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COMPARISON OF THE EFFECTIVENESS OF ANTI-DETONATION DEVICES IN INCREASING THE OCTANE NUMBER OF AUTOMOBILE GASOLINE

Abstract. Knocking is a very harmful phenomenon. Under detonation modes of combustion, engine power decreases, specific fuel consumption increases, engine operation becomes stiff and uneven. A high level of knock resistance of gasoline is achieved by increasing the proportion of high-octane components in its component composition.

The article presents the results of the influence of anisole, acetone and methyl tert-butyl ether on the anti-knock characteristics of local AI-80 motor gasoline.

Keywords: gasoline, oxygenates, anisole, acetone, MTBE, octane number, antiknock properties.

Enter. The sharp increase in demand for oil and gas products is causing various serious environmental problems in the world. Taking this into account, the Republic of Uzbekistan pays great attention to improving the quality of oil products and producing environmentally friendly oil products based on local raw materials and technologies.

The main part of the chemical poisoning of the environment is caused by gases emitted from internal combustion engines (IYoD). Due to the physical-mechanical processes in the engine cylinders, a complex composition consisting of more than 200 toxic components is released [1–2]. The table below shows the composition of toxic gases emitted from diesel and gasoline engines [3].

Taking carbon monoxide from these above components, they form compounds such as carboxyhemoglobin (HbCO), even at low partial pressures, since they exhibit hemoglobin-like properties. HbCO dissociation is 3600 times slower than oxyhemoglobin (HbO_2). In this case, hypoxemia occurs and oxygen permeability of tissues to the body decreases. At the same time, the constant presence of low concentration of carbon monoxide leads to a decrease in the sensitivity of the visual organs to light and colors, changes in the brain, disruption of mental reactions in a certain period of time, changes in the morphological indicators of the blood composition, such as erythrocytosis, polyglobulia. Constant exposure to carbon dioxide causes headaches, dizziness, rapid fatigue, emotional instability, and heart pain [4; 5].

Table 1. – The composition of automobile toxic gases

Component	Quantity,%	
	Gasoline engine	**Diesel engine**
1	**2**	**3**
Nitrogen	74–77	76–78
Oxygen	0.3–8.0	2–18

1	2	3
Water vapors	3.0–5.5	0.5–4.0
Carbon dioxide	5.0–12.0	1.0–10.0
Carbon monoxide	5.0–12	0.01–0.5
Nitrogen oxides	0.0–0.8	0.0009–0.5
Non-carcinogenic carbohydrates	0.2–3.0	0.009–0.5
Aldehydes	0.0–0.2	0.001–0.009
Saja	0.0–0.4 g/m^3	0.01–1.1 g/m^3
Benz(a)pyrene	Up to 10–20 $\mu g/m^3$	up to 10 $\mu g/m^3$

Along with the above, benzene in gasoline also poses various risks to human organs. Under the influence of high concentration of benzene, the areas of the human brain are greatly affected, and many times under the influence of low concentration of benzene, blood and circulatory organs are affected first. The effect of benzene in the blood leads to its accumulation in the brain, disruption of nucleic acid synthesis, damage to basic cells, disruption of their chromosomal structure, and a number of similar effects. There is a linear relationship between the concentration of benzene in motor gasoline and all of its unburned by-products, such as toxic gases, fuel system emissions, and refueling vapors. Every 1% increase in the amount of benzene in fuel causes a 0.7–0.8% increase in the content of toxic gases [6].

Based on the above information, it should be said that reducing the impact of motor vehicles on the environment is becoming one of the urgent problems of today.

Table 2. – Modern requirements for gasoline quality

Indicators	**Requirements**		
	Euro-3	**Euro-4**	**Euro-5**
Benzene content,%	1.0	1.0	1.0
Sulfur content,%	0.015	0.005	0.001
Amount of aromatic hydrocarbons,%	42	35	35
Amount of olefinic hydrocarbons,%	18	14	14
Oxygen content,%	2.3	2.7	2.7
Saturated vapor pressure, kPa	summer 70 winter 90	summer 70 winter 90	summer 70 winter 90

The fuel industry of Uzbekistan is making the transition to the requirements of European standards (Euro-3, Euro-4, Euro-5) regarding the anti-detonation and environmental properties of gasoline and diesel fuel (table 2) [7].

If we take gasoline as an example, in order to obtain gasoline that meets the above requirements (Euro-3, Euro-4, Euro-5), it is necessary not only to increase its octane number, but also to reduce the amount of sulfur, olefins and aromatic hydrocarbons (especially benzene) in gasoline. must In addition, it is necessary to transfer excess aromatic hydrocarbons to isoparaffins, to add oxygen-retaining components, antioxidants, detergents and other necessary additives to gasoline.

If we look at the detonation process from a chemical point of view, the final fuel power is affected by the primary oxidation products of hydrocarbons – hydroperex and their highly active free radical decomposition products. The higher the formation of peroxide in this working mixture, the more glowing burning is observed [8; 9].

The main factor in the formation and intensity of detonation is the chemical composition of the fuel, because the oxidation tendency of different groups of hydrocarbons is different under the same conditions. If the hydrocarbons in the fuel do not form enough peroxide under the conditions of oxidation before combustion, then decomposition due to glow does not occur, and as a result, the mixture is not affected by active substances, combustion takes place at a normal rate without detonation. Detonation stability or anti-detonation properties of hydrocarbons and fuels are determined in a special one-cylinder laboratory device [10; 11].

To increase the environmental safety and quality of gasoline, it can be achieved by changing their hydrocarbon and chemical composition. The use of antidetonators based on tetraethyllead (TEQ) is completely prohibited. After banning the inclusion of such types of antidetonators in gasoline, a lot of attention is being paid to testing and industrial production of mainly aliphatic and aromatic compounds [12].

Aliphatic-based compounds have become widespread in the United States. This was done by building new devices for catalytic cracking and alkylation processes. U.S. non-ethyl gasoline is characterized by a low amount of aromatic hydrocarbons. Their detonation stability is improved due to high-octane isoparaffins [13].

The aromatic route, aimed at reforming properly driven low-octane gasoline, was widely used in Western Europe and Russia. This type of deethylated brand gasoline consists mainly of aromatic hydrocarbons, and olefinic hydrocarbons are almost absent. Therefore, this type of gasoline exhibits a high level of stability along with high detonation stability and contains a small amount of sulfur compounds [14].

In recent years, the USA, Western Europe and Russia have started adding oxygen-preserving compounds such as ether and alcohol with a high octane number to gasoline [15].

The main purpose of this study is to study the effect of oxygenates such as acetone, anisole and butyl-carbitol on the octane number of domestic AI-80 gasoline and to compare their octane number increase indicators.

Research object and methods. The research objects are: domestic industry gasoline AI-80, acetone, annisol, MTBE.

Modern and traditional methods of determining the physical and chemical properties of domestic AI-80 gasoline and its compositions with oxygenates were used in the research work.

The octane number of the obtained new gasoline samples was determined on a one-cylinder UIT-85 universal device (Fig. 1).

The study was conducted in the following sequence:

We determined the pressure of the first laboratory room using a barometer. Room pressure – 95200. This indicator is measured *in mm.sim.ust.* by the following calculation: 95200–190 (according to the barometer passport) = 95010. From the table, the indicator of 95010 is 712.6 *mm.sim.ust.* was found to be equal to Barometric pressure is corrected for relative accuracy by the following equation:

$$K = (760 - R) \cdot 0.03 = (760 - 712.6) \cdot 0.03 = 1.42$$

Figure 1. One-cylinder UIT-85 universal device

Using this coefficient, we determined the degree of compression of gasoline samples of different octane numbers (O. S.) (79, 80, 81):

$$79 \rightarrow 15.69 + 1.42 = 17.11$$
$$80 \rightarrow 15.88 + 1.42 = 17.30$$
$$81 \rightarrow 16.05 + 1.42 = 17.47$$

Starting the experiment, the UIT-85 device was prepared for operation: first, the circulating oil was heated to 50–60 °C. After that, the engine was fired with the help of an electric generator. After the engine started, the circulating water was heated to a temperature of 96 °C. Then the standard gasoline sample was checked and the detonometer reading was corrected to 55 ± 3.

Obtained results and analysis. In our research, new gasoline compositions were obtained by compounding domestic AI-80 automobile gasoline with various oxygenates.

At the first stage of our research, domestic AI-80 gasoline with a composition of 1–7% acetone was taken, and the octane number of these gasoline samples was determined by the research method (T.U.). The results of the study are presented in Figure 2.

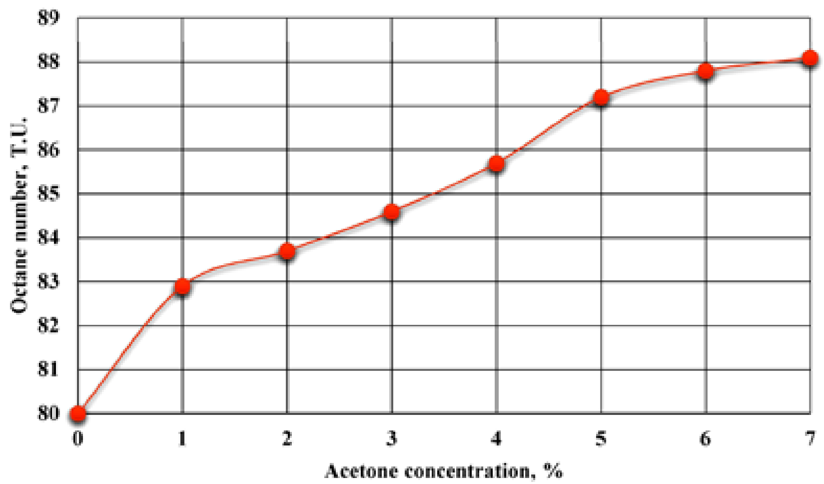

Figure 2. The level of acetone to increase the octane number of domestic AI-80 gasoline

As can be seen from Figure 2, with increasing acetone concentration, the octane number of gasoline compositions also increased. When the concentration of acetone reached 7%, the octane number reached 88.1 points.

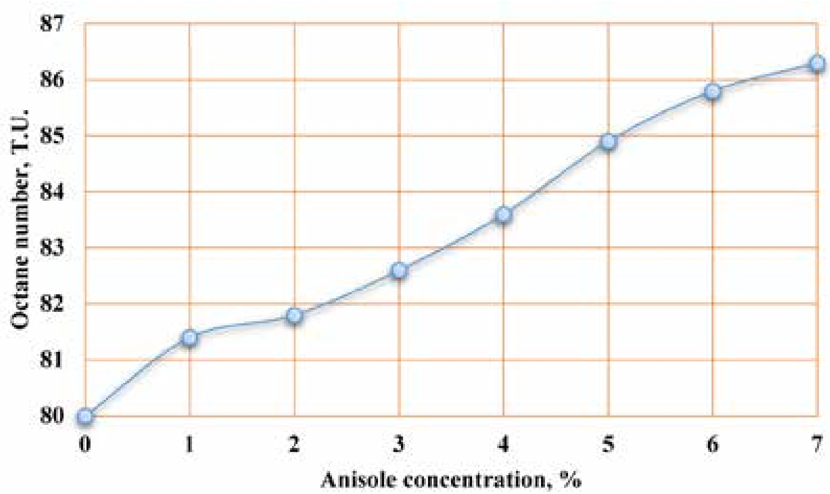

Figure 3. The octane rating of Annisol's domestic AI-80 gasoline

In the next step, we used anisole as an additive that increases the octane number. The degree of increase in the octane number of anisole is presented in Figure 3.

The results of the study increased the octane number of anisole by 6.3 points. This increase was lower than that of acetone. Analyzing these indicators, this increase is not enough for the production of AI-92 and higher octane gasoline.

At the next stage of our research, we tried using the Butyl-carbitol compound. This oxygenate has been used on an industrial scale in the world in recent years. The results of the increase in the octane number of butyl carbitol are shown in the figure below (Figure 4).

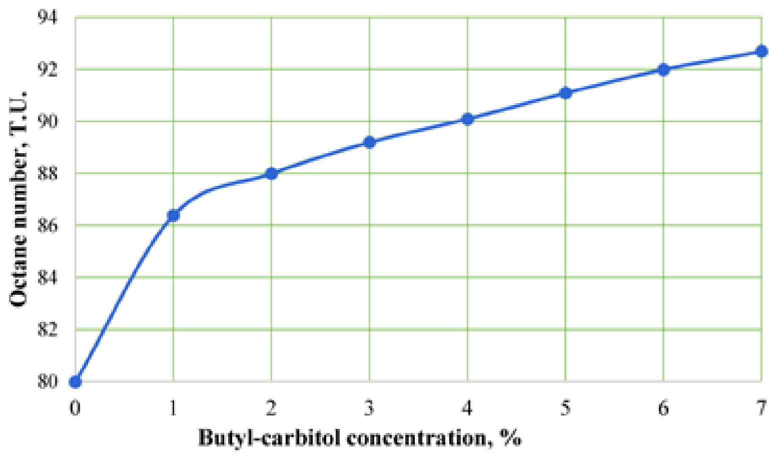

Figure 4. The level of Butyl-carbitol to increase the octane number of domestic AI-80 gasoline

The results of the study showed that the additives we studied significantly increase the octane number of domestic industrial gasoline. Among these tested compounds, Butyl-carbitol showed a relatively high performance. When adding 7% to AI-80 gasoline, the octane number increased by 12.7 points to 92.7.

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