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TESTING TECHNIQUE OF MOTOR PETROL PHYSICAL STABILITY ESTIMATION AND FORECASTING

The technique of petrol physical stability assessment and forecasting was tested. The results of study aimed at investigation of modern motor petrols evaporability are presented in the article. The refractive index is shown to be useful tool in making prognosis about evaporation losses of motor petrol. The validation of this technique was conducted and recommendations are given on its application.

Апробовано методику оцінки та прогнозування фізичної стабільності автомобільних бензинів. Подано результати випробувань випаровуваності сучасних автомобільних бензинів. Доведено раціональність використання показника заломлення для визначення величини втрат бензину від випаровування. Проведено перевірку методики. Наведено рекомендації щодо її використання.

evaporation losses, motor petrol, physical stability, refractive index

Introduction

In the modern world when every year the quantity of natural energy carriers decreases, one of priority directions of nations' economics development involves energy saving and rational nature management. The basic modern energy carrier for transport is oil products, therefore public needs in motor fuels steadily grow with expansion of transport park. According to world balance automobile petrol makes 57 % of all fuel kinds used by vehicles [1].

Development of methods and ways of preventing fuel losses resulting from evaporation, and also efficiency definition of these methods is inseparably related to defining the nature of losses and their calculation [2−4]. Efficiency of any way of prevention of fuel losses resulting from evaporation is defined by the technical and economic assessment, namely: definition of losses value from evaporation at various technological operations for the certain time interval (for example, daily, monthly or annual losses). Therefore correctness of technical and economic calculation essentially depends on accuracy of losses determination. Imperfect calculation can lead to insufficient efficiency of developed methods of fuel losses prevention and unreasonable capital and operational expenses.

One of the determining conditions while forecasting quantitative and qualitative changes of hydrocarbonic fuels is also the choice of a method to determine these losses [5−13].

In practice, to quickly characterize composition of petroleum products, and also to control quality of products by their manufacturer, such optical properties, as refraction factor, molecular refraction and dispersion are used [10; 14]. These parameters are included in many standards on petroleum products and resulted in reference books [15; 16]. Compared with other physical and chemical parameters of hydrocarbons optical properties allow to quickly identify individual hydrocarbons or their mixtures, known earlier.

Taking into account all mentioned above, we offered earlier a technique of an estimation and forecasting of motor fuels propensity to losses from evaporation (physical stability) [17]. The idea of such technique is based on complex application of graphic, refractometric and analytical ways of losses estimation.

Task solution

For approbation of the technique the modern automobile gasolines of grades A - 80, A - 92, A - 95 were chosen.

The primary goal of the experiment was approbation and check of the technique suggested earlier.

The basic stages of experiment were:

− sample tests (100 ml) of researched gasolines have been selected and their parameters of refraction (N_{20}^{D}) have been determined;

− the selected samples have been placed in the cylindrical graduated vessels;

− samples have been evaporated and refraction parameters ($N_{20}^{D}{}_{i}$) have been determined after each 2−5 ml of researched gasoline volume change;

− difference of refraction parameters (ΔN_{20}^{D}), measured at sample evaporation ($N_{20}^{D}{}_{i}$) and initial (N_{20}^{D}), has been determined $\Delta N_{20}^{D} = N_{20}^{D}{}_{i} - N_{20}^{D}$;

− the calibration of dependence of losses on evaporation *(G)* and difference of refraction parameters (ΔN_{20}^{D}) has been carried out (the calibrating graph has been constructed);

− a technique involving reverse experiment has been inspected: by measuring refraction parameters during natural evaporation the required value of losses from evaporation with the help of the reference characteristic (calibrating graph) has been determined.

With the received data dependences of relative losses value change on the refraction parameter (fig. 1, *a*), and also on the difference of fuel refraction parameters (fig. 1, *b*) have been constructed.

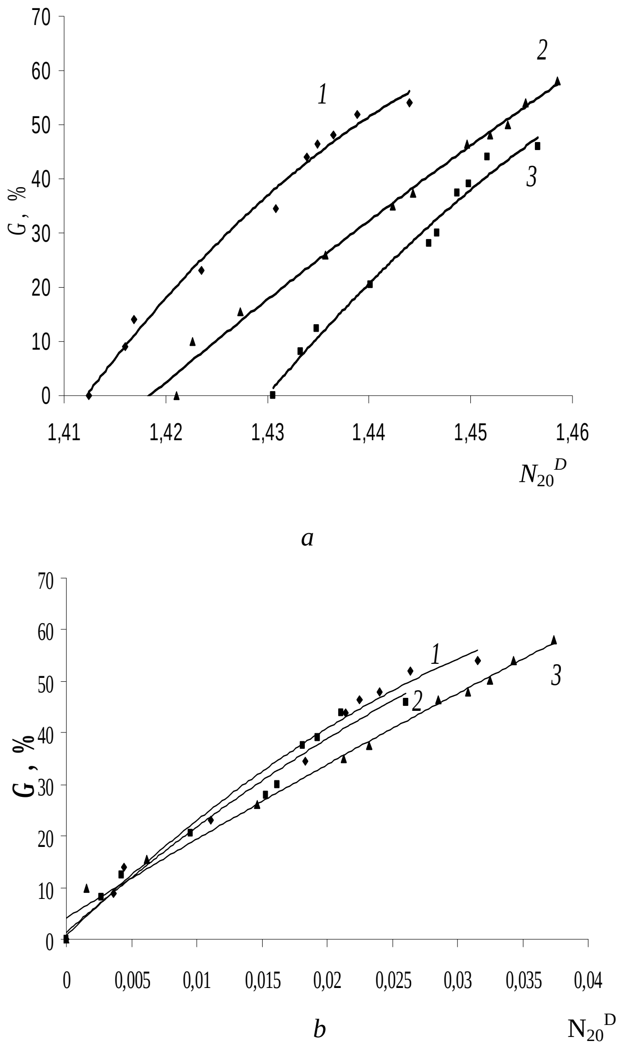

Fig. 1. Dynamics of changing relative losses value and refraction factor for motor petrols:
a:1 – A-80; *2* – A-95; *3* – A-92;
b:1 – A-80; *2* – A-92; *3* – A-95

The dependence of relative losses value on time also has been constructed (fig. 2).

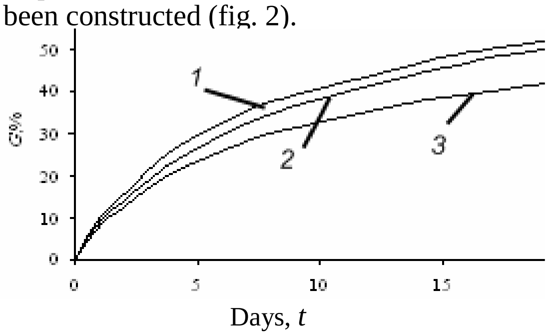

Fig. 2. Kinetics of petrol evaporation process:
1 – A-95;
2 – A-80;
3 – A-92

As it was specified earlier, after carrying out the experiment we made a check of suggested techniques. The check has been made by the method of reverse experiment, that is petroleum products losses from evaporation have been predicted on measured refraction parameters. The received dependences are shown in fig. 3.

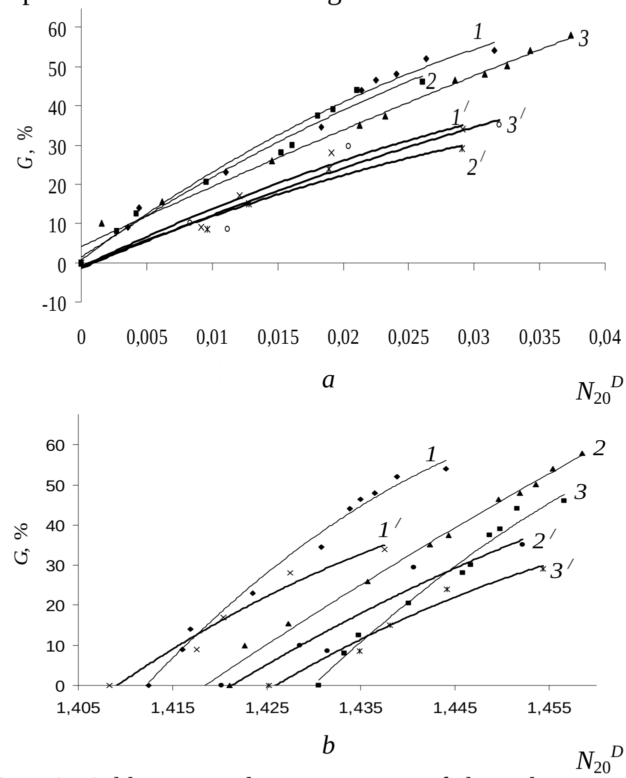

Рис. 3. Calibrating and testing curves of dependence of petrol losses from evaporation and difference of refraction factors:
a: 1 – motor petrol A-80; *2* – A-92; *3* – A-95;
1′ – testing curve for petrol A-80;
2′ – testing curve for petrol A-92;
3′ – testing curve for petrol A-95;
b: 1 – motor petrol A-80; *2* – A-95; *3* – A-92;
1′ – testing curve for petrol A-80;
2′ – testing curve for petrol A-95;
3′ – testing curve for petrol A-92

The received results show the possibility of using the dependence of a refraction parameter on evaporation losses value for forecasting physical stability and petroleum products losses from evaporation.

In an ideal case curves of calibrating and testing dependences should coincide (fig. 3), but there are errors of measurements. According to calculation of a root-mean-square deviation a divergence between curves on fig. 3 makes less than 5 % in comparison with fig. 3 where the error is higher.

Having compared the received dependences and values of errors, we can make a conclusion, that the most suitable as calibrating one is dependence of relative losses value on the petrol refraction parameter that simplifies a settlement part of the method. Thus the suggested technique has been improved and simplified.

Conclusion

Practical application of the given method consists in an opportunity to determine relative losses value at storage of gasolines with the help of calibrating dependence, having measured a parameter of refraction. The simplicity of performance and accessible hardware are advantages of the method.

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