CHEMMOTOLOGY

AN ANTIKNOCK ADDITIVE OF THE NEW GENERATION

Yu. V. Politanskii and S. Yu. Politanskii

An antiknock additive which is a mixture of an aromatic amine, an antioxidant, the straight-run naphtha cut of naphthene–aromatic base crude oil, and chloro- and isoparaffins, is proposed. The additive is given antiknock activity by passing it through a catalyst – manganese – at the boiling point and atmospheric pressure. In a concentration of 0.03-0.2 wt. %, the additive increases the motor octane number of low-octane motor fuels by 5-14 points.

Production and use of gasoline containing tetraethyl lead (TEL) and manganese- and iron-based additives are prohibited in the territory of the RF. Gasolines with TEL are toxic, gasolines with manganese-containing additives are unstable, and those with iron-containing additives increase engine wear. In addition, manganese- and iron-containing additives poison exhaust-gas neutralization catalysts.

In our opinion, the niche previously occupied by metal-containing additives in production of automotive gasolines can be filled by a new antiknock additive and its subsequent analogs.

The effect of this additive is based on a previously unknown physicochemical event: acquisition of antiknock activity by a certain mixture of components after treatment with metallic manganese. The proposed additive is comparable to metal-containing additives with respect to antiknock activity. When 0.7-1.2 cm$^3$ of additive is added to 1 dm$^3$ of a reference mixture consisting of 70 vol. % isoctane and 30 vol. % n-heptane, the motor octane number (MON) increases 12-17 points. The shelf life of the additive with no decrease in activity is a minimum of one year.

With respect to the additivity of the toxicometric characteristics of the components, the additive has a provisional safe level (PSL) of 18 to 28 mg/m$^3$. As a function of the chloroparaffin and aromatic amine content, it belongs to class IV of low-hazard substances according to GOST 12.1.005–88.

The additive is a clear, colorless, mobile liquid with a density of 720±10 kg/m$^3$ at 20°C and a slight odor of amine. Its solid point is a maximum of −60°C and distillation is from 75±8 to 155±15°C. It is readily soluble in hydrocarbons, insoluble in water, is not washed out of gasoline by bottom water, and does not have a corrosive effect on fuel-system construction materials in internal combustion engines.

The method of manufacturing the additive is protected by RF Patent No. 2402349 and know-how. All components of the additive are large-tonnage domestic products. Either the naphtha cut obtained from naphthene-aromatic-base crude or turpentine is used as the base component.

With respect to the physicochemical properties, the additive satisfies the following requirements:

Antiknock activity (GOST 511–82):
increase in the octane number of a reference blend, min 12
Saturated vapor pressure (GOST 1756–52), Pa (mm Hg), max 46,663 (350)
Particulate contaminant and water content (GOST 2084–82) Abs.
Clarity Clear
Color Colorless
Density (GOST 3900–81) Not regulated, determination mandatory

The compositions of experimental batches of fuel compositions (automotive gasolines) with the additive based on the straight-run naphtha cut and turpentine are reported in Tables 1 and 2.

Approximately 530 tons of automotive gasolines of all brands, including approximately 100 tons of AL-98 gasoline based on AL-95 gasoline, was treated with the naphtha-cut additive. The additive is irreplaceable for production of environmentally safe automotive gasolines for cities with a population of one million.

The studies showed that when 0.03-0.3 wt. % of this additive was incorporated in heavy (density of 930-980 kg/m$^3$) waxy crude with atmospheric distillation from a flask with a reflux condenser, the total yield of IBP-360°C light cuts increased by 10-20 rel. %.

A diagram of production of the additive is shown in Fig. 1. Straight-run petroleum naphtha, isooctane, aromatic amine, chloroparaffin, and an antioxidant are continuously fed in a fixed ratio into a standard mixer. All

### Table 1

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>without additive</td>
<td>with additive</td>
<td>without additive</td>
<td>with additive</td>
</tr>
<tr>
<td>Straight-run naphtha cut</td>
<td>100</td>
<td>99.93</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>A-76 gasoline</td>
<td>–</td>
<td>–</td>
<td>93</td>
<td>92.97</td>
</tr>
<tr>
<td>MTBE</td>
<td>–</td>
<td>–</td>
<td>7</td>
<td>6.998</td>
</tr>
<tr>
<td>Ekstralin</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Naphtha-cut additive</td>
<td>–</td>
<td>0.07</td>
<td>–</td>
<td>0.03</td>
</tr>
<tr>
<td>MON</td>
<td>62.2</td>
<td>76.1</td>
<td>78.1</td>
<td>85.3</td>
</tr>
<tr>
<td>Increase in MON</td>
<td>–</td>
<td>13.9</td>
<td>–</td>
<td>7.2</td>
</tr>
</tbody>
</table>

Note. The motor octane number of A-76 gasoline is 76.3 and that of methyl-tert-butyl ether (MTBE) is 102.