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Influence of hydrodynamic cavitation on the rheological properties and microstructure of formulated crude oil

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ABSTRACT

The article presents the results of theoretical and experimental studies on the mechanical activation of viscous oil, which confirmed the effectiveness of cavitation on their rheological properties. The major making source of raw materials of oil branch stocks heavy and bituminous crude oils are. Improvement of technologies transportations it is, caused by their high resource potential. Capacity and economic efficiency of the oil pipeline depends on properties of the pumped-over oil. The main obstacle for ensuring necessary speed is viscosity. Recently the steady tendency to magnification of bulks of haul, oil and oil products was out lined. Thus, for problem solution on magnification of bulk of an oil pumping and oil products, developments new or optimization of applied technologies of haul of crude oil and crude oil products taking into account their rheological behavior and operating characteristics of pipelines are indispensable. With that, end in view the big practical and theoretical interest is, represented by working out of new methods of struggle against formation of paraffin adjournment. Considering problem urgency, from our party experiences on

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influence studying cavitation on formation asphaltene - pitch - paraffin adjournment on an internal surface of the pipeline have, been spent. The possibility of an intensification of process of influence of chemical reagent by cavitation for decrease in viscosity of oil is established. Results of pilot studies on complex influence of chemical reagents and cavitation on viscosity crude oil with various structural and group structure are received. As have shown experiments, as a result cavitation in oil there are irreversible changes of viscosity, pressure of sated steams, shares: paraffin, asphaltene and pitch hydrocarbons.

***Keywords*:** Cavitation, asphaltene, high-paraffinic, oil transport, toluene, crude oil

1. INTRODUCTION

In recent years, Azerbaijan becomes more and more important player in the world market of energy resources. Having the largest explored reserves of crude oil near the Caspian Sea. Characteristic of modern oil production is increase in world structure of raw material resources of a share of hardly removable stocks. Due to the tendency of exhaustion of stocks of lungs, crude oil interest in hardly removable crude oils has increased in the world. Production of the majority of fields of Azerbaijan are viscous and high-paraffinic crude oil. Viscosity such high-viscosity crude oil at fall of temperature increases to such an extent that they become nontransportable (Gogate and Pandit 2000). At transport high-paraffinic the intensive parafinization of pipelines, decrease in their capacity occurs crude oil that considerably complicates operation and leads to growth of labor and material inputs. The existing ways of impact on rheological properties viscous crude oil and oil products not fully satisfy consumers because of their low energy efficiency and low reliability. Therefore scientists and designers intensive search of new ways of their transportation and creation the power effective of designs of devices of impact on rheological properties of viscous liquids with application of the new, earlier not studied physical phenomena continues (Hilgenfeldt et al. 1999). On this subject in the press and Internet resources there are numerous publications on developments of highly effective devices which often have disputable results. Their analysis allows to allocate the ways of impact on the rheological properties of viscous liquids applicable which are most acceptable, in our opinion, in practice.

Mechanical influence: The easiest way of decrease in static and dynamic stress of shift and by that decrease in hydraulic losses at transfer is mechanical impact on oil with destruction of a crystal paraffin grid. However, it is necessary to notice that machining is effective in a certain area of temperatures when the connected crystals of paraffin create a branched lattice. Work of the mechanical grinders based on impact of the processed liquid about a surface of elements of a grinder thanks to presence of relative speeds causes emergence of a high gradient of pressure, promotes emergence in liquid of wave processes. When crushing impurity very convincing results are received, however, such devices for improvement of rheological properties of oil aren't tested yet. Spend researches from a crude oils have shown that mechanical impact on the paraffin structures which are formed in oil considerably lower durability of secondary structures, reduces temperature of their hardening, viscosity, static and dynamic tension of shift. At the particular conditions mechanical impact on crude oil it is possible to achieve that it loses the non-Newtonian properties and becomes the Newtonian. According to processing can provide with mechanical grinders considerable improvement of rheological properties of oil. As a rule, they not power-intensive. However for their broad industrial application additional experimental works are required (Bubulis et al. 2010; Safar 1969).

2. MATERIALS AND METHODS

Processing by cavitation. In recent years interest on direct transformation of mechanical energy in thermal in so-called "hydrodynamic heaters of liquid" (HHL) or "vortex heatgenerators" (VTG) has increased. According to conclusions of authors, heating of liquid in them happens as at the expense of the hydrodynamic, and cavitational phenomena. Their principle of action is often similar to such devices, already widely known in equipment, as a hydrobrake or the hydrocoupling. Cavitation, in a general sense words, is understood as emergence in drop liquid of areas (cavities) filled with vapors and gases emitted from liquid. Cavitation belongs to the non-stationary phenomena and happens when absolute pressure falls in some area of drop liquid below some critical value of P_{kav} at which there is a rupture of a continuity of a stream and the cavities filled with vapors or gases are formed. At advance of a stream to the area of an elevated pressure (according to Bernoulli's equation, area of falling of speed of a stream) there is a interlocking (condensation) of gas bubbles leading to blows of particles of liquid the friend about the friend and also walls.

The positive effect from cavitation is an obtaining fine monotonous mass of liquid, i.e. crushing of paraffinic educations in oil. One of features of cavitational process when pumping oil - significant influence of thermodynamic properties of oil. It is well visible on the example of expansion of initial bubbles at steam cavitation. In case of existence of a steam cavity (a subcavity we will accept in this case the cavity in the form of a bubble filled with steam) cavitation is provided with the continuous process of evaporation coming at a heat transfer from a cavity wall. As sources of heat are absent, it is supposed that heat, necessary for evaporation, is selected from the liquid surrounding a cavity (Chivate and Pandit 1995). Local self-cooling of the liquid surrounding a cavity at formation of cavitational bubbles can significantly reduce pressure of vapors of oil in a cavity. Besides thermodynamic properties, cavitation emergence intensity of her development are influenced pressure of saturated steam of oil, the steepness of curve dependence of pressure of saturated steam of oil on temperature, by viscosity, a superficial tension, amount of the dissolved and free gas, time of stay of oil in a zone with the lowered pressure, character of a stream (laminar or turbulent), etc. (Gogate et al. 2006). Dependence of a critical cavitational stock of any element of hydraulic system on change viscosity of oil can have double character. First, forces of viscosity of oil slow down the growth rate of a cavitational bubble and by that interfere with development of cavitational process. Besides, in some cases viscosity of the pumped-over oil can alter an diagrams of speeds of flowing part of canals and, thereby, reduce extent of depression of a stream, i.e. also "tighten" the beginning of cavitation. Secondly, viscosity leads to increase in hydraulic resistance on a site from an entrance to a hydraulic element, to places of the minimum pressure that finally accelerates approach of the cavitational mode. Shows results of researches that growth of bubbles in oil significantly more slowly, than in ideal liquid. Viscosity of oil exerts considerable impact on growth of a bubble (Nesterenko and Berlizov 2007; Sawarkar et al. 2009; Tomita and Shima 1986).

It should be noted that despite abundance of experimental works, more or less satisfactory theoretical settlement techniques of the effects arising in HHL and VTG from the point of view of classical aerodynamics and hydrodynamics still aren't available. There are also numerous works in which their incredibly high efficiency (which is often exceeding 100%) is noted. The impossibility to explain process from the point of view of traditional physics has led to the fact that the vortex power system was strongly, proved in the list of the "pseudoscientific" directions. Meanwhile, developments of working models of the HHL and VTG installations realizing the principle described above are already widely presented at the market. At present time for territories of Russia, some republics of the former Soviet Union and a number of foreign countries hundreds of vortex heatgenerators of various power made by a number of the domestic scientific and production enterprises successfully function (Guangtian et al. 2006; Liu et al. 1993).

So, according to authors of development of VTG use of VTG for processing of oil leads to the following results:

1. Cavitation accelerates diffusion of oil in a paraffin cavity, intensifies process of his destruction. Acceleration of dissolution of paraffin happens for счѐт intensifications of hashing of oil on border oil-paraffin and actions of impulses of pressure which as if spray paraffin particles.
2. Oil doesn't possess the viscosity submitting to laws of Newton, Poiseuille, Stokes as the long randomly located molecules of paraffin and pitches form some flexible lattice in which solution settles down. Therefore the system renders considerable resistance to shift forces. Cavitation breaks off a continuous chain, destroying communications between separate parts of molecules. These communications are rather small therefore insignificant influence is necessary.
3. After the termination of influence of a molecule of paraffin and pitches, slowly restore initial system thanks to random Brownian motion. However when processing oil by the cavitational field the final product is stable not less than 60 days. The analysis of researches shows that under the influence of the cavitational field the C-C communications in paraffin molecules are broken owing to what there are changes of physical and chemical structure: reduction of molecular weight, crystallization temperature, etc.
4. Cavitation influences change of structural viscosity, i.e. a temporary break-up of Van-der-vaals of communications. Irreversible reduction of viscosity of oil takes place after oil radiation by the cavitational field this effect is, gained for one pass through the VTG installation. The vortex VTG-110 heatgenerator makes heating of oil with simultaneous change structures that reduces load of the crude oil pipeline and costs of crude oil pumping (Gordon et al. 2010; Neppiras 1968; Neppiras 1980).

To category of the most effective receptions improving rheological properties viscous crude oil and crude oil products, it is necessary to carry complex methods of influence, for example combination of introduction of solvent or reagent and cavitational processing of oil that will allow to increase the gained effect of every way separately.

3. RESULTS AND DISCUSSIONS

Justification of the choice of the modes of processing of oil, the choice of chemical reagents is given, experiment planning is carried out, variation intervals are set, pilot studies of process of decrease in viscosity of oil under the influence of cavitation with use of reagents are described explanations of results of experiments are provided. For definition of effect of application of cavitation for the purpose of decrease in viscosity of oil experiments on three, various the crude oils with different structural and group structure and physicomechanical characteristics have been, made. For experiments have been selected paraffinic oil of the field Shikhbagi, Bulla-deniz and resinous oil of the field Shirvan, shows Table 1. The picked-up samples of crude oil allow to conduct researches in the wide range high-viscosity crude oil.

Table 1. Structural and group structure investigated by crude oils.

Oil field	Dynamic viscosity at 15 °C, mPa·s	Contents, % of masses		
		Paraffin	Pitch	Asphaltene
Shikhbagi	573	12,9	15,58	2,69
Bulla-deniz	358	9,7	5,32	0,28
Shirvan	8152	3,88	13,27	6,24

For determination of rational parameters of cavitational processing of oil a series of experiments with processing of oil at various intensity during different periods has been, carried out, Figure 1 shows.

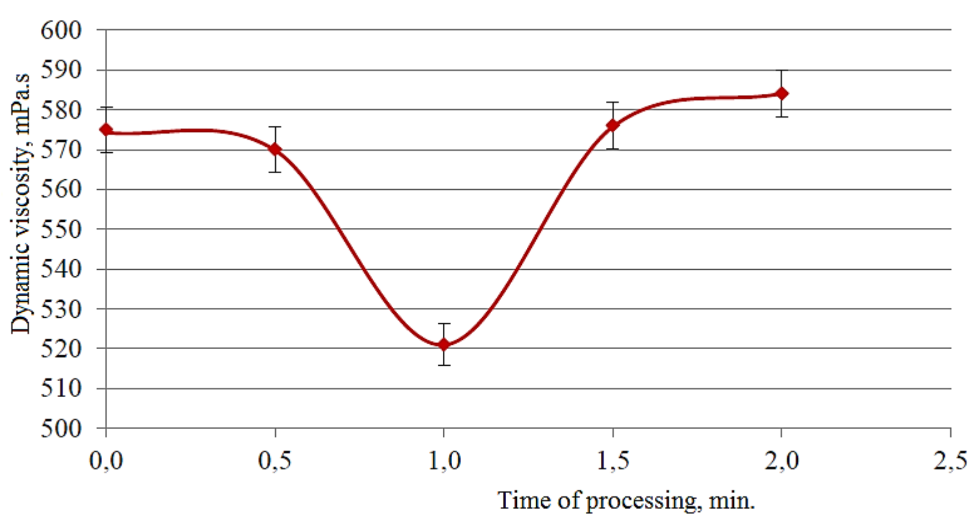

Figure 1. Change of dynamic viscosity of crude oil of the field Shikbagi depending on test processing time

Further a series of experiments for selection of reagent and its concentration has been carried out. Results of experiments are given in the histogram (Fig. 3). The best results have been received at introduction to crude oil of a xylene and a butilatsetat. So, introduction of 2% of masses. a xylene butylacetate introduction – for 23% has allowed to reduce viscosity of crude oil by 27%, and. The subsequent measurements of viscosity of samples of oil in 24, 48 and 72 hours have shown that growth of viscosity of oil after introduction of reagent doesn't exceed 5-7%.

Further a series of experiments on research of process of complex processing of oil by reagent and cavitation with use of the parameters of processing received in the previous series of experiment has been carried out, Figure 2 shows.

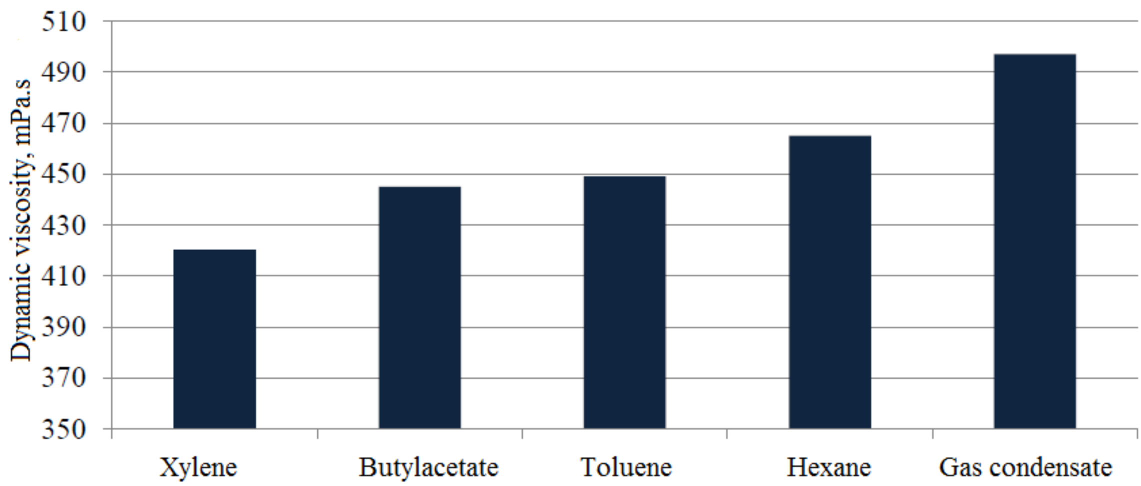

Figure 2. Change of dynamic viscosity of oil of the field Shikbagi after introduction of 2% of mass reagent

For studying of process of complex influence of reagent and cavitation on field oil Shikbagi it is necessary to compare the data obtained before cavitational processing. The corresponding schedules of dependence of dynamic viscosity of oil from relaxation time have been for this purpose constructed.

Experiments have shown that complex influence of reagent and cavitation considerably reduces viscosity of initial crude oil in comparison with influence only of reagent. The additional effect of decrease in viscosity due to cavitational processing has made 25-35% depending on the applied reagent. The best result at complex influence was shown by a series of experiments with a xylene and toluene. So, at introduction of 2% of mass. a xylene and crude oil processing viscosity of crude oil has decreased by 44%, at introduction of toluene and similar influence, viscosity of crude oil has decreased by 37%, Figure 3 shows.

The subsequent measurements of viscosity of samples in 24, 48 and 72 hours have shown that growth of value of viscosity after complex processing is characteristic of field oil Shikbagi. Depending on the applied reagent dynamic viscosity of oil has increased for 25-35%.

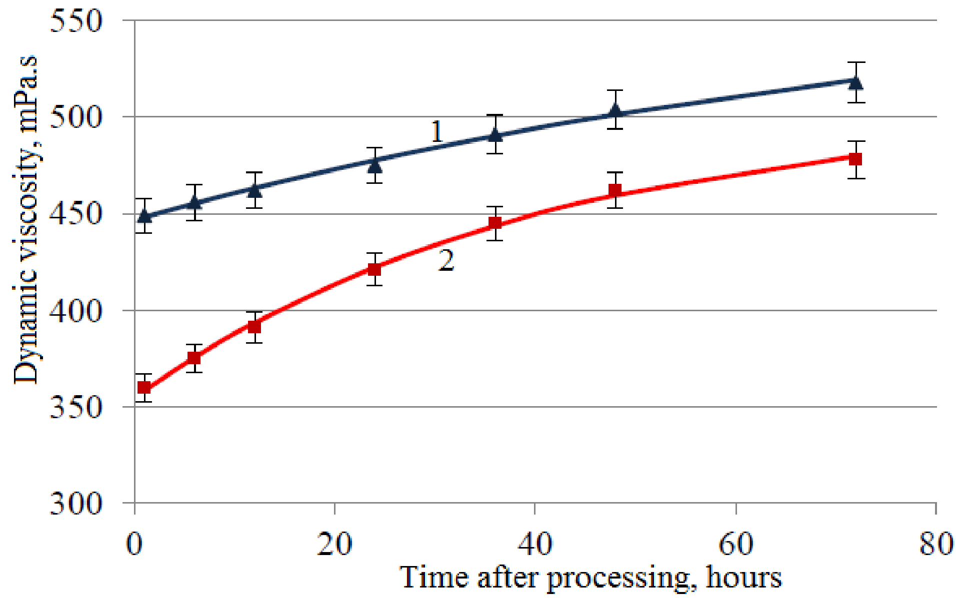

Figure 3. Change of dynamic viscosity of oil of the field of Shikbagi from a test storage time after introduction of 2% of masses. toluene and hashing: 1-without cavitational processing; 2-after cavitational processing

For crude oil of the field Bulla-deniz the following parameters of processing have been picked up: Figure 4 shows intensity, frequency of fluctuations, processing time.

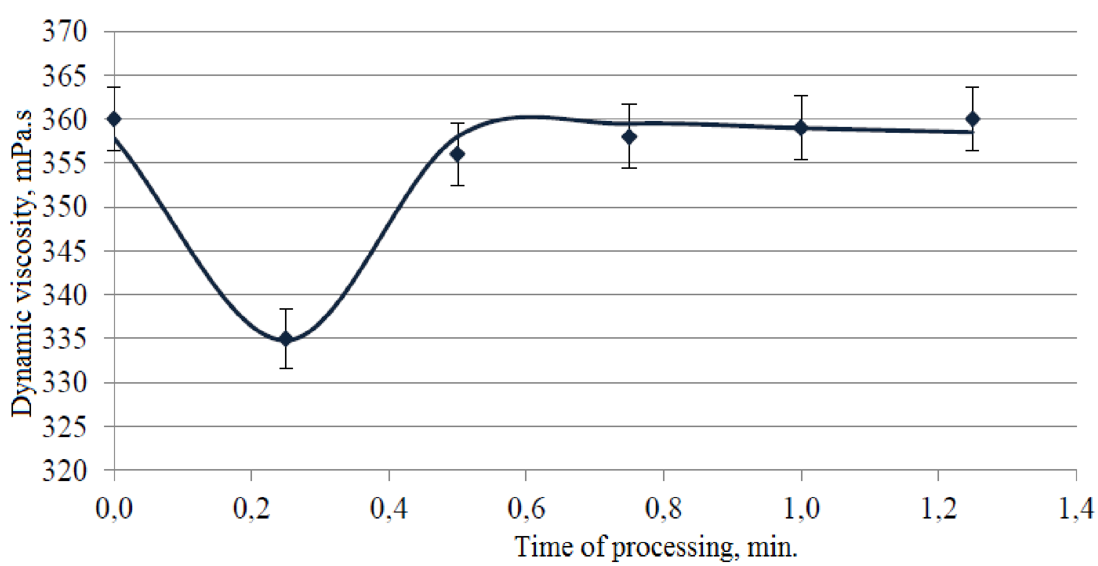

Figure 4. Change of dynamic viscosity of crude oil of the field Ashchisay in dependence on test processing time

3. 1. Results

Results of a series of experiments on selection of reagent and its concentration are given in the histogram (Fig. 7). The best results have been received at introduction to butylacetate crude oil. So, introduction of 2% of masses. butylacetate has allowed to reduce viscosity of oil by 29%. The subsequent in 24, 48 and 72 hours have shown that growth of viscosity of oil after introduction of reagent doesn't exceed 10-12%, figure 5 shows.

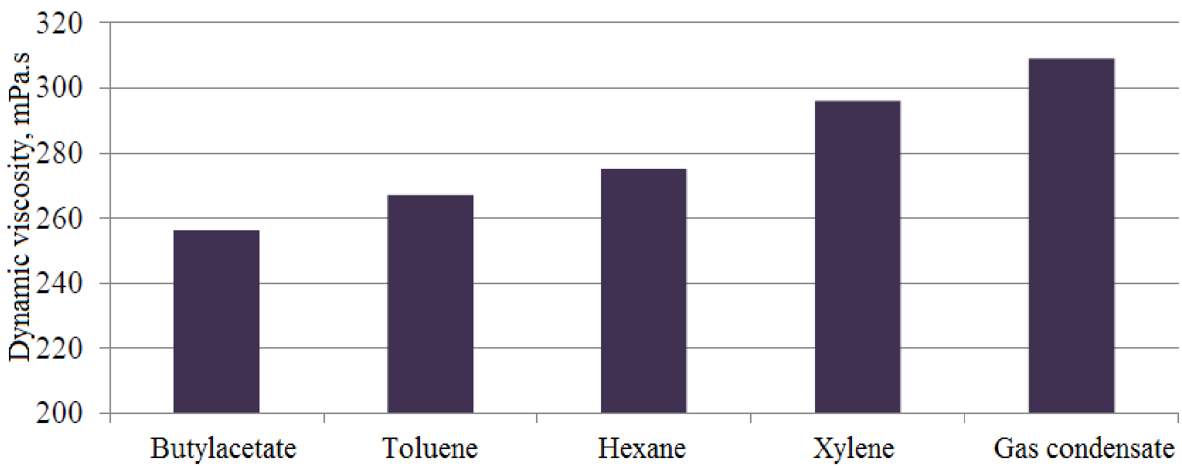

Figure 5. Change of dynamic viscosity of oil of the field Bulla-deniz after introduction of 2% of mas reagent

Further a series of experiments by definition of effect of complex processing of oil of the field Bulla-deniz by reagent and cavitation with use of the parameters of processing received in the previous series of experiment has been, carried out, Figure 5 shows.

Experiments have shown that complex influence of reagent and cavitation considerably reduces viscosity of oil of the field Bulla-deniz in comparison with influence only of reagent. The additional effect of decrease in viscosity due to cavitational processing has made 17-19%. The best result at complex influence was shown by a series of experiments with butylacetate. So, at introduction of 2% of masses. butylacetate and oil processing, viscosity has decreased by 42% Figure 6 shows.

The subsequent measurements of viscosity of samples in 24, 48 and 72 hours have shown that growth of value of viscosity after complex processing is characteristic of field crude oil Shikbagi. Depending on the applied reagent dynamic viscosity of crude oil has increased for 11-20%.

Thus, experiments have shown that field Bulla-deniz oil, unlike field oil Shikbagi, keeps the rheological properties after complex processing better.

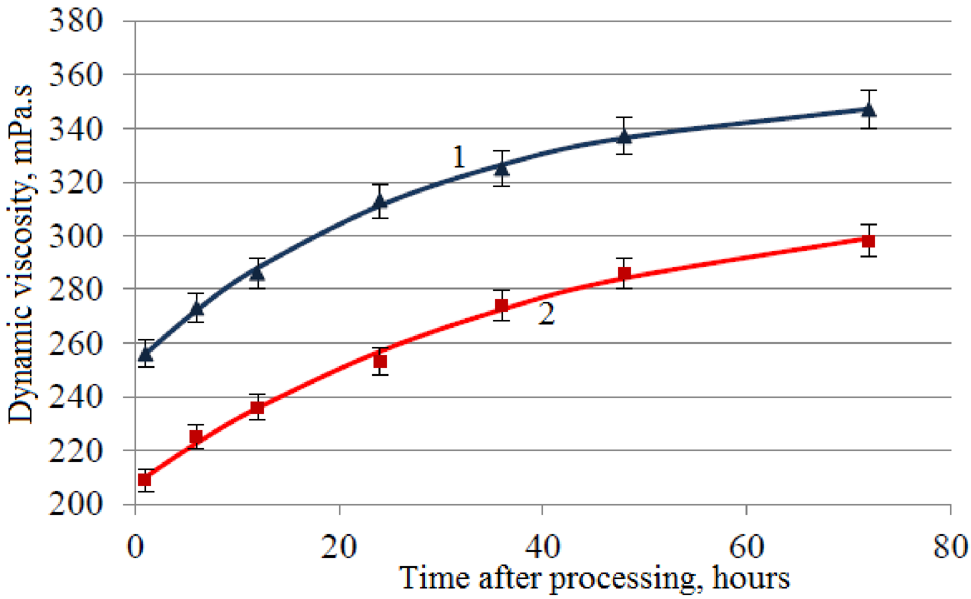

Figure 6. Change of dynamic viscosity of oil of the field Bulla-deniz from a test storage time after introduction of 2% of masses. butylacetate and hashing: 1 – without cavitational processing; 2 – after cavitational processing

Results of experiments on complex processing of crude oil of the field Shirvan reagent and cavitation have shown that this crude oil, unlike paraffinic crude oil fields Bulla deniz and Shikbagi is more weakly subject to impact of cavitation. The additional effect of decrease in viscosity due to cavitational processing has made 2-3% in comparison with influence of reagent, Figure 7 shows.

On the basis, of the made experiments the following regularities have been revealed: cavitational processing influences rheological characteristics of oil differently, depending on intensity and duration of influence. The greatest effect of decrease in viscosity of oil is, gained at intensity of processing. Paraffinic oil are better subject to processing, than resinous. The greatest effect of introduction of reagent is, gained at introduction of a xylene, toluene and butylacetate. Viscosity of oil decreases at increase in a dosage of reagent. The relaxation of properties after complex processing is characteristic of oil.

3. 2. Results analysis

On the basis, of the made supervision and studying of nature of impact of cavitation on oil, it is possible to draw a conclusion that cavitation leads to destruction of paraffin and supramolecular structures of oil (associates, micelles) and to reduction of their, size that promotes decrease in viscosity.

But eventually, the shattered particles reestablish intermolecular communication that leads to restoration of dynamic viscosity of crude oil.

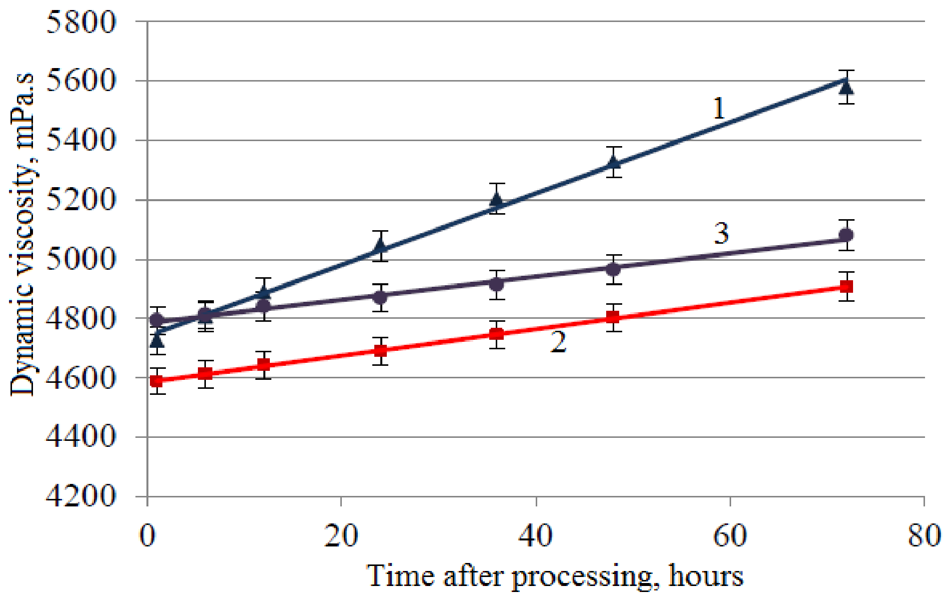

Figure 7. Change of dynamic viscosity of oil of the field Shirvan from a test storage time after introduction of 2% of mass. butylacetate and hashing: 1 – without cavitational processing; 2 – after cavitational processing within 1 min.; 3 – after cavitational processing within 3 min.

3. 3. Chance of qualiy indicators of cargo crude oil in cavitation zone

The steady tendency was observed recently to increase in crude oil production and transportation of so-called abnormal oils with the high paraffin content and high set point and, accordingly, abnormal flow properties and consistency curves which disobey Newton's law under normal conditions. High-paraffin crude oil pumping through long-distance pipelines and their transportation in tanks, in tankers is complicated, due to their abnormal viscosity and static shear stress under the ambient temperatures as well as due to asphaltene-resin-paraffin deposits which they form on the internal surface of pipes, tanks, tankers and other equipment.

The results of an experimental research of oil viscosity fluctuation under the cavitation are of significant interest. Cavitation - is fracturing of liquid continuity as a result of local pressure decay. The cavitation effect is accompanied by micro explosions, ultrasound, as well as mechanical cuts and impacts under the effect of hundreds of the cutting pairs moving towards each other with high linear speed. The rate of speed is several tens of meters per second that gives the chance to cut dispersible agents on the smallest micro particles (Nesterenko and Berlizov 2007; Sawarkar et al. 2009; Tomita and Shima 1986).

Oil does not possess the viscosity following the laws of Newton, Poiseuille, and Stokes as the long randomly located molecules of paraffin and resin form some flexible lattice where the solution is placed. Therefore the system resists to shear forces. Cavitation breaks off a continuous chain, destroying connections between separate parts of molecules. These connections are comparatively small; therefore insignificant influence of acoustic waves is required. The research analysis shows, that under long-term big intensity cavitation C-C connections in paraffin molecules break which leads to changes of physical and chemical structure, reduction of molecular weight and crystallization temperature. During cavitation process the energy released at implosion of cavitation bubbles, is used for bond opening between atoms of the big molecules of hydrocarbon compounds. Dissociation energy of connections widely changes in hydrocarbons, approximately from 40 up to 400 kJ/mol. Bonding strengths of C-C-H is less, than C-H, the hydrogen atom is easier tea red off in the middle of a molecule of normal paraffin, than from the end. Energy of C-C connections rupture in molecules of nor-mal paraffin also decreases to the middle of a carbon chain; long hydrocarbonic molecules automatically break off in the center (Vichare et al. 2000).

Our researches have shown that cavitation zones improve rheology of the Azerbaijan crude oil. Results of an experimental research are shown in the table 2. Experiments were spent on the device of the cavitation affecting installed on a line of the pipeline which is the hollow cylindrical case of a variable section which are switching on a smooth contraction, providing origination of cavitation.

The working part of a water tunnel serves for reception of high speeds of a stream at which pressure drops to value of pressure of saturated steams. Cavitation here originates as on the examinee the sample placed in this part of a pipe, and on walls of the pipe. Essential advantage of the given method in comparison with others is that condition that here we deal with a true hydrodynamic cavitation. Irreversible change of viscosity, saturated vapor pressure, iodine value, fractional structure and oil density takes place in one pass through cavitation zones. As a result of cavitation oil undergoes a process of micro cracking, it destructs molecules. For studying micro cracking process, we realized oil distillation under atmospheric conditions. Apparently from the table the initial boiling point in the received light fractions decreases, the volume percent at 350 °C fractions raises.

The increase in iodine number in these fractions proves that under the cavitation oil undergoes the process of micro cracking. The share of paraffin hydrocarbons, and share resinous decreases and aspaltens hydrocarbons increases. Thus, if the mass fraction of paraffin hydrocarbons in a stream as it is known, it is not so dependent on a share resinous decreases and aspaltens hydrocarbons the quantity aspaltens-rezins-paraffins adjournment decreases. Without looking change of parametres of oil, its elementary composition not change. This is given by the grounds, at a hydrodynamic cavitation in oil there are phase transformations. At phase the transformation, each phase separates from competitive a boundary at which intersection chemical and physical characteristics of oil fractions almost instantly change. Change of such factors by cavitation application at a pipeline transport is one of ways of struggle with, aspaltens-rezins-paraffins adjournment. The basic deficiency of this device is intensive cavitation deterioration of its working surfaces oscillating cavitation vials, which bulk occurrence on these surfaces.

The working part of a water tunnel serves for reception of high speeds of a stream. However erosion begins in 16-24 hour after the beginning of tests, and speed of a stream is necessary for its origination above 40 km/s. After cavitation zones in pipes there is a water hammer. On the basis of the made observations and studying of character of affecting of cavitation on oil, it is possible to draw a leading-out that cavitation leads to destruction of parrafins and on the molecular oil structures, assosits, misels and to decrease of their size that promotes viscosity decrease. But eventually, the shattered corpuscles rebuild intermolecular links that leads to restoration of dynamic viscosity of oil.

Table 2. Resulted in oil property change in cavitation zone.

№	Test (name and detals)	Before suppos. cavitat. zone.	After the suppose. cavit. zone. 1-th day	After the supposed cavit. zone. 5-th day	After the supposed cavit. zone. 10-th day	Method
1	Density: 20 °C – də, kq/m^3	863,2	862,6	862,2	861,8	ASTM D1298
2	APİ Gravity, ^{0}APİ	29,92	30, 14	30, 23	30,30	ASTM D1250
3	Sulphur, %-mass	0,213	0,213	0,212	0,212	ASTM D4294
4	Water, %- mass	0,12	0,12	0,10	0,10	ASTM D4006
5	Kinematic viscosity, cSt 0 °C-də 10 °C-də 20 °C-də 30 °C-də 40 °C-də 50 °C-də	 - - 78,55 42,26 31,75 24,52	 98,43 86,75 54,53 39,97 28,46 23,39	 95,86 85,78 54,14 38,75 26,17 22,98	 94,27 85,56 53,75 38,23 24,42 22,19	ASTM D445
6	Reid vapour pressure, Kpa	24,3	26,1	27,5	28,6	ASTM D323
7	Pour point, °C	+3	0	0	-3	ASTM D5853
8	Sediment by extraction, % - mass	0,0086	0,0079	0,0071	0,0058	ASTM D473
9	Conradon carbon residue? In residual > 260 °C-, % - mass	3,45	3,27	3,14	3,09	ASTM D189
10	Merkaptan sulphur, ppm	14,0	13,0	13,0	12,0	UOP 163
11	Hydrogen sulphide, ppm	nil	nil	nil	nil	UOP 163
12	Chlorine in crude oil, ppm	1,7	1,5	1,5	1,4	ASTM D4929
13	Chlorine in fr. 204 °C, ppm	7,2	6,8	6,5	6,2	ASTM D4929
14	Total nitrogen, ppm	1134	1123	1114	1112	ASTM D4629
15	Salts, mq/l	34,9	30,7	28,9	25,3	ASTM D3230
16	Asid number, mq KOH/q	0,12	0,12	0,11	0,10	GOST 5985
17	Ash content, % - mass	0,014	0,012	0,011	0,010	ASTM D482
18	Asphalthenes, % - mass	0,27	0,26	0,26	0,25	İP 143

19	Wax content, % - mass	6,59	6,12	5,94	5,43	BP 237/76
20	Brome (Iodine) num. gr. of brome (iodine) in 100 gr. frac. 360 °C, q/100gr	2,6	2,9	3,1	3,2	ASTM D1159/1160
21	Vannadium, ppm	3,4	3,1	2,9	2,9	ASTM D 5708
22	Nickel, ppm	2,7	2,5	2,3	2,2	ASTM D 5708
23	Iron, ppm	5,6	5,7	5,5	5,4	ASTM D 5708
24	Arsenic, ppm	10,4	10, 3	10,1	10,1	ASTM D 5708
25	Copper, ppm	1,1	1,0	1,0	0,8	ASTM D 5708
26	Lead, ppm	1,5	1,4	1,3	1,2	ASTM D 5708
27	Sodium, ppm	13,5	13,2	13,0	12,8	ASTM D 5708
28	Silicon, ppm	18,8	18,6	18,5	18,4	ASTM D 5708
29	Aluminum, ppm	2,8	2,6	2,5	2,4	ASTM D 5708
30	Cadmium, ppb	32,6	31,8	31,5	30,6	ASTM D 5708
31	Mercury, ppb	43,9	42,5	41,8	41,3	ASTM D 5708
32	Molecular weight, q/Mol	321,35	318,45	316,28	315,83	ASTM D2502
33	Characterization factor, SU	11,26	11,38	11,52	11,84	UOP 375
34	Distillation (at 101,5 kPa), °C Initial boiling point 10 % - distilled at 15 % - distilled at 20 % - distilled at 25 % - distilled at 30 % - distilled at 35 % - distilled at 40 % - distilled at 45 % - distilled at 50 % - distilled at 55 % - distilled at 60 % - distilled at 65 % - distilled at 70 % - distilled at 75 % - distilled at 80 % - distilled at 85 % - distilled at Final recovered, % v/v	 61 158 164 172 189 198 215 243 287 325 352 369 371 375 378 381 383 385	 59 141 160 169 187 195 211 233 281 321 348 368 369 375 378 381 383 385	 57 138 158 165 182 193 209 231 278 319 344 366 368 374 378 381 383 385	 55 131 155 161 180 191 207 229 275 315 341 365 367 374 378 381 383 385	GOST 2177

4. CONCLUSION

On the basis of the made supervision and studying of nature of impact of cavitation on oil, it is possible to draw a conclusion that cavitation leads to destruction of paraffin and supramolecular structures of oil (associates, micelles) and to reduction of their size that promotes decrease in viscosity. But eventually, the shattered particles reestablish intermolecular communication that leads to restoration of dynamic viscosity of crude oil.

Introduction of reagent changes molecular mobility of group components of the oil disperse systems (ODS) and leads to decrease in viscosity and aggregate stability of the ODS.

At complex influence, cavitation allows reagent to influence more effectively group components of oil due to reduction of their size and increase in the area of contact. Reagent interferes with restoration of intermolecular communications and formation of supramolecular educations in oil after processing at the expense of what the bigger effect of decrease in viscosity is reached.

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