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ARTICLE

STUDY OF ASPHALTENE SUBSTANCES TO DETERMINE THE OPTIMAL METHOD OF DEALING WITH DEFERRED

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ABSTRACT

In the work, a comparative analysis of asphaltene substances deposits (ASP-B) from pipelines of two oil enterprises was carried out. The similarity of the group components of the ASP-B data is revealed. To determine the optimal method for controlling sediments, a classification was made and the most effective solvent was selected. 3 deposits ASP-B (PJSC Tatneft) belong to the paraffin type, therefore, the most effective solvent will be solvents on a paraffinic, naphthenic or unsaturated basis. Since the main mass of the deposit is paraffin hydrocarbons, the removal of these deposits will be more effective when dissolving the paraffinic part of the sediments. 2 deposits of ASP-B (JSC Tatnefteprom-Zyuzeyevneft) belong to the asphaltene type. For ASP-B asphaltene type, the most effective solvent is an aromatic solvent. These solvents have a good dissolving power with respect to asphalt-resinous substances. The solutions of each component of the sediments were analyzed by the conductometric method of dispersion analysis with the help of the particle size analyzer Coulter Counter in order to determine the particle size, the comparative evaluation of the sizes and ratios in sediments of various oils. It has been revealed that in the investigated sediments, despite the different origin and differences in the group composition, the components of the ASP-B do not differ in their characteristics from each other, the group components have a similar molecular mass and structure.

KEY WORDS
asphalt and resin paraffin substances, particle size, conductometric method, chromatography, group composition.

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INTRODUCTION

The problems associated with oil transportation occupy an equal position with the problems of oil preparation. When transporting highly paraffinic oils, the problem of occurrence of deposits of asphalt-resin-paraffin (ASP-B) is sharply raised [1]. The occurrence of these deposits leads to a sharp deterioration in the conditions for the transport of oil, a reduction in capacity, an increase in the hydraulic resistance of the pipeline, the loss of the most valuable components of oil entering the composition of ASP-B [2]

Problems of ASP-B are a rather complex structure. A lot of factors influence the formation of ASP-B and its formation, and the process of deposition is possible both in the bottomhole formation zone [3] and in the pipeline of prepared oil [4-5].

Currently, a fairly wide range of methods and means of disposal, preventing the formation of ASP-B is applied. A huge amount of reagents, solvents with excellent performance indicators was developed. But this is not the limit. The problem in this area is the lack of empirical dependencies between the physic-chemical characteristics of oil and the choice of the most effective method of preventing deposits. At the moment, the selection of reagents and the choice of the method of protection is determined in a practical way in the laboratory, which complicates and narrows the possible choice of means of influencing oil [5-7].

The purpose of this work is to determine the group composition of ASP-B, to study solutions of group components of ASP-B, and to make a comparative analysis of the data obtained. Which, in turn, can be the initial data for modeling the processes of formation and prevention of ASP-B.

METHODS

Determination of particle size of oil dispersed systems was carried out by conductometric method using the Coulter Counter analyzer of the TA-II model of IDF Production (UK) [8]. The determination of dispersity by the conductometric method is based on measuring the electrical resistance at the moment when the particles pass through the calibrated micro-holes [8].

To determine the particle size of the disperse system, working apertures (tubes) of different diameters were used, the working volume of the sample was 0.5 ml.

The determination of the composition of ASP-B was carried out by liquid chromatography. The technique is based on the different solubility of the components of ASP-B in various solvents and their different sorption capacities for the silica gel.

RESULTS

In the course of the work, 3 samples of ASP-B sediments were examined from the pipelines of NGDU "Zainskneft", NGDU "Nurlatneft". OGPU Pocachevneft PJSC Tatneft and 2 samples of sediments ASP-B of the Zyuzeyevskoye deposit of JSC Tatnefteprom-Zyuzeyevneft. The results of the studies are presented in [Table 1].

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Table 1: Compositions of ASP-B deposits

Sample name	Composition, in %				
	Minerals	Asphaltenes	Resins	Hydrocarbons	Losses and water
Zainskneft	1,32	13,68	12,5	65,57	6,73
Pokachevneft	5,66	3,33	6,92	79,04	5,03
Nurlatneft	0,66	37,2	2,55	55,62	3,97
Zyuzeyevskoye fld., well No. 2321	1,5	5,1	22,5	62,1	6,0
Zyuzeyevskoye fld., well No. 961	8,6	5,5	18,0	62,0	5,8

Based on the data obtained, we classify the type of these deposits, for the convenience of selecting the most effective solvent ASP-B. The results are shown in [Table 2].

Table 2: Classification of ASP-B

Name	P / (C + A)	Content of the impurity mixture	ASP-B Type	Type
Zainskneft	2,47	1,32	Paraffinic	P_3
Pokachevneft	7,71	5,66	Paraffinic	P_3
Nurlatneft	1,4	0,66	Paraffinic	P_3
Zyuzeyevskoye fld., well No. 2321	0,15	0,15	Asphaltene	A_1
Zyuzeyevskoye fld., well No. 961	0,17	0,19	Asphaltene	A_1

As can be seen from [Table 2], the samples of ASP-B deposits of PJSC Tatneft belong to the paraffin type, therefore the most effective solvent for them will be solvents on a paraffinic, naphthenic or unsaturated basis, since the main deposit mass is paraffin hydrocarbons, and the removal process These deposits will be more effective when dissolving the paraffinic part of the sediments.

Samples of deposits ASP-B of JSC Tatnefteprom-Zyuzeyevneft belong to the asphaltene type. For ASP-B asphaltene type, the most effective solvent is an aromatic solvent [9]. These solvents have a good dissolving power with respect to asphalt-resinous substances. The nature of the action of the solvent consists in dissolving the resins, which are the binding agent of paraffin agglomerates and the partial dissolution of asphaltenes, transferring deposits on pipelines into suspended particles that are easily carried away by the flow.

Also in the course of this paper, solutions of each component of deposits were analyzed on a particle size analyzer and particle size analyzer Coulter Counter, in order to determine the particle size and comparative evaluation of sizes, their ratios in sediments of various oils, the results of the studies are presented in [Table 3-7] and [Fig. 1 -3].

Table 3: Particle sizes of ASP-B of NGDU "Zainskneft" PJSC "Tatneft"

Channel range μm	% of the total number of particles		
	Paraffins	Resins	Asphaltenes
1	2	3	4
1,26-1,59	0	0	0
1,59-2	5,6	5,5	6,2
2-2,52	7,1	7,3	7,6
2,52-3,17	5,8	7	6,1
3,17-4,00	7,1	8,2	7,5
4,00-5,04	6,1	5,5	6,1
5,04-6,35	7	6,8	6,8
6,35-8,00	7,1	6,5	6,9
8,00-10,1	4,6	5	4,3
10,1-12,7	8,8	8,6	7,7
12,7-16,0	8,3	8,2	6,9
16,0-20,2	6,9	6,3	5,9
20,2-25,4	6,4	6,6	5,8
25,4-32	6,2	5,8	6,5
32-40,3	5,3	5,3	5,1
40,3-	7,3	7,4	7,9

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Table 4: Particle sizes of ASP-B "Pocachevneft" PJSC "Tatneft"

Channel range µm	% of the total number of particles		
	Paraffins		Paraffins
1,26-1,59	0	0	0
1,59-2,00	6,3	6,1	6,5
2,00-2,52	7,6	7,5	7,6
2,52-3,17	6,1	6,1	6,1
3,17-4,00	7,5	7,5	7,6
4,00-5,04	6,3	6	6,2
5,04-6,35	6,8	6,8	6,9
6,35-8,00	6,8	6,8	6,7
8,00-10,1	4,3	4,3	9,3
10,1-12,7	7,7	7,8	7,7
12,7-16,0	6,8	6,8	6,7
16,0-20,2	5,8	5,8	5,8
20,2-25,4	5,8	5,9	3,5
25,4-32	6,4	6,4	6,6
32-40,3	5	5,2	5,1
40,3-	7,9	8	7,7

Table 5: Particle sizes of ASP-B of NGDU Nurlatneft PJSC Tatneft»

Channel range µm	% of the total number of particles		
	Paraffins		Paraffins
1,26-1,59	0	0	0
1,59-2,00	6,3	6,1	7,2
2,00-2,52	7,6	7,5	7,6
2,52-3,17	6,1	6,1	5,9
3,17-4,00	7,5	7,5	7,2
4,00-5,04	6,3	6	5,9
5,04-6,35	6,8	6,8	6,7
6,35-8,00	6,8	6,8	7,3
8,00-10,1	4,3	4,3	4,2
10,1-12,7	7,7	7,8	7,5
12,7-16,0	6,8	6,8	6,7
16,0-20,2	5,8	5,8	5,2
20,2-25,4	5,8	5,9	5,7
25,4-32	6,4	6,4	6,7
32-40,3	5	5,2	5,2
40,3-	7,9	8	8,7

Table 6: Particle sizes of ASP-B in the Zyuzeyevskoye oilfield well No. 2321. JSC Tatnefteprom-Zyuzeyevneft

Channel range µm	% of the total number of particles		
	Paraffins		Paraffins
1	2	3	4
1,26-1,59	0	0	0
1,59-2,00	6,7	6,9	7,1
2,00-2,52	8,2	7,9	8,7
2,52-3,17	5,9	6,3	6,3
3,17-4,00	7,5	7,7	7,4
4,00-5,04	6,5	6,3	5,8
5,04-6,35	6,7	6,8	6,8
6,35-8,00	7,9	7,7	7,5
8,00-10,1	4,8	4,3	4,3
10,1-12,7	8,1	7,9	7,7
12,7-16,0	7,1	7	6,8
16,0-20,2	5	5,4	5,3
20,2-25,4	5,9	5,8	5,7
25,4-32	5,3	4,3	5,2
32-40,3	4,9	5	5
40,3-	8	7,9	7,8

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Table 7: Particle sizes of ASP-B in the Zyuzeevsky deposit, borehole. No. 961 of JSC Tatnefteprom-Zyuzeyevneft

Channel range μm	% of the total number of particles		
	Paraffins		Paraffins
1	2	3	4
1,26-1,59	0	0	0
1,59-2,00	6,1	6,8	7,6
2,00-2,52	7,5	7,7	8
2,52-3,17	6,1	6,1	6,2
3,17-4,00	7,5	7,5	7,6
4,00-5,04	6,1	6	6,2
5,04-6,35	6,8	6,7	6,8
6,35-8,00	6,9	7,5	7,6
8,00-10,1	4,3	4,2	4,3
10,1-12,7	7,8	7,6	7,7
12,7-16,0	6,9	6,8	6,8
16,0-20,2	5,9	5,3	5,4
20,2-25,4	5,8	5,6	5,8
25,4-32	6,6	5	4,6
32-40,3	5	5	5
40,3-	8,2	7,8	7,9

DISCUSSION

The purpose of this work was a comparative analysis of five different deposits of ASP-B. All deposits were taken from different deposits, therefore, they represented sediments of various oils. As indicated above, these sediments differ in the group composition of the components. And the most interesting task was to reveal the similarity of the group components of some sediments with the group components of others. It was decided to investigate 1% solutions of each component for size and particle size ratio and give a comparative description of the data obtained. In parallel, work was carried out to study the structural and group composition, which, in turn, can confirm or disprove the results of this work.

The particle sizes are represented as the Poisson distribution in [Fig. 1–3].

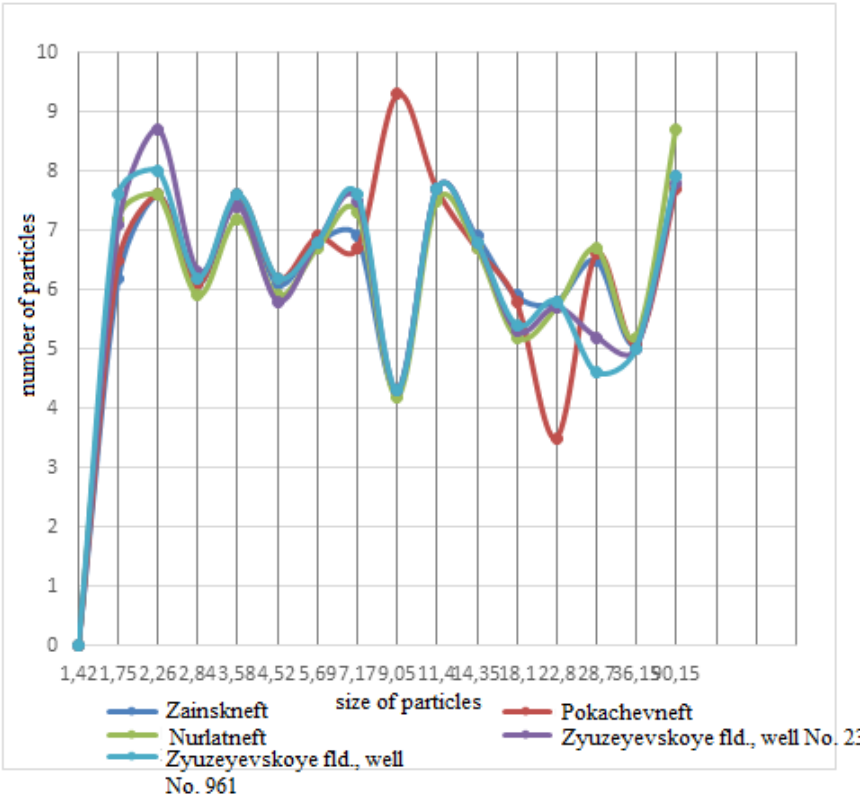

Fig. 1: Poisson distribution of asphaltene particles in a solution of benzene.

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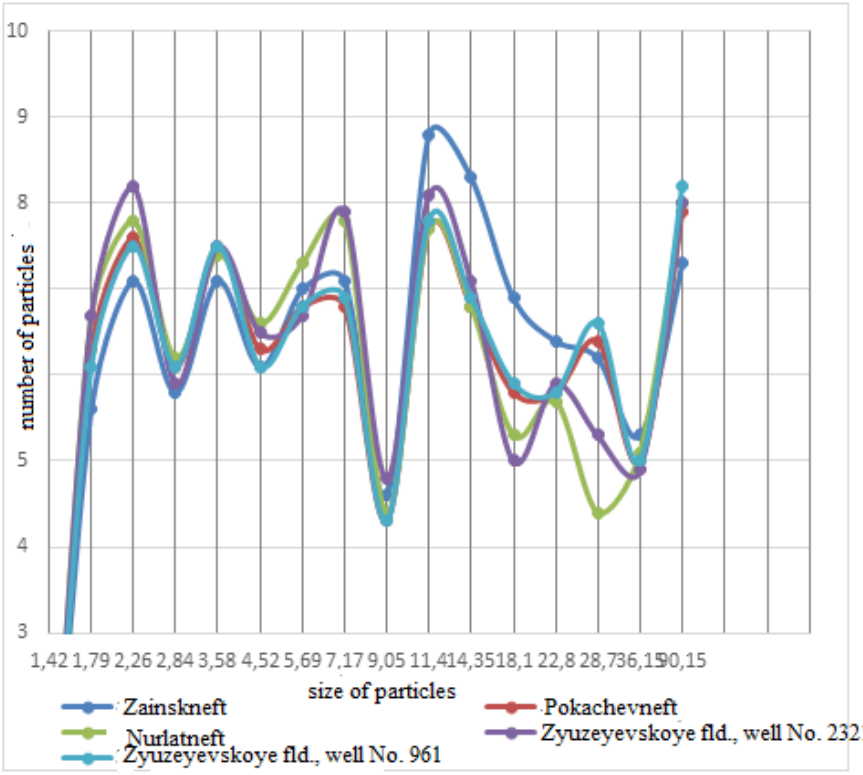

Fig. 2: Poisson distribution of paraffin particles in a solution of hexane.

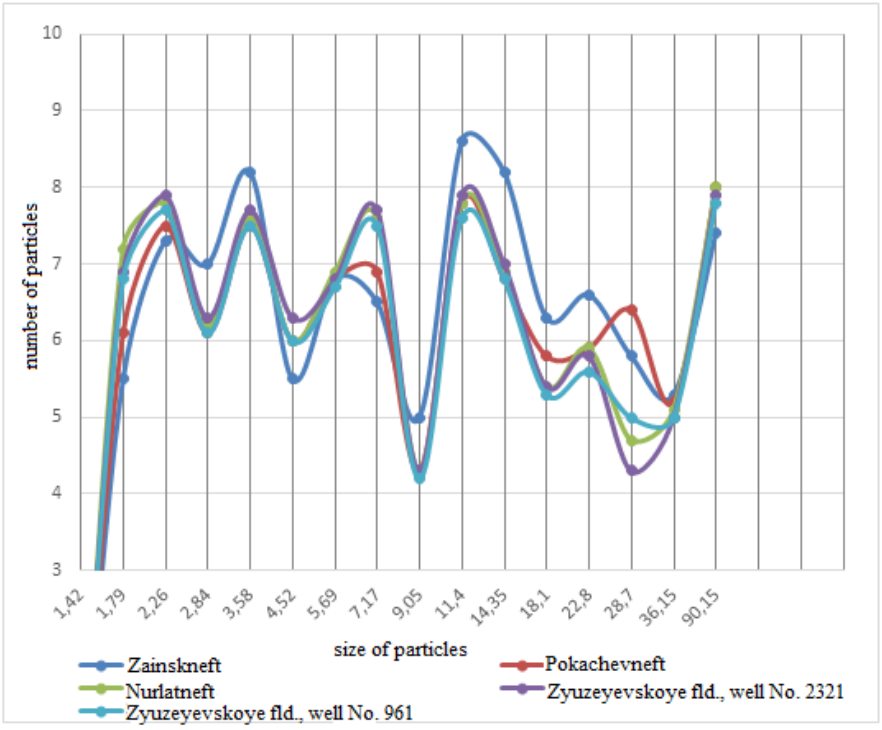

Fig. 3: Poisson distribution of resin particles in a solution of benzene.

As can be seen from the graphs, almost identical repetition of the curves obtained during the analysis of the group components of various ASP-B is observed. In our opinion, this gives the right to preliminarily conclude that in the investigated sediments, despite the different origin and differences in the group composition, the components of the ASP-B do not differ in their characteristics from each other in their characteristics. it is possible to assume that the group components have approximately the same molecular mass and structure [10].

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SUMMARY

In the course of this paper, various ASP-B deposits were analyzed, and the results suggested the similarity of the group components of different ASP-B.

It was revealed that 3 deposits of ASP-B (PJSC Tatneft) belong to the paraffin type, therefore the most effective solvent for these ASP-B will be solvents on a paraffinic, naphthenic or unsaturated basis, since the main deposit mass is paraffin hydrocarbons, and The process of removing these deposits will be more effective when dissolving the paraffinic part of the sediments.

2 deposits of ASP-B (JSC Tatnefteprom-Zyuzeyevneft) belong to the asphaltene type. For ASP-B asphaltene type, the most effective solvent is an aromatic solvent. These solvents have a good dissolving power with respect to asphalt-resinous substances. The nature of the action of the solvent consists in dissolving the resins, which are the binding agent of paraffin agglomerates and the partial dissolution of asphaltenes, transferring deposits on pipelines into suspended particles that are easily carried away by the flow.

In the work, solutions of each component of the sediment were measured at the Coulter-Counter particle distribution counter, in order to determine the particle size and the comparative estimation of the sizes, their ratios in the sediments of various oils. Based on the results of the studies, almost identical repeatability of the curves obtained in the analysis of the group components of various ASP-B is observed. It was revealed that in the investigated sediments, despite the different origin and differences in the group composition, the components of the ASP-B do not differ in their characteristics from each other in their characteristics, so it is possible to assume that the group components have approximately the same molecular mass and structure.

CONCLUSION

The process of formation of ASP-B is determined by many factors, among which are the operating conditions of the process equipment for the extraction, transportation and storage of hydrocarbons, the properties of the hydrocarbons themselves. Particular importance in a number of factors that determine the propensity of hydrocarbons to form ASP-B, have high-molecular components of oil, namely, their composition, structure and percentage ratio. Knowing the properties and composition of hydrocarbons, their thermal and hydrodynamic conditions in the reservoir, and correctly selecting methods of combating ASP-B sediments, it will be possible to avoid deterioration of oilfield equipment and pipeline communications, which at one time is economically beneficial for the oil and gas industry, to reduce the number of repairs and reduce downtime of wells, will allow to extend the service life of equipment, to ensure rhythmic work of the fishery and to reduce the cost of oil production.

CONFLICT OF INTEREST

The authors declare no conflict of interest relating to the material presented in this paper.

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FINANCIAL DISCLOSURE

None

REFERENCES

[1] Tatyana OS. [2008] Investigation of the conditions of formation of deposits in the oil transport system OS. Tatyana RZ, Sakhabutdinov FR. Gubaidullin Oilfield business. 8:43 - 46.
[2] Sorokin SA, Khavkin SA. [2007] Features of physicochemical mechanism of formation of AFS in wells Drilling and oil. 10:30-31.
[3] Sunyaev ZI. [1990] Oil dispersed systems ZI. Syunyaev RZ, Syunyaev RZ. Safiyev. Moscow: Chemistry. 226. 8.
[4] Acevedo S. [2007] Relations between asfaltene structure and their physical and chemical properties: the rosary-type structure S. Acevedo A, Castro JG, Negrin A, Fernandez G, Escobar V. Piscitelli Energy & Fuels. 21:2165 – 2175.
[5] Kyeongseok Oh. [2004] Asphaltene aggregation in organic solvents Oh Kyeongseok A, Ring Terry D. Deo Milind Journal of Colloid and Interface Science. 271:212 – 219.
[6] Mastobayev BN. [2002] Chemical means and technologies in pipeline oil transport BN, Mastobayev AM, Shammazov EM, Movsumzadeh. Moscow: Chemistry. 296. 3
[7] Kemalov F, Kemalov RA. Scientific and Practical Bases of the Physico-Chemical Mechanics and Statistical Analysis of Disperse Systems: Educational Textbook [in Russian], Izdatel'stvo Kazanskogo Gosudarstvennogo Tekhnoilicheskogo Universiteta, Kazan' [2008]. 6
[8] Kemalov F. [2005] Dissertation for Doctor of Technical Sciences, Kazanskii Gosudarstvennyi Tekhnologicheskii, Universities, Kazan'. 4
[9] Yagudin ShG. [2006] Composite reagents for extraction and preparation of heavy high-viscosity oils: the author's abstract of the dissertation of the candidate of technical sciences: 02.00.13 Yagudin Shamil Gabdulkhaevich. Kazan. 19. 7
[10] Kemalov AF, Kemalov RA, Valiev DZ. [2013] Study of the structure of complex structural units of heavy oil from Zyuzeevskaya field by NMR relaxometry and rheological studies. Oil Industry. 2: 63-65.