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EXPERIMENTAL INVESTIGATION OF THE TEMPERATURE DEPENDENCE OF ULTRASONIC VELOCITY IN CRUDE OIL AND IN SOME PETROLEUM

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The outcomes of experimental investigation the temperature dependence of ultrasonic velocity in crud oil ahd some petroleum (aitomobile gasoline of the different marks, kerosene and diesel fuel) and also of ultrasonic veiocity in gasoline inclusive varied percent diesel fuel are represented.. Research were conducted with help of an interferometer on to frequency of a ultrasonics 350 kHz in temperature range from 5 up to 40°Ñ. Was established, that the average velocity of a ultrasonics decreases with the temperature rising in limits from 5 up to 40°Ñ displaying at that an linear dependence, which can be described by the formula c (T) =c_0 (1-g ΔT), where g=4,4.10^{-3} 1/°C, ΔT=T-40°Ñ, and c_0-average velosity of a ultrasonics in each investigated liquid at to temperature 40°Ñ. Also was established, that with increase percentage (on a volume) in gasoline "Kalosha" diesel fuel at temperature 18°C the velocity of a ultrasonics linearly increases approximately on 2,5 m/s at increase of a composition diesel fuels on 1 %. The description of construction and a principle of work of the interferometer is given.

The items of information on temperature dependence of ultrasonics veiocity in crude oil and petroleum, made from her (in gasoline, kerosene and diesel fuel) has large scientific and practical value. So, in practice, these items of information introduce considerable concern for the implementators of instrumentation intended for definition fluid level in different capacitances by an acoustic method (method echo rangings). In scientific aspect they can be utilised for finding - out of patterns and physical nature of investigated liquids. However, to the present time in the published literature such it is not enough of the items of information also they are shown in rather narrow temperature range.

Outgoing from this in 1998-99 years. by us were conducted experimental researches of temperature dependence of ultrasonics velocity in crude oils and in some petroleum (automobile gasoline the different marks, kerosene and diesel fuel) in enough broad band temperatures from 5 up to 40°Ñ. Measurements of ultrasonic velocity in indicated liquids were conducted in laboratory conditions with the help designed by us of an interferometer on frequency of a ultrasonics 350 êÃö. This interferometer consist of following leading particulars: the generator sinusoidal electrical oscillations, cathode-ray oscillograph and the acoustic vibrator. The acoustic vibrator served source and receiver of a ultrasonics. By piezoelement in the vibrator served cylindrical ring manufactured from piezomatfrial of group titanate - circonate of lead (CTS). The ring had the following sizes: the internal and external diameters equalled accordingly 1 and 2 ñm, and altitude - 0,5 sm. We have used acsialnye a mode of oscillations of a ring on a resonance frequency 350 êHz. The electrodes were marked on end surfaces of a ring. The ring was mounting in thin-wall cylindrical glass from plexiglas with a flat base surface, and one of his end surfaces had an acoustic contact with a flat surface of bottom, and other end surface was damped with the help of the rubber ring. At opening-up for measurement of a ultrasonic velocity the vibrator consolidated on raise-lowering the device. bring in movement on a vertical with help of a micrometer screw, was established in vessel with by investigated liquid so, that his receiver-radiating surface was is parallel refiecning surfaces of bottom of a vessel. During measurement of velocity of sound on input of the vibrator on cable through active resistance R=10 kΩ with oscillator output was lead continuous sinusoidal electrical signal on frequency 350 êHz. This signal was converted vibrator in the acoustical signal, which one was radiated in an investigated liquid. At slowly the movement of vibrator on vertical each time, when the distance between him and by bottom of vessel with liquid equel by whole a number halfwave, between the radiating surfase of vibrator and the bottom surface was established the standing acostic wave. At movement vibrator on vertical the knot and the clusters of this wave could be watched on screen of the oscillograph, connected up to an input of the vibrator, as alternating maxima and minima tension of sinusoidal oscillations. Having counted up quantity adjacent maxima (or minima) this signal

N at movement of the vibrator on a known section of a path L, determined on a measuring scale, can be determined average value of half of wavelength of a radiated signal $\lambda/2$ and at a known signal frequency f, it is possible to determine and average velocity of ultrasonics c under the formula:

$$c = 2Lf / N \qquad (1)$$

Experimental values of average velocity of a ultrasonics in investigated the liquids in temperature range 5-40°Ñ were determined with an interval 5°Ñ from a point to a point. For the same liquid in each point measuring of a ultrasonics velocity repeated multiply, then was made statistical average of the obtained data. As have shown experiments, for all investigated liquids average value of velocity of a ultrasonics with probability 90 % lied inside a confidence interval ($c \pm 0{,}003\ c$). The volume of investigating liquid compose 40-50 ml. In each point of temperature band with the help of the thermostat temperature of a liquid was supported by a constant and was measured by the mercury thermometer with accuracy 0,05°Ñ. Outcomes of the researches, conducted by us, of temperature dependence the average veiocity of a ultrasonics for some flammable fluids are shown in the table 1. For matching in the table are shown and applicable the data of other writers, published in activities [1,2].

TABLE 1

Awerage velocity of a ultrasonics (m/s) in the dependence from a temperature (°C) for different flammable fluids

Flammable fluid	Òåmperature in °C							
	5	10	15	20	25	30	35	40
Crude oil	1510	1500	1475	1465	1430	1410	1380	1360
Crude oil [1]		1520			1460	1440	1420	1410
Diesel fuel	1475	1450	1420	1400	1375	1355	1320	1300
Diesel fuel [2]						1345	1315	1300
Kerosene	1370	1350	1325	1310	1275	1260	1225	1200
Kerosene [2]						1275	1250	1230
Avtogazoline 95	1315	1295	1270	1262	1220	1200	1176	1150
Avtogazoline 92	1260	1241	1210	1190	1180	1145	1130	1100
Gazolin “Kalosha”	1230	1195	1170	1150	1120	1095	1070	1050

The data analysis, introduced in the table 1, demonstrates, that in all considered temperature range the greatest values average velocity of a ultrasonics take place for crude oil and least - for gasoline "Kalosha”. Besides at increase of temperature in limits from 5 up to 40°Ñ the average velocity of a ultrasonics for all liquids decreases displaying at that an approximately linear dependence, which can be described by the formula:

$$c = c_0 (1- g\Delta T) \qquad (2)$$

where $g=4{,}4.10^{-3}$ 1/°C, $\Delta T=T-40$°Ñ and c_0- average veiocity of a ultrasonics at temperature 40°Ñ. Matching of the data obtained in present to activity, with the applicable data, obtained other explorers [1,2], demonstrates, that they satisfactorily are agreeed with each other. The average velocity of a ultrasonics as it is visible from the table 1 for gasoline "Kalosha” it is much less, than applicable value for kerosene and diesel fuels. As these liquids are by the product of clearing of the same raw material - crude oil, they it is good are mixed with each other and addition to clean gasoline some quantities of kerosene or diesel fuel, apparently, should result to increase of a ultrasonics velocity in a mixture. For finding - out of this problem we have conducted research of a ultrasonics velocity in clean gasoline “Kalosha” with the different contents (on a volume) in a him of diesel fuel in limits from 20 up to 100 %. The outcomes of researches are shown in the table 2.

TABLE 2

The average velocity of a ultrasonics (m/s) in mixture of gazoline “Kalosha” with diesel fuel in dependence from of percentage diesel fuel (%)

Percentage	0	20	40	60	80	100
The average velocity	1160	1235	1265	1310	1360	1410

From table follows, that at increase in mixture of gasoline "Kalosha" with by diesel fuel of percentage of diesel fuel in limits from 0 up to 100 % the velocity of a ultrasonics in a mixture increases approximately on 2.5 m/s at increase in gasoline of percentage of diesel fuel on 1%. Therefore, the percent of admixture of diesel fuel or kerosene in the clean gazoline can be determinated on the basis of calibrate data of a ultrasonics velocity in gasoline.

R E F E R E N C E S

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