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Analysis of Methods for Reducing the Amount of Aromatic Hydrocarbons in the Process of Obtaining High-Octane Gasoline

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Abstract. The world produces different types of gasoline. They can be divided into three levels. The first level includes permanent ordinary gasoline. It has the recommended properties in terms of 90-92 octane number according to the research method and the amount of sulfur, aromatic hydrocarbons, benzene and olefins in a certain area and it will have an octane rating of at least 95 and the characteristics that define the area to be produced, and finally the third tier will include Super gasoline. This includes the requirements for the octane number of gasoline to be not less than 98 and the content of sulfur, aromatic hydrocarbons, benzene and olefins.

Keywords. Chemical composition, isomerization process, quality indicators of gasoline, high temperature isomerization device, hydrocarbon fractions

Introduction. The first letter on the brand sign indicated that the fuel belonged to gasoline. The numbers would indicate the octane number; The second letter, if any, would indicate that the octane number was measured according to the research method. In developed countries, octane number measurement (OST) has been adopted. In the United States and Europe, it is calculated as half the sum of octane numbers (octane number in traffic) obtained by research and motor methods. This semi-aggregate is also called an anticonvulsant-detonation index. The parameters of Russian gasoline differed from the accepted international norms. This was especially

true of environmental requirements. The function of the isomerization process is to obtain isoparaffins from these paraffin hydrocarbons. Two processes of isomerization have been mastered in oil refineries: In this section, we consider the process of isomerization of a light gasoline fraction (62 ^{o}C). In recent years, this process has become one of the most profitable ways to obtain high-octane and environmentally friendly components of gasoline. It is widely used in oil refining to increase the octane number by regrouping the molecular structure of normal paraffin C_5- C_6 to their isomers with a higher octane number [1].

Methods. The main component for the production of motor gasoline is usually catalytic reforming or catalytic cracking gasoline. Catalytic reforming gasolines are characterized by low sulfur, they contain almost no olefins, so they are very stable during storage. However, the increase in aromatic hydrocarbons in them is an environmentally limiting factor. Their disadvantages also include the uneven distribution of detonation resistance by fractions.Isomerizate is a valuable component of commercial gasoline because it does not contain benzene, aromatic hydrocarbons, sulfur compounds, olefin hydrocarbons, has a high octane number according to research and engine method. The isomerizate is characterized by a minimal difference (2-3 points) between the octane numbers determined by research and motor methods, because isoparaffins have almost the same octane number determined by each method as opposed to aromatic and unsaturated hydrocarbons. The olefin formed in the acidic center is easily converted to an isomeric carbon ion. Isomer carbon ions are converted to iso olefins by returning the proton to the acidic center of the catalyst, which is hydrogenated to isoparaffins at the metal centers. The active centers of the catalyst are poisoned very rapidly as a result of coking, so the process is carried out under the conditions of circulation of a gas that retains hydrogen under high pressure to attenuate the additional reactions of cracking [2].

Mass production conditions require the possibility of using the most common petroleum raw materials with hydrocarbon and fractional composition and various sulfur compounds, which to some extent affects the establishment of standards in the specifications of the relevant quality indicators of gasoline. To increase the profitability of gasoline from refined crude oil, production is interested in raising the final boiling point, and efficient use of gasoline in the engine is possible with a certain limitation of

the composition of high-boiling fractions. In addition to hydrocarbons, gasoline contains small amounts of heterotopic hydrocarbon compounds, including sulfur, oxygen, and nitrogen. They are converted to gasoline from refined oil, and oxygen compounds are formed during the oxidation of hydrocarbons during storage of gasoline. Gasoline components, as a rule, do not contain organometallic fatty compounds accumulated in high-boiling fractions. To improve the physicochemical and operational properties of gasoline, oxygen components (ethers and alcohols), as well as special anti-knock additives, including those containing metals, are added in limited quantities. An increase in sulfur compounds in gasoline, an increase in carbon formation and wear of engine parts, aging of engine oil occurs. In addition, it has a significant negative impact on the environment. An increase in the amount of aromatic hydrocarbons in gasoline contributes to an increase in benzene emissions into the environment. Studies have shown that there is a linear relationship between the amount of benzene in gasoline and its concentration for all types of unburned hydrocarbon emissions: in exhaust gases; in vapors in the fuel system; while refueling the car [3].

Table 1.

Quality indicators of gasoline

Indicator	A-80	AI-92	AI-95	AI-98
Density below 20°C, kg/m³, not more than indicated.	755	770	The amount is not specified	
Detonation stability (octane number), not less than indicated: Motorized method, Research method	76 80	83 92	85 95	88 98
Fractional content:				
Driving head, °C; 10% driven at a temperature not exceeding the specified level in an amount not less than. 50% is driven below °C, at a temperature not higher than specified.	35 70 120	35 75 120	30 75 120	35 75 120

A temperature not higher than 95% is driven below °C.	190	190	180	190
Boiling point is not higher than °C	215	215	205	215
Saturated vapor pressure, KPa, is not higher than indicated.	79.9	79.9	66.7-93.3	79.9
The amount of resin mg/100 sm^3 , not higher than indicated	5.0	5.0	5.0	5.0
Mass content of sulfur,% not higher than indicated	0.05	0.05	0.1	0.1

The thermodynamic study of isomerization reactions of normal alkanes shows that their conversion to branched structures is more likely at much lower temperatures (not higher than 100 °C for butane, not higher than 150 °C for pentane), but the rate of reactions at these temperatures is very small.In the process of isomerization, bifunctional catalysts are used, which retain platinum or palladium in fluorine or chlorine-treated aluminum oxide and aluminosilicates or zeolites embedded in the aluminum oxide matrix (they are called bifunctional). Their main advantage is good selectivity. It should be noted that the use of bifunctional catalysts imposes strict requirements on the quality of both the raw material and the gas that retains hydrogen. The physicochemical properties of gasoline are assessed by its appearance, the presence of mechanical compounds, water-soluble acids and alkalis, as well as their density. In the same group of operational requirements for fuel, the low-temperature properties of gasoline are also taken into account [4].

The appearance of gasoline is used to assess its color and transparency. Gasolines are colorless. The possible yellowing color of gasoline is due to the presence of resinous substances in its composition. Such fuel is sediment and filtered before use. The presence of water in gasoline is especially dangerous in the winter, as ice crystals interfere with the dose of gasoline formed and can even lead to a complete cessation of its delivery. In addition, water increases the corrosively of gasoline compared to metal parts of fuel systems. The specification of gasoline ensures that it does not contain water. However, water in gasoline can dissolve and also fall into fuel tanks and accumulate freely in them. The amount of free water depends on the conditions of

transportation and storage. Therefore, for the reliable operation of equipment, storage tanks and vehicles for refueling, it is important that they are not only aggressive in themselves, but also have the ability to reduce the rate of electrochemical corrosion in the fuel-metal-water system. Organic acids, especially non-ferrous metals - are deadly to lead and zinc. Acids interact with metals to form soaps that are insoluble in gasoline, which precipitate in the form of clots, clogging the engine power system [5].

According to the fractional composition and saturated vapor pressure, motor gasoline is divided into gasoline used in summer and winter. This allows you to start the gasoline cold engine up to -30 ^{0} C, without partial heating, and to prevent the formation of vapor clots in the supply system up to +30 ^{0} C. When summer gasoline is used, steam clusters can form when the air temperature is above 45-50 ^{0} C and the engine, cold engine, can be started up to -10 ^{0} C. Although aromatic hydrocarbons have a high octane number, their amount is limited in gasoline because they are carcinogenic and have a detrimental effect on the human body. The presence of high levels of arenas in diesel fuel reduces the combustion process of the fuel. Lateral short-chain multi-cyclic arenas fall into oily fractions during oil extraction. In this case, they should be removed during the cleaning process, as surkov has a negative impact on the operational properties of oils. The raw material is heated in a heat exchanger 2, delivered to an is pentane column 3, where a mixture of pure raw material and a stable isomerization is separated into a mixture of butane with is pentane (exiting from the top of the column) and n-pentane with a mixture of hexanes (exiting from the bottom of the column). In Bhutan column 4, the target isopentane is separated from the butanes. From the bottom of column 4, the isopentane fraction is transferred to the vessel by means of a pump through a heat exchanger 22 and a cooler 24. The initial pogo (butanes formed after condensation in the air-cooling apparatus 17) is partially sent for irrigation, and the balance amount is expelled from the device. a mixture of n-pentane and hexanes passes from the bottom of the column through a heat mixer 28 to the pentane column 5, where the n-pentane is separated from the hexanes. The hexane mixture is then delivered from the bottom of the pentane column 5 to the is hexane column 6, where the is hexane is removed from the top of the column and cooled in an air cooler 19, the vessel 14 is separated from the additives, partially returned to column 6 for irrigation. The n-pentane and n-hexane fractions are mixed

with the VSG coming from compressor 12, heated in heat exchanger 1 and furnace 7, and delivered to the catalyst-filled reactor 8. At the beginning of the distance traveled, the temperature in the reactor is 380 ° C, and at the end it rises to 430-450 ° C due to a slight decrease in the activity of the catalyst [6].

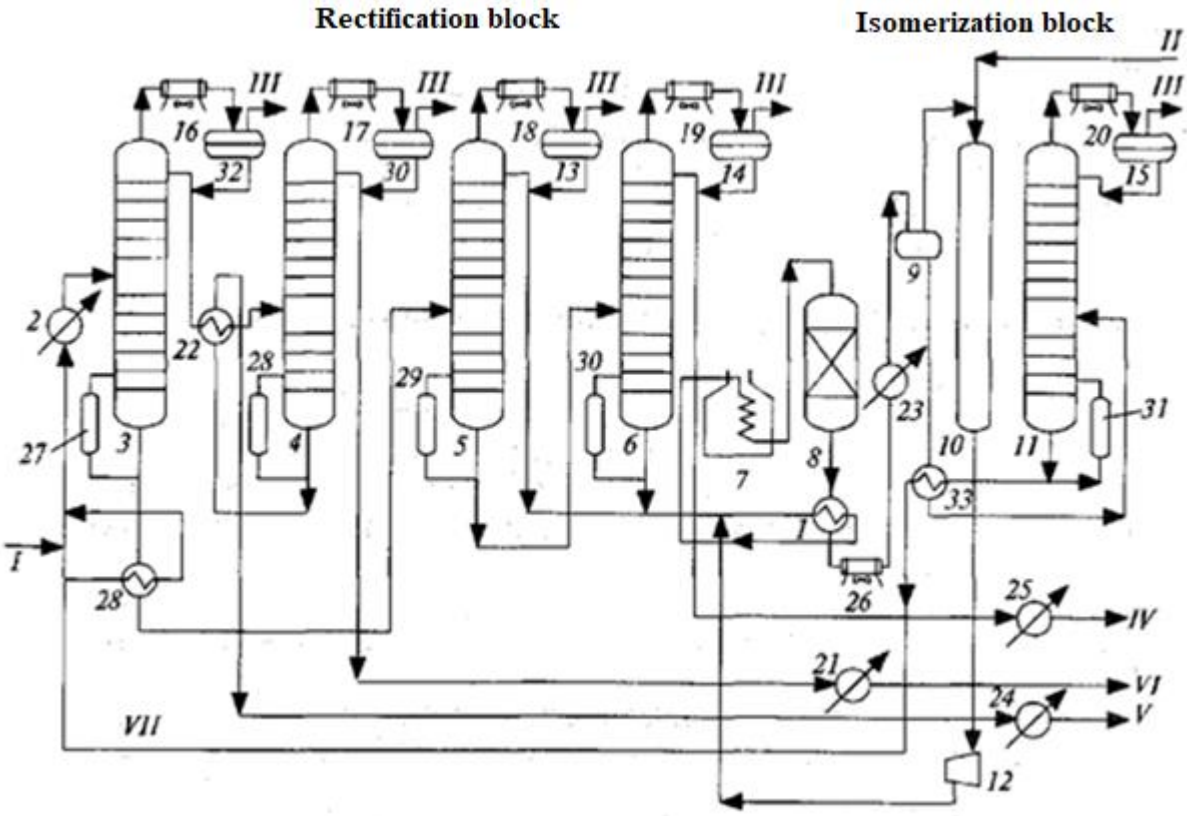

Figure 1. The structure of the isomerization device in the process of obtaining high-octane gasoline

There: 1,22,28,31-heat exchangers; 2,21,23,25 refrigerators; 3-isopentane column; 4-butane column; 5-pentane column; 6-isohexane column; 7-pech; 8-reactor; 9-separator; 10-adsorber; 11 stabilization column; 12-compressor; Vessels 13-15,31,32; 16-20,26 air cooling devices; 27-30,33-steam heaters; I- raw materials; II-pure hydrogen storage gas; III- hydrocarbon gas; IV-isohexane; V-isopentane; VI-butanes; VII-stable isomerizate.

The gas product from the reactor is cooled in heat exchanger 1 and coolers 26 and 23, which are then sent to separator 9. The circulating VSG from the apparatus 9

is removed and mixed with pure gas, the adsorber 10 is dried with zeolites and then returned to the suction flow of the compressor 12. The compressed hydrogen stored gas is mixed with the raw material. The unstable isomerizate is sent from the separator 9 through the heat exchanger 32 to the stabilization column 11, which releases C_3-C_4 hydrocarbons from the top of the column, mixes with the raw material from the bottom, and then delivers the stable isomerizer to column 3. The production of synthetic rubbers in the chemical industry of benzene, toluene, ethylbenzene, isopropylbenzene, xylenes, naphthalene is important for many processes of organic synthesis, including industries such as plastics, synthetic fibers, flammable substances, varnishes and dyes, as well as pharmaceuticals. The amount of arenas in the middle fractions is much higher than in the gasoline fractions obtained from the same oil, and fluctuates in the range of 15-35%. The upper fractions of the oil were found to have very complex multi-cyclic arenas consisting of three, four, and five condensed benzene rings, which are homologues of atsenaften, anthracene, phenanthrene, and pyrene. In terms of physical properties, benzene and its homologues differ sharply from alkanes and cycloalkanes, in which the number of carbon atoms in the molecule is exactly the same. The density and refractive index of the arenas will be high. The melting point of benzene, n-xylene, durol, tetra, penta and hexamethylbenzene is higher than 0 ^{o}C. Arenas are easily involved in various reactions. They are characterized by the introduction of halogenation, sulfation, nitration reactions, as well as the oxidation of side chains, alkyd, dealkidation and hydrogenation reactions of benzene circles [7].

Most of the hydrocarbons in the oil have a mixed (hybrid) structure. This means that the molecules of hydrocarbons of this structure contain elements of different composition. In particular, they contain aromatic rings, five and six cycloalkane rings and alkane chains. Fatty fractions are almost entirely composed of mixed hydrocarbons. They can be divided into three types: Alkane, cycloalkane, alkane aren, alkane cycloalkane and aren. The first type of hydrocarbons refers to cycloalkane hydrocarbons consisting of alternating long alkane chains or cycles of different levels consisting of several very short side alkane chains. The second type of mixed alkane arena hydrocarbons consists of long alkane chains with phenyl counterparts at the end of the chain. The number of aromatic circles in them does not exceed 2. Such hydrocarbons may contain solid paraffins and ceresins. All constituent elements in the

molecules - arenic, cycloalkane and alkane hydrocarbons belong to the 3rd type of hydrocarbons with a mixed (hybrid) structure. They are the most common of the hydrocarbons located in the high molecular weight of oil. The most prone to oxidation are gasoline obtained by thermal and catalytic cracking, coking, pyrolysis, and containing many olefins and diolefin hydrocarbons. Gasolines obtained by catalytic reforming and direct distillation, as well as alkyl gasoline, are more chemically stable.

Conclusion. The research illustrates that the physicochemical properties of AI-80, AI-91 gasoline are studied, the composition of aromatic hydrocarbons is studied, and the effect of additives that increase the octane number on the composition of gasoline is studied. Petroleum fuels play an important role in all spheres of life today. As the population grows and their lifestyles improve, so does the demand for high-quality, environmentally friendly energy resources that serve as fuel for vehicles. Increased demand for motor fuels, especially gasoline, will lead to an increase in greenhouse gas emissions. Therefore, the amount of aromatic hydrocarbons in gasoline is of great importance to improve the environmental quality of petroleum products.

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