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EDUCATION MECHANISMS CAVITATIONAL ZONES BY MENAS OF ASPHALTHEN- PITCH -WAX DEPOSITS ON A SURFACE TO A PIPELINES

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ABSTRACT
In work the major factors influencing on are listed formation of APWD. The special attention is paid to a group chemical composition of initial raw materials and mutual influence of separate high-molecular components of oil on structurization in oil system at low temperatures. Influence of structural and group composition of oil on the formation mechanism, structure and APWD properties is shown. Ours, researches show that, cavitation can happen not only in pumps, water-wheels and depends on physical and chemical and rheological properties of mixes high-paraffinic, asphaltic, high-stiffening the crude oil. Such oil form cavitational zones in pipeline transport, in use oil pipelines. formations, structure and APWD properties. Cavitational zones form APWD it is on an internal surface of a pipe. The working part of a hydrodynamic pipe serves for obtaining high speeds of a stream. Cavitation arises as on the examinee the sample placed in this part of a pipe and on walls of the pipe. In article the general information about cavitation is resulted and at present and conditions known at present and consequences of its occurrence, as hydraulic phenomenon are listed.

KEYWORDS— cavitation, vapor pressure, wax, oil transport, brome number, crude oil.

INTRODUCTION
In practice of operation of wells meet various complications caused by wax deposits, carrying out of sand and formation of sandy traffic jams, adjournment of mineral salts on a well face in lifting pipes, in the land and underground equipment, etc. As shown above the greatest percent of equipment failures is caused by adjournment of the asphalthen - pitch -wax substances (APWS). The asphalthen - pitch -wax deposits (APWD) are formed generally by paraffin, pitches and asphalthen which in the conditions of layer are kolloids dissolved in oil. equipment, etc. Intensity of formation of APWD in system of transport, collecting and preparation of oil is influenced by a number of factors, basic of which are:

- pressure decrease in the field of a face and the violation connected with it hidro- dynamic balance of gas-liquid system;
- intensive gas emission;
- reduction of temperature in layer and a trunk of a well;
- change of speed of the movement of gas-liquid mix and its separate components;
- composition of hydrocarbons in each phase of mix;
- ratio of volumes of phases (oil-water).

In a bottom hole zone of layer the listed factors change continuously from the periphery to the central region in a well, and in the well from a face to the mouth therefore the quantity and nature of deposits aren't constants. The place of allocation of APWD can be at various depth and depends on a well operating mode. Among the conditions promoting formation of deposits it is possible to call pressure decrease and temperatures, and also an oil the gasification. Except the specified major factors water content of production and size pH reservoir waters can have impact on intensity of a waxing of pipelines at transportation of the flooded production of wells. And influence of these factors ambiguously and can be various for different fields [1-3].

APWD isn't simple mix of asphalthen, pitches and paraffin, and represent the difficult structured system with a pronounced kernel from asphalthen and sorption salty a layer from oil pitches. The pitches which are a part of APP are presented first of all by the neutral pitches emitted by means of silica gel and chloroform (four-chloride carbon). These are semi-fluid, sometimes semi-firm dark brown or black color of substance. The relative density of pitches is from 0,99 to 1,08 g/cm^3. The molecular mass of pitches can reach 1200. They are well dissolved in all oil products and organic solvents, except for ethyl and methyl alcohols. On average pitches contain to 15-17% of oxygen, sulfur, nitrogen. With increase of molecular mass of pitches the content of oxygen, sulfur and nitrogen decreases. A basis of structure of molecules of pitches is the flat condensed polycarbocyclic grid consisting mainly of benzene rings. This structural grid can contain naphthenic and heterocyclic rings (five and six-membered). The peripheral part of the condensed system of APWD pitches is replaced on hydrocarbonic radicals (aliphatic, cyclic and mixed). The nature and number of these deputies strongly depends on properties of oil. Deputies can include functional groups (-IT, - SH, - NH2, =SO, etc.). When heating to 260-350 °C of pitch start being condensed and turn into asphalthen. With increase of concentration in pitch solution, on the one hand, slow down growth of crystals, and with another, – promote deformation of a surface of crystals and emergence on them the new centers of crystallization. Extent of manifestation of this or that tendency is defined by the nature of pitches and causes the corresponding form and the size of crystals of solid hydrocarbons. On modern representations of an asphalthen are the polycyclic aromatic strongly condensed structures with short aliphatic chains in the form of dark-brown amorphous powders. Density of asphalthen is slightly more than unit. In the asphalthens contains (% of masses.): 80... 86% of carbon, 7... 9% of hydrogen, to 9% of sulfur and oxygen, and to 1,5% of nitrogen. Asphalthen don't crystallize and can't be divided into individual components or narrow fractions. When heating higher than 300-400 ^{0}C they don't melt, and decay, forming carbon and flying products. Asphalthen are considered as products of consolidation of pitches. Accumulation of APWD in flowing part of the oil-field equipment and on an internal surface of pipes leads to decline in production of system, reduction of work of wells and overall performance of pump installations. APWD represent the difficult hydrocarbonic mix consisting of wax (20-70% mas.), AWS (20-40% mas.) silikogels pitch, oils, water and mechanical impurity.

MATERIALS AND METHODS

Wax - hydrocarbons of a methane row from $C_{16}H_{34}$ to $C_{64}H1_{30}$. In sheeted conditions are in oil in the dissolved state [4, 5]. At oil production of one of the problems causing complications in work of wells, the oil-field equipment and pipeline communications APPD (fig. 1, 2) are. Depending on the content of paraffin of oil classify on GOST 912-66: the low-wax - less than 1,5% mas, paraffin - from 1,5 to 6% Mas, high-wax - more than 6% mas.

The mechanism of a waxtion is understood as set of the processes leading to accumulation of a firm organic phase on an equipment surface.

Thus, formation of deposits can happen or due to coupling with a surface of already ready, formed in a stream particles of a firm phase, or due to emergence and growth of crystals directly on a surface of the equipment [6-9]. But at all possible variety of structures for all deposits it is established that the contents in them asphaltic and paraffin components will be the return: the more in ASWD the share of asphaltic substances, the less will contain paraffin that in turn will be defined by their ratio in oil. Such feature is caused by nature of mutual influence of the paraffin, pitches and asphalthen which are in oil until their allocation in deposits. As showed pilot and practical studies before paraffin is emitted for surfaces of the borehole equipment, its crystals make transformation of the structures so that, connecting among themselves, will organize a continuous lattice like a wide tape. 5% and above), their depressor action affects.

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Figure 1. APWD causing complications in work of wells.

Figure 2. Complications of APWD of pipeline communications.

Asphalthen can act as the germinal centers. Paraffin molecules participate in a sokristallization with alkilny chains of asphalthen forming dot structure.

That is formation of a continuous lattice doesn't happen. As a result of such process wax is redistributed between a set of the small centers and release of wax on a surface is significantly weakened.

Pitches, owing to the structure, on the contrary, promote creation of conditions for formation of tape units of paraffin crystals and to their sticking to a surface and the presence interfere with impact of asphalthen on wax, neutralizing them. As well as asphalthenes, pitches influence the size of temperature of saturation by oil paraffin, however nature of this influence the opposite: with growth of their mass content in oil temperature of saturation increases (if, for example, to increase presence of pitches with 12 to 32%, temperature of saturation will increase from 22 ^{0}C to 43 ^{0}C). Oil saturation temperature wax is in direct dependence on mass concentration of pitches and in the return from concentration of asphalthen [10-12].

Thus the steady tendency to increase in volumes of production and transportation so-called abnormal crude oils with the high content of paraffin which have high temperatures of hardening and, respectively, abnormal rheological properties was outlined recently, curve currents of oil don't submit to the law of Newton in normal conditions.

Transfer high-paraffinic crude oils on the main oil pipelines and their transportation in tanks, in tankers is complicated as at ambient temperatures they possess abnormal viscosity and a static stress of shift, and are also inclined to formation the APWD of deposits on an internal surface of pipes, tanks, tanks and other equipment. Thus, for the solution of a task of increase in volume of transfer high-viscosity, high-paraffinic development new and optimization of the applied technologies of transportation crude oils taking into account their rheological properties and operational characteristics of oil pipelines is necessary for the crude oils. The great interest is represented by results of a pilot study of change of viscosity of oil with cavitation application. Cavitation arises in cranes, gates, latches, jets, pumps and water-wheels, reducing thus their efficiency, and at long impact of cavitation there is a destruction of the details subject to vibration. The device of cavitational influence containing the hollow cylindrical case of variable section including the smooth narrowing providing cavitation emergence in the line of the pipeline is offered. The cavitational bubbles possessing the high speed at the expense of what there is a decrease in viscosity of oil act as high-amplitude fluctuations in liquid [13,14].

RESULTS AND DISCUSSION

Ours, researches show that, cavitation can happen not only in pumps, water-wheels and depends on physical and chemical and rheological properties of mixes high-wax, asphaltic, high-stiffening the crude oils. Such oil form cavitational zones in pipeline transport, in use oil pipelines. Cavitational zones form APWD on an internal surface of a pipe. The working part of a hydrodynamic pipe serves for obtaining high speeds of a stream. Cavitation arises as on the examinee the sample placed in this part of a pipe and on walls of the pipe. Essential advantage of this method in comparison with others is that circumstance that here we deal with true hydrodynamic cavitation. We conducted pilot studies showed that, rheological properties of the Azerbaijani oil improve. Results of a pilot study are shown in the table. Release of paraffin not in itself, but their adjournment on a pipe surface in the direction of a heat transfer is almost important. Such deposits are formed at observance of a number of conditions: existence in oil of high-molecular hydrocarbons, first of all methane row; decrease in temperature of a stream to values at which there is a loss of a firm phase; existence of a substrate with the lowered temperature, on which hydrocarbons and to which they are so strongly linked crystallize that possibility of failure of deposits is practically excluded by a stream at the set technological mode. By researches it is authentically established that direct link between the content of paraffin and intensity of its adjournment isn't present. Lack of such communication is caused, first of all, by essential distinction of composition of solid hydrocarbons of wax, namely, distinction in ratios of aromatic, naphthenic and methane connections in high-

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Table 1. Results of oil property change in cavitation zone

№	Test (name and detals)	Before supposed cavitation zone.	After the supposed cavitation zone.	Method
1	Density: 20°C – də, kq/m^3 15°C – də, kq/m^3 Spesific gravity 60/60 ^{0}F	876,1 872,7 876,6	870,1 868,4 871,9	ASTM D1298
2	APİ Gravity, ^{0}APİ	29,92	38, 84	ASTM D1250
3	Sulphur , %-mass	0,238	0,176	ASTM D4294
4	water, %- mass	0,24	0,15	ASTM D4006
5	Kinematic viscosity, cSt 0 ^{0}C-də 10 ^{0}C-də 20 ^{0}C-də 30 ^{0}C-də 40 ^{0}C-də 50 ^{0}C-də	 - 59,48 33,55 21,62 13,68 10,12	 68,76 27,34 12,89 6,34 3,87 2,65	ASTM D445
6	Reid vapour pressure, Kpa	14,6	23,8	ASTM D323
7	Pour point, ^{0}C	-6	-12	ASTM D5853
8	Sediment by extraction, %- mass	0,0095	0,0124	ASTM D473
9	Conradon carbon residue? In residual > 260 ^{0}C-, %- mass	4,32	3,68	ASTM D189
10	Merkaptan sulphur, ppm	14,0	11,0	UOP 163
11	Hydrogen sulphide, ppm	nil	nil	UOP 163
12	Chlorine in crude oil, ppm	2,3	1,8	ASTM D4929
13	Chlorine in fr. 204 ^{0}C, ppm	9,3	7,6	ASTM D4929
14	Total nitrogen, ppm	1225	1195	ASTM D4629
15	Salts, mq/l	54,6	48,5	ASTM D3230
16	Asid number, mq KOH/q	0,16	0,11	GOST 5985
17	Ash content, %-mass	0,015	0,008	ASTM D482
18	Asphalthenes, %-mass	0,30	0,18	İP 143
19	Wax content, %-mass	8,12	5,43	BP 237/76
20	Brome (Iodine) num. gr. of brome (iodine) in 100 gr. frac. 360 ^{0}C, q/100gr	3,7	4,8	ASTM D1159/1160
21	Vannadium, ppm	7,2	6,9	ASTM D 5708
22	Nickel, ppm	3,8	3,5	ASTM D 5708
23	Iron, ppm	5,1	5,3	ASTM D 5708
24	Arsenic, ppm	12,2	12, 4	ASTM D 5708
25	Copper, ppm	1,6	1,3	ASTM D 5708
26	Lead, ppm	2,2	1,9	ASTM D 5708
27	Sodium, ppm	12,4	11,9	ASTM D 5708
28	Silicon, ppm	20,2	19,4	ASTM D 5708
29	Aluminum, ppm	3,3	3,1	ASTM D 5708
30	Cadmium, ppb	58,2	57,9	ASTM D 5708
31	Mercury, ppb	68,4	69,2	ASTM D 5708
32	Molecular weight, q/Mol	360,18	290,76	ASTM D2502
33	Characterization factor, SU	12,17	13,49	UOP 375
34	Distillation (at 101,5 kPa), ^{0}C Initial boiling point	 80	 53	GOST 2177

	10 % - distilled at	163	125	
	20 % - distilled at	230	171	
	30 % - distilled at	272	204	
	40 % - distilled at	308	233	
	50 % - distilled at	347	278	
	80 % - distilled at	376	343	
	Final recovered, % v/v	81,0	89,5	

molecular part of hydrocarbons which at standard methods of research of the crude oil isn't defined.

Meanwhile, it is proved what exactly distinctions as a part of solid hydrocarbons in the basic and predetermine features of formation of paraffin deposits. The content of hydrocarbons with branched structures aromatic is higher, naphthenic and the izoalkans, the wax deposits as connections of this kind possess the increased ability to keep crystal educations liquid weight appear less strong. Hydrocarbons of a metane row, especially high-molecular wax, on the contrary, are easily emitted from solution with formation of dense structures. It is clear, that friable and semi-fluid crystal deposits rather easily can be removed with a natural stream of liquid in use of a pipeline, without causing any complications, and, on the contrary, the dense and strong deposits created generally from n-alkanes create serious complications for which elimination many means and work are spent. With increase in productivity the speed of loss of rainfall also increases, and with the lowest productivity of the oil pipeline with an expense of 200 m^3/h, in 200 days rainfall appears almost imperceptibly.

With an the decline of density of strong substance this time interval grows. Irreversible change of viscosity, pressure of saturated steam, wax hydrocarbons, asphalthen of hydrocarbons, resinous hydrocarbons after pass through a zone cavitations for once. Cavitations in oil are resulted by microcracking process, it is led up in molecules by destruction. For specification process of a mikrokreging, from our party of a sdelen distillation of oil at atmospheric conditions and as a result received light fractions. Increase in brome (iodic) number in these fractions are proved that, at cavitations in oil there is a process of a mikrokreging.

CONCLUSION

Experiments showed that after cavitation processes dynamic viscosity of the Azerbaijan oil decreases on 9 %. For oil restoration of initial value of viscosity within 72 hours after processes is characteristic.

Change of such factors during pipeline transportation presents a problem for commodity operations Regardless improvement in oil flow properties the long term process leads to the increase of emergency in pipeline systems. It follows that, on the basis of cavitation processes it is possible to establish the general laws of regulation of physical and chemical properties of oil, to use high-wax crude oils in pipeline transport technology through improvement flow properties of pumped oil.

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Recently the steady tendency to magnification of bulks of haul, oil and oil products was outlined. 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 oil and oil products taking into account their rheological behavior and operating characteristics of pipe lines are indispensable.

Vapor pressure testing is an important safety check in the transport, storage and blending of crude oil. In article the general information about cavitation is resulted and at present and conditions known at present and consequences of its occurrence, as hydraulic phenomenon are listed. It is noticed, that despite negative influence cavitation the phenomena can be used it for the useful purposes.

Under laboratory conditions were analysis physical - chemical features oils Azerbaijan with small content wax on borders cavitation the zones which results are resulted in the table. The carried out researches show that having applied cavitation technologies to oils and to mineral oils, it is possible to improve them rheological characteristics and

quality indicators. On the basis of the resulted facts, perspectives of application cavitation technologies affirms at transport and oil refining.

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