-pressure feed line, and 15 to 25% of the total delivery of the oil pump should pass through the disperser.

For testing the disperser, we have set up a test stand with the following flow plan for the oil (Fig. 2): Oil from the tank 1 is fed by the pump 2 through the flexible hose 3 to the disperser 4 and then back to the tank.

The oil pressure is regulated by means of the bypass valve 5 and is indicated by the gage 6. The oil is heated by means of the heater unit 7, the temperature being determined by the mercury thermometer 8.

A series of hydraulic characteristic curves for the disperser were determined with this test stand. In particular, the relationship between oil flow rate through the nozzle and oil pressure and temperature was determined. A series of experiments was conducted to determine how the jet pressure was effected by the distance (a) from the end of the nozzle to the end-plate of the cap (see Fig. 1).

In order to assess the effect of disperser operation on the physical and chemical properties of lubricating oils, we tested four types of used oils; these were subjected to treatment by the disperser in the test stand. Test pressure was maintained at 3.0–4.5 kg/cm² and oil temperature at 80–85°C, corresponding to average working pressures and temperatures for oil in an engine. The spacing (a) was set at 2 mm with a nozzle opening 2 mm in diameter.

The oil properties before test are shown in Table 1.

Oil samples were drawn for analysis at predetermined time intervals during the tests.

Effects of the oil treatment were evaluated on the basis of the dispersant-stabilizing capability (DSC) of the oil, which was determined by spot chromatography [5, 6]. The DSC was calculated from the formula

$$\text{DSC} = 1 - \frac{d^2}{D^2},$$

where d is the diameter of the central spot and D is the mean diameter of the aureole.

The results of treating these oils in the test stand are shown in Fig. 3. It can be seen that the dispersant properties of the oils were improved substantially by this treating procedure—on the average, a twofold improvement.