Physico-chemical properties and research of acids contained in oils of Uzbekistan

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Abstract. The suitability of a new fuel can be assessed by comparing its profile with existing fuels in the library. Here we propose to use the same reasoning to develop a regression model for the physicochemical properties of the fuel.Determination of the physico-chemical properties of oxygen compounds of oil and petroleum products, and determination of the negative or positive effect of properties on the processes in practice is the direction of dolbzar. In this scientific study, the physicochemical properties of Petroleum acids were studied.

1 Introduction

Currently, the physicochemical properties of the fuel, such as viscosity and elemental composition, comply with ASTM D4814 for gasoline, ASTM D975 for gasoline diesel and ASTM D7467 for biodiesel blends. In our previous work, we proposed the use of chemometric methods in combination with a library of analytical profiles (eg chromatograms) for specific fuels [1-4]. The suitability of a new fuel can be assessed by comparing its profile with existing fuels in the library. Here we propose to use the same reasoning to develop a regression model for the physicochemical properties of the fuel. Relevant properties are measured for the substances in the fuel library and the regression model fits these measurements [3-6]. This model can then be used to predict the physicochemical properties of any other fuel. if there can be a large number of quantitative and quantitative properties [7-10].

Methods for determining the viscosity of hydrocarbon mixtures have been the subject of previous studies although the relationships proposed in the literature are empirical relationships for certain mixtures [8, 12-14]. Petroleum derivatives have a composition of hundreds or thousands of compounds, and modeling the relationship between the composition and physicochemical behavior of mixtures of this complexity requires a similar number of correlation coefficients. Chemometric methods offer alternative ways to establish the relationship between compositional and physicochemical properties without

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requiring precise determination of the composition. In this work, we use standard ASTM methods to determine physicochemical properties and use these methods along with gas chromatography profiles to build regression models to predict the properties of an unknown substance [15, 16]. The aim of the study is not to replace ASTM methods with chemometric models, but to provide a model that can be used as a screening test to determine the need for fuel production in terms of quantity.

Chemometric analysis has been successfully used to quantify and control fuel quality. Palow et al. used calibration kits and a selection strategy to build robust partial least squares (PLS) models to simultaneously determine seven properties of biodiesel and diesel blends, i.e. density, cetane index, fatty acid methyl esters (FAMEs) and clouds [10, 17]. Point, recovery point, 95% boiling point, near infrared (NIR) spectroscopy flash point, and sulfur. Pinto et al. used hydrogen nuclear magnetic resonance spectroscopy (H-1 NMR), principal component analysis (PCA), and soft independent class analogy modeling (SIMCA) to distinguish between conventional and additive gasolines [1-4, 8]. Morales-Medina and Guzmán used principal components regression and PLS to predict the viscosity and density of crude oil. Some authors support the vector machine as linear, use non-standard methods. SVM) to study fuel. Rocha et al. used SVM for exploratory analysis of various biodiesel samples. In this work, SVM can give the best classification results. Alves et al.used SVM to determine the biodiesel content of diesel blends with more efficient, accurate and consistent results than PLS. Balaban et al.analyzed data for gasoline, ethanol-gasoline (bioethanol), and diesel fuel using various chemometric methods. SVM models have shown the best results for solving classical regression and interpolation/extrapolation problems [1, 2, 10].

Viscosity of petroleum acids. The greater the value of viscosity or internal friction is, the greater is the resistance to movement of the fluid during movement. If the viscosity of the product increases, the cost of moving it increases. For example, a car's fuel system is overloaded if it runs on very viscous gasoline [12-14]. In addition, by analyzing the sample only for this indicator, it gives an opportunity to guess what its composition is. Such an analysis is very convenient for produced oil, if the crude oil does not have a high viscosity, which means that it has few light hydrocarbon fractions. The viscosity of petroleum products is always determined in petrochemical laboratories. This indicator is included in quality certificates and affects the practical properties of oil products [1-5].

2 Materials and Methods

This determination method was used in the study because the most convenient and non-systemic unit of viscosity index used in engineering, especially in the oil and chemical industry, is Engler's level, i.e. conditional viscosity of liquids (SAE VG, oE).In this SAE VG– oE–number is determined by the ratio of the time (seconds) for the flow of 200 cm^3 of petroleum acid through the capillary from the Engler type viscometer at a temperature of 20 °C to the time that 200 cm^3 of distilled water flows from this device at a temperature of 20 °C [6-8].

Conversion of Engler degrees to units of kinematic viscosity (cm^2/s) can be done according to the table or according to the empirical equation of Ubbelode:

$$E= 0.07031^oE-\frac{0,06031}{oE} \tag{1}$$

The results of the study showed that the viscosity of naphthenic acids is much higher than the viscosity of the distillates from which they are separated. For example, when the viscosity of heavy solyar oil has a value of 0.5– 0.9, the viscosity of the acid extracted from

this (°e=18.82) is converted into kinematic viscosity units (cm^2/s) according to the Ubbelode equation,it has an indicator of 1.32 cm^2/s [9-13].

The viscosity of acids can be explained by the fact that they have relatively high values of the extracted petroleum products with hydrogen bonds present in acids.

As a result of the scientific research, it was established that an increase in the molecular mass of naphthenic acids leads to an increase in the viscosity of their acids (Table 1). For example,at a temperature of 30°C, the viscosity of acids extracted from the paraffin fraction is 4.03 °E, while the viscosity of light and heavy diesel oils is 14.08 and 18.82, respectively.

Table 1. Viscosity of petroleum acids extracted from oil.

Distillate Naphthenic Acids	Viscosity, °E			
	30°C	50°S	70°C	100°C
Kerosene	4.03	2.06	1.06	1.01
Solarthe oil is light	14.08	5.57	2.79	1.39
Solaroil is heavy	18.82	6.18	2.77	1.56
Chakhbut oil	34.68	10.06	4.18	1.83
Car oil	47.74	13.33	5.19	2.10
Cylinder oil	97.92	23.80	8.09	2.72

It is known that an increase in temperature causes a decrease in the viscosity index. Naphthenic acids are not exception for this statement. For instance, if the viscosity of acids extracted from car oil at a temperature of 30°C is °E= 47.74, at temperatures of 70°C and 100°C it decreases to 5.19 and 2.10, respectively.

2.1 Petroleum acid's surface tension

It is known that dispersed systems are heterogeneous systems consisting of two or more phases, which are separated by a developed surface in between.

Oil itself can be described as a complex and multi-component mixture capable of changing aggregate and volume parameters at different values of thermobaric parameters.

The two above mentioned facts show how important surface tension is in the processes, such as oil fractionation or breaking up oil emulsions [4, 5, 10-12].

Existing methods for determining surface tension are divided into three groups: static, semi-static and dynamic. In this research, the method "Surface tension of liquid and maximum bubble pressure" was used [1-4].

The method is based on increasing the pressure inside the bubble in the liquid, the volume of the bubble increases to a pressure proportional to the surface tension of the liquid, then the bubble breaks off from the capillary touching the surface of the liquid and the pressure in the bubble returns to zero. As air is introduced into the capillary with repeated instillation, a new bubble forms and grows to a pressure proportional to the surface tension of the liquid [10, 11, 16]. If P is the bubble rupture pressure,then the surface tension of the liquid (σ) can be calculated from the following equation:

$$\sigma = K \bullet P \qquad (2)$$

3 Results and Discussion

To determine the surface tension, the device presented in the fig. 1 was used. The vessel was poured with a substance whose density was determined in an amount lower than the height of the tap in the left side (5).
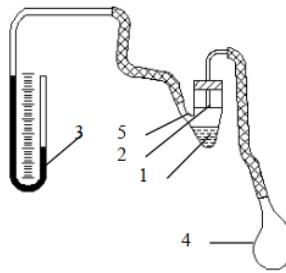

Fig. 1. The experimental device

The container 2 was tightly closed with a cap that passes through the capillary. The tip of the capillary touches the surface of the liquid,making it sink its surface a little placed.

With the help of a pressure Ball (4), the air was gradually transferred to the capillary, and the value difference (3) in the pressure gauge was recorded during the rupture of the bubble inside the liquid from the capillary. The experiment was repeated several times and the average pressure value was obtained.

σ =K•P since K in the equation is a constant value that depends on the radius of the capillary and does not depend on the nature of the liquid, it was determined using water (Table 2), the surface tension of which is known at different temperatures. The above-mentioned methodological laboratory work was used to determine the capillary K.

Table 2. Surface tension of water

t, °C	σ, N/m	t, °C	σ, N/m
12	73.70	22	72.22
14	73.41	24	71.93
16	73.11	26	71.63
18	72,82	28	71.33
20	72.53	30	71

If the measured bubble rupture pressure for water is R_{H2O} (the average value of several experimental results), then K will be:

$$K = \frac{\sigma_{H_2O}}{P_{H_2O}}$$

The value of the unit x of the liquid in which the surface tension is determined can be found using the following equation:

$$\sigma_x = \frac{\sigma_{H_2O}}{P_{H_2O}} \cdot P_x .$$

Oil-distilled water, a solution of oil and salt water, the surface tension at the oil-air interface decreased 4 times with the addition of 10% petroleum acid. The greatest decrease in surface tension on the above-mentioned surfaces is observed in the case of adding 0.1-0.2% petroleum acid soap.

As naphthenic acids and their salts have high surface activity, these significantly reduce the surface tension at the interface with water. As a result of the study, it was confirmed

that with an increase in the molecular mass of acids in accordance with the fraction being obtained, the surface tension at their border with water decreases.

Number of iodine. In structure, naphthenic acids are similar to saturated naphthenic hydrocarbons. As the molecular weight of the extracted naphthenic acids increases, their iodine number decreases. It can be assumed that this is the result of thermal decomposition in the extraction jar.

4 Conclusions

It has been found that the solubility of petroleum acids in water is not high and that they decrease as their molecular weight increases. For acids extracted from gasoline, kerosene and diesel oil, the solubility in 1 liter of water, in 20°C consumption was 37; 22 and 7 mg, respectively.

Naphthenic acids are organic compounds in which the degree of dissociation of naphthenic acids is higher than in organic acids. With an increase in the molecular weight of naphthenic acids, their dissociation occurs.

Like its fatty acids, naphthenic acids can react with alkalis to form salts; enter into an etherification reaction with alcohols, etc.

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