NANO-OBJECTS AND THEIR INFLUENCE ON PROPERTIES OF MOTOR OILS


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ABSTRACT
Results of researches of various nature nano-objects and tribotechnical researches of the motor oils containing nano-sized particles were examined.

INTRODUCTION
Performance of constantly growing ecological requirements to the automobile (Euro - 4 and Euro - 5) demands application of motor oils with new structure. The most complicated problem is put before manufacturers of motor oils. Content of additives in oils should be sharply reduced, but their properties of wear resistance and terms of permanent work must be kept at the achieved level. Sulfate ash value of new oils describing content of washing additives should not exceed 1 %. Content of sulfur and phosphorus (active elements of antioxidizing and wear resistance additives) should be accordingly less than 0.25% and 0.07 %. New oils inevitably must contain nonconventional and more effective additives [1].

NANO-OBJECTS
One of ways to create nonconventional additives is use of nano-technology principles, namely, creation of steady dispersions of nano-sized particles in motor oil. Within the framework of this direction “Laboratory of Tribotechnology” has carried out researches of tribotechnical prop-rties of the motor oils containing nano-sized particles of the various origins.

In the given work the following nano-sized particles with the average size 40-100 nanometers were investigated. The morphology of nano-sized particles was investigated by a method of electronic microscopy with the help of a raster electronic microscope “Stereoscan-360”.

1.Smectite modified by hydrocarbon quaternary ammonium salt (the analogue of the additive “Bentone” manufactured by Elementis Specialties, Inc.).

\[
[C_{6}H_{2n+1}(CH_{3})_{2}CH_{2}C_{4}H_{5}]^{+}Cl^{-}
\]

2.Smectite in Na+-form modified by F/C quaternary ammonium salt [2] (Fig.1):

\[
[R_{f}SO_{2}NHC_{6}H_{4}N(CH_{3})_{2}]^{+}Cl^{-}
\]

\[
CH_{2}CH_{2}OH, \text{ where } R_{f} = C_{3}F_{7}O(CF_{2}-CFO)_{2}
\]

\[
\text{CF}_{3}
\]

3.Nano-sized diamonds of detonation synthesis. Nano-diamonds were received at detonation transformation of powerful explosive structures of composition CaHbNcOd into an inert atmosphere.

4.Nano-sized silicon received by decomposition of monosilane in the inert environment at resonant absorption of laser radiation of the CO_{2}-laser (Fig. 2).

Fig.1.An appearance of nano-sized layered particles of smectite modified by F/C compounds.
TRIBOLOGICAL RESEARCHES AND RESULTS

For tribological researches dispersions of nano-particles in polyester in concentration of 1 mg/ml have been prepared. The received structures were entered into motor oil in concentration up to 5%.

Tests of oil samples were carried out by the machine of friction according to a method of comparison of measurement results: loads of scratch, resistance of friction, a spot of contact, oil temperature.

An operating mode of samples:

- “A disk on a fixed disk”; a sample and a counter-sample - diameters are 40 mm; a material is steel 40 X;
- Frequency of a sample rotation - 1600 min-1;
- Loading on a counter-sample - up to 400 N.

Results of tests are shown in the Table 1.

<table>
<thead>
<tr>
<th>Sample name</th>
<th>Load of scratch, N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base oil API SF/CC, SAE 10W-30</td>
<td>20</td>
</tr>
<tr>
<td>Base oil with polyester</td>
<td>180</td>
</tr>
<tr>
<td>Base oil with a dispersion of organic bentonite in polyester</td>
<td>220</td>
</tr>
<tr>
<td>Base oil with a dispersion of fluoridated organic bentonite in polyester</td>
<td>280</td>
</tr>
<tr>
<td>Base oil with a dispersion of nano-diamond in polyester</td>
<td>180</td>
</tr>
<tr>
<td>Base oil with a dispersion of nano-silicon in polyester</td>
<td>350</td>
</tr>
</tbody>
</table>

Tests results of nano-objects in motor oil (100-250 mg of nano particles in oil system of the engine) confirm their high efficiency on increase of antiseizure properties of motor oils.

REFERENCES

2. Patent of Russian Federation 2001106921