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EFFECTIVE METHODS OF REGENERATION OF USED MOTOR OILS

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Abstract: In this article, the increasing demand for oil produced as a result of oil refining and the damage it causes to the environment as a result of its use, as well as the analysis of the global growth trend of the need for lubricants are presented. Taking into account the increasing need for lubricants, we conducted research on the processing of used oils. . In our experiments, studies were conducted using chloride, nitrate, sulfate, vinegar, trichloracetic acids for oil processing by acid adsorbent method. The viscosity, viscosity index, and cloud point of the oils obtained as a result of the research were compared with the physical properties of new and used oils. The results of our experiments show that it is possible to obtain good results in the processing of oils using the acid adsorption method.

Keywords: acid, adsorbent, viscosity, cloud point, mesh, segmentation.

Introduction. In the developed global world, it is impossible to imagine without technical devices [1]. In order to reduce the coefficient of friction in almost all technical devices, oils produced as a result of oil refining are being used [2-3]. Based on this, the demand for oil is growing year by year. This demand cannot be fully covered by oil refining [4-7]. Therefore, it is urgent to carry out research on new technologies for processing used oil in order to cover the requirements for oil [8]. As a result of improper disposal of used oil, toxic substances are released into the atmosphere and have a significant negative impact on living organisms [9].

The general trend of growing demand for lubricants worldwide is shown in Figure 1[10].

In the given diagram, the most used oils are automotive oils, their share in the total account is 56% [11-13]. Hydraulic oils are the next most used oils with a share of 13%. The share of natural industrial oils is 11%, and mainly these oils are used in printing ink oils, cosmetics and format antiseptics, leather treatment and several other areas [14-16]. 10% of technological oils are special oils used as raw materials or auxiliary raw materials for processing in various chemical and technical industries [17]. Special oils used in marine transport (5%) engines are resistant to corrosion, friction and a number of negative effects. Solid and semi-solid oils (3%) are used as a means of preventing water ingress into mechanisms and protect against rust, as well as reduce friction in machines. Gear oils (2%) are specially produced for friction and long-term service of gear devices [18]. As it can be seen from the given data, due to the high demand for oils, a large amount of waste oil is generated from the use of these oils in mechanisms [19-21]. Experiments are being conducted to obtain secondary products by regeneration of processed oils. In them, the optimal options for oil processing by acid adsorbent method are determined.

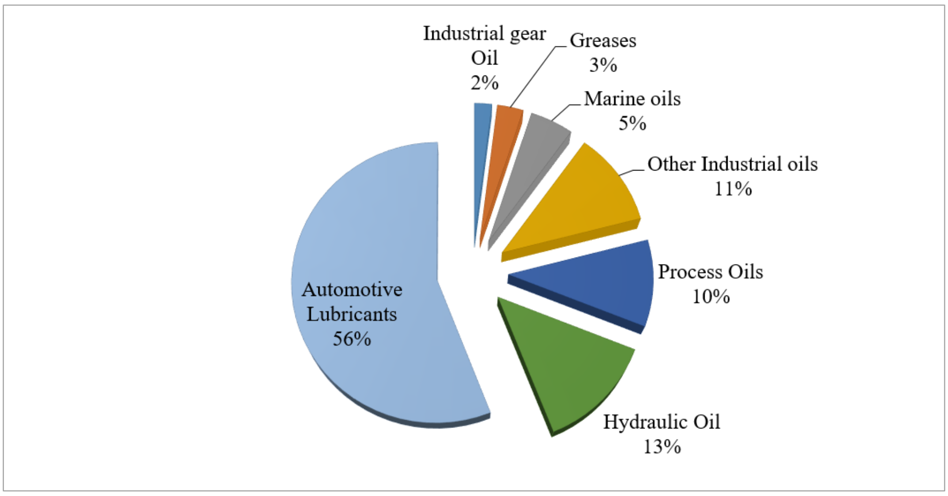

Figure 1. Global demand for various lubricants.

Method and materials. Samples were collected from oil change stations and oil storage warehouses in our experiments in order to select the optimal working parameters of oil processing by the acid adsorbent method and bring the working technical parameters of processed oils closer to the new oil base. In the experiment, the Z-206-A centrifuge of the Labnet International company was used. HCl, HNO_3, H_2SO_4, HNO_3, CH_3COOH, CCl_3COOH and alkali NaOH were used as adsorbents. Bentonite was used as an adsorbent. The kinematic viscosity of the processed oil was determined by the device "Haake viscometer 1 plus" of the company "Rhelogy solutions", and the cloud point was determined by the device "ATP-LAB-12".

Experience part. During the experiments, the oils initially used in the internal combustion engine at a distance of 7000 km were kept at room temperature for 48 hours in order to partially precipitate them in atmospheric conditions. A sample of 50 ml of the diluted oil was taken in two containers, spun in a centrifuge at a speed of 2000 rpm for 10 minutes, and relatively large particles in the oil were precipitated by centrifugal force. A sample of 100 ml was prepared in five flasks from oil purified in a centrifuge. Each sample was poured into a 500 ml beaker and stirred in a magnetic stirrer at a speed of 50 rpm. The heating element of the magnetic stirrer was activated and the oil in each container was heated to 40 °C. The oils in the containers were exposed to acids in the range of 10-15 ml and stirred for 20-25 min. Five acid-treated oil samples were placed in separatory funnels and left to settle at room temperature for 48 hours. Oil samples were separated through a mass separating funnel. The diluted oil part was placed in a magnetic stirrer at a temperature of 110 °C, 15 g of bentonite was added as an adsorbent to carry out the adsorption process, and it was slowly added and mixed in a stirrer at a speed of 50 rpm. To neutralize the acid content of the adsorbed oil, a 10% solution of NaOH was added and it was deposited in separatory funnels for 24 hours to effect segmentation. To filter the separated oil samples, filter paper No. 0.02 was placed in a Buechner funnel and installed in a bunzer flask, and the oils were filtered by a vacuum pump with a pressure of 0.9.

Results are judgments. The kinematic viscosity, viscosity index, and clouding temperatures of oils processed by the acid adsorbent method were determined using modern laboratory equipment. For effective lubrication of friction mechanisms, the viscosity of oils plays an important role. The kinematic viscosity of an oil is a measure of its internal resistance to flow under the influence of gravity and is determined by measuring the time in seconds required for a solid volume of liquid to travel a certain distance by gravity through a capillary inside a calibrated viscometer at controlled temperatures. This value is measured in centistokes (cSt) or (mm^2/s)[22-24]. The kinematic viscosities of the analyzed oils are presented in Fig. 2.

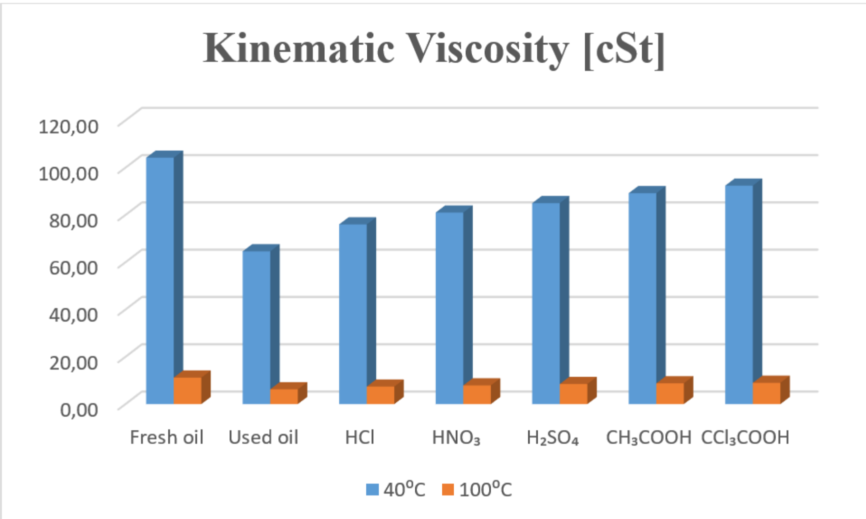

Figure 2. Change of kinematic viscosity of new, used and processed oils depending on temperature.

In this diagram, the new oil's viscosity at 40 °C is 104.2 cSt, but as the temperature rises to 100 °C, it changes to 11.2 cSt. It was determined that the viscosity of used oil at selected temperatures changed from 64.6 to 6.25 cSt. As a result of acid processing of used oils, the best indicator of their kinematic viscosity is CCl_3COOH, which changes to 92.4 cSt at 40 °C and 9 cSt at 100 °C.

From the conducted experiments, in all the tests used for oil analysis, the kinematic viscosity of the used oil was 1.6 times lower than the viscosity of the new oil, and the kinematic viscosity of the oil treated with acid and bentonite was 1.4 times higher than the viscosity of the used oil.

The viscosity index of the oil is considered one of its most important properties. Viscosity index can be defined as the oil's resistance to flow and shear. This is affected by several factors such as water, particles or other lubricant contamination. A proactive approach to monitoring the viscosity index of lubricants can make a big difference in the technical strength and technical condition of the machine. When determining the viscosity index, based on the kinematic viscosity of oils at temperatures of 40 and 100 oC, the viscosity index was calculated using a calculator [25]. The results of the calculations are presented in Figure 3.

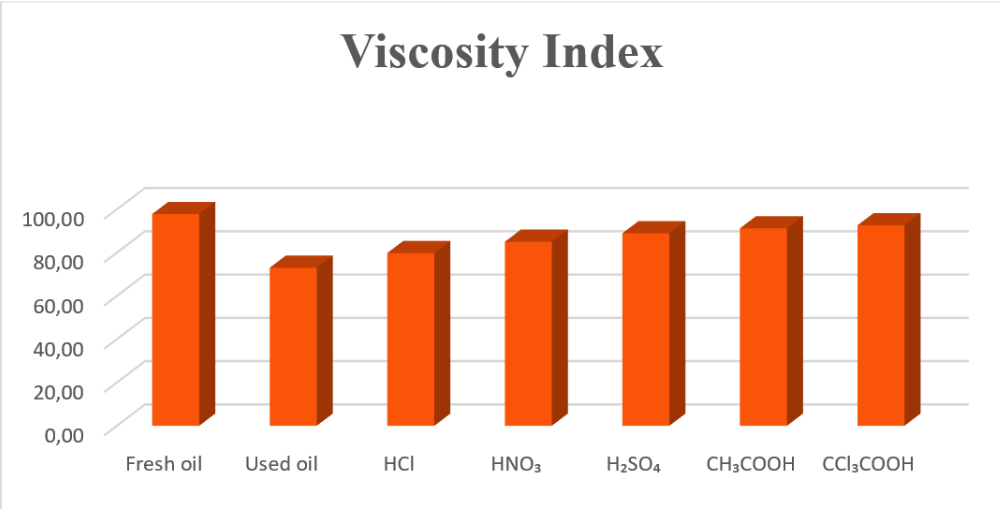

Figure 3. Oil viscosity index values are given.

The viscosity index (QI) of the new oil shown in **Figure 3** was 97.8, but after treatment the oil decreased to 73. After acid treatment, the lowest value was found at 79.8 HCl, while the highest value was obtained by treatment with CCl_3COOH, 92.6.

Cloud point refers to the temperature at which heavy hydrocarbons or other solid components in petroleum products begin to precipitate and cause it to become cloudy or hazy. This process can occur in various petroleum products. Understanding the cloud point is very important in the petroleum industry because it directly affects the flow characteristics of the product and its ability to work in low temperature environments[26]. The results of the experiment on determining the clouding points of the objects of prohibition are presented in Fig. 4.

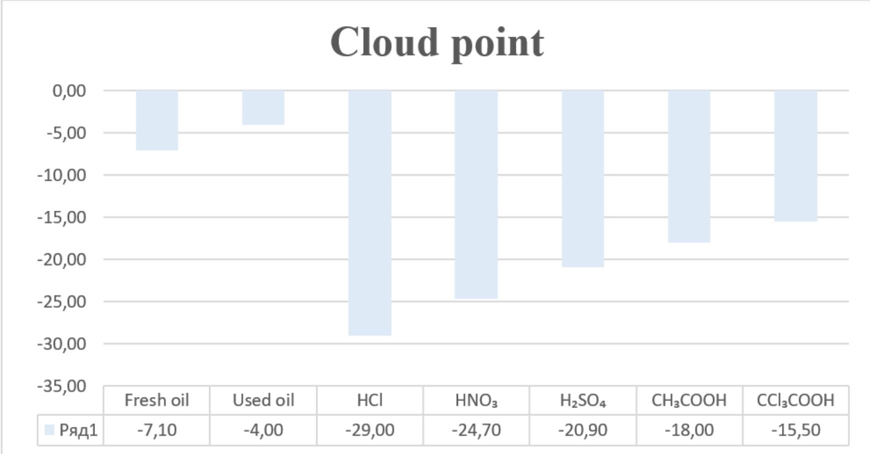

Figure 4. Oil clouding (fogging) temperatures.

The cloud point of fresh, unused oil showed a temperature of -7.1 °C as a result of the study. The result after the full exploitation of the oil shows that the temperature drops to -4 °C. After the acid regeneration process, the cloud point recapture capabilities of used oils are not very effective. However, the best performance after regeneration with acid and adsorbent was obtained by treatment with trichloracetic acid, which was also found to be up to twice the standard (-15.5 °C).

Summary. Based on the results obtained by cleaning the used oils obtained during the experiments by acid-adsorbent method, the following conclusion can be made:

the use of inorganic acid and adsorbent treatment method provides an opportunity to effectively improve the quality of oil.

Treatment of refined oils with organic acids (CH_3COOH, CCl_3COOH) has been shown to give better results than treatment with inorganic acid [N_2SO_4]. It will be possible to compare the results of treatment with these acids (N_2S0_4, CH_3COOH, CCl_3COOH) and bentonite with the physical properties of new oil.

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