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Results of the Examination of the Physico-Chemical Properties of Technical Circulation Waters

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Abstract

The article presents the results of a study to determine the colloidal properties of mechanical impurities in the Tudakul and Kuymazar waters. The dispersion of solid particles of mechanical impurities was determined by sieve analysis (sizes from 0.25 µm to 50 µm). Also investigated, reducing the amount of fine solid particles of mechanical impurities during their coagulation from 24.3% to 15.3% in the gravitational field.

Keywords: solid particles, industrial water, coarsening, coagulation, precipitation, sticking

Introduction

The treatment of the circulating technical waters of the refinery is a current problem. The technical water-colloidal dispersion system, in which the particle size ranges from 0.25 10-6-50 10-6 m, the fine particles do not settle at any time during which the dispersion system is protected [1,2]. The colloidal particles, in Brownian motion, can approach on impact to the extent that the forces of Vander Waals begin to manifest themselves. As a result, the particles begin to fuse, and the particles of the dispersal phase are aggregated. For the most part, flakes are so large (flocculation process) that they are precipitated (sedimentation process) [3,4]. Not only do the solids stabilize the water emulsion, they reduce the performance of apparatuses and pipelines, as a result of salt and precipitation, they increase the fuel consumption following the decrease in the heat transfer coefficient in heat exchangers, but the conditions for localization of corrosion processes are also created, and sometimes they contribute to the erosion of the parts of centrifugal pumps, connections, fittings and stop-valves. Mechanical impurities also form a dispersed system with technical water - «liquid-solid body», which is separated by a method of protection in separators and separators in fisheries. [5-8].

Before purifying the circulating waters of the refinery from mechanical impurities and mitigating them, we first studied the chemical (elemental) composition of the Tudakul Water of the Bukhara Viloyat and the Kuimazar Water of the Kashkadarya Viloyat under investigation (which are used for cooling hydrocarbon raw materials on BuHP3) with specialists of the Institute of Geology of Hydromineral Resources Laboratory «Hydrochemical Laboratory». The results are shown in tables 1 and 2.

1 table: Element analysis of Tudakul Water

	Element name					
	Hg	*Ai*	*As*	*Be*	*Mo*	*Mn*
Content of elements, mg/l	0,000063	0,030	0,0035	0,000004	0,0075	0,0059
MAC (maximum permissible concentration), mg/l	0,0005	0,2	0,05	0,0002	0,25	0,1

2 table: Element analysis of Tudakul Water

	Element name						
	Pb	*Ni*	*Se*	*Cu*	*Zn*	*Cd*	*Sr*
Content of elements, mg/l	0,00011	0,0029	0,0066	0,010	0,0037	0,000031	3,4
MAC (maximum permissible concentration), mg/l	0,03	0,1	0,01	1,0	3,0	0,001	7,0

The content of Hg in Tudakul water is 0.0000063 mg/l and the MAC concentration is not to exceed 0.0005 mg/l (table.1). The Ai content was 0.030 mg/l and the MAC content was 0.2 mg/l. Other elements (Pb, Ni, Se, Cu, Zn, Cd, Sr) are also defined in the water under investigation. The results of the research are shown in table 2.

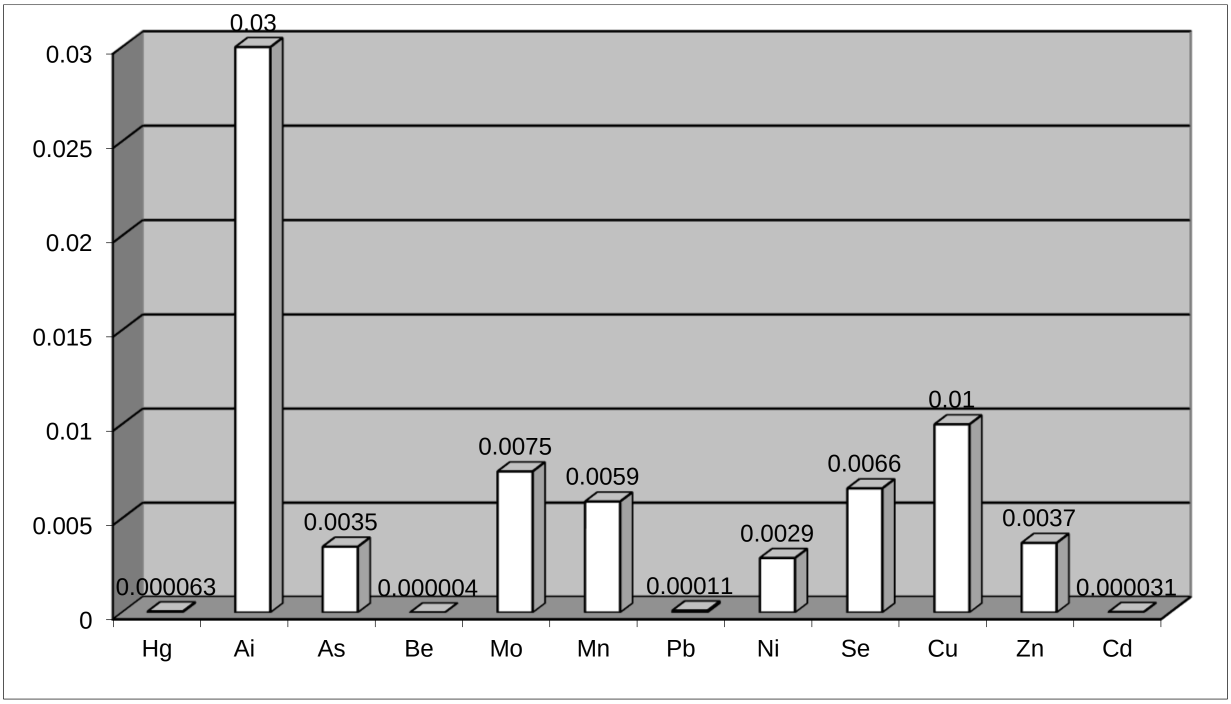

Figure 1. Chemical content of Tudakul technical waters.

It can be seen from Figure 1 that the Tudakul Water content of Pb is 0.00011 mg/l and the limit value is 0.03 mg/l. From the studies carried out to determine the elemental composition of the water under investigation, the content of all the elements listed in table 1 and 2 does not exceed the limit values.

Cation and anion in the water under investigation are also determined from the experimental studies. The results are given in table 3.

3 table: Cation and anion content in Tudakul Water

Cations	**Litre**		
	mg/l	mg-equine/l	% -equine/l
Na^{+}	213	9,27	41
K^{+}	6	0,15	1
NH_4^+	<0,1	-	-
Ca^{2+}	152	7,60	33
Mg^{2+}	68	5,60	25
Fe^{3+}	<0,3	-	-
Fe^{2+}	<0,3	-	-
Total		**22,62**	**100**
Anions	**Litre**		
	mg/l	mg-equine/l	% -equine/l
Cl^{-}	230	6,50	29
SO_4^2	675	14,06	62
NO_2^-	<0,01	-	-
NO_3^-	4	0,06	-
CO_3^-	None		
HCO_3^-	122	2,0	9
Total		**22,62**	**100**

Table 3 shows that the cation content, i.e. Na+ in the water studied was 41%, K+ 1.0%, no content, Ca 2+ 33%, Mg 2+ 25%, Fe 3+ and Fe 2+ are missing. The content of Cl-anions was 29% , - 62%, and almost not noticeably, - absent, - 9%.d

We have also identified other indicators of Tudakulla Water (table 4).

4 table: Physico-chemical indicators of Tudakul Water

Stiffness, mg/l, total	13,20
Fixable	-
Permanent	-
Carbonate	2,0
Non-carbonate	11,2
pH	6,5
CO_2 swab. mg/l	22
CO_2 aggregation. mg/l	4
Oxidizability, mg O_2/л	1,26
SiO_2 mg/l	10
H_2S mg/l	there was no
PO_4 mg/l	
Dry balance:	
experiment. mg/l	1488
computed. , mg/l	1419
Physical properties:	
Transparency	transparent
Taste	sl.
Color	colourless.
Smell	lawless.
Sediment	sediment-free.
Standing change	nonsense.

Table 4 shows that the rigidity of Tudakul water is 13.2 mg-equine/l, water pH 6.5 i.e. almost neutral, free CO_2 – 22 mg/l, CO_2 Unit. - 4 mg/L, oxidizing 1.26 mg O_2/l, SiO_2 – 10 mg/l, H_2S and PO_4 – there is no. The physical properties of the given water are also determined: transparency - transparent, taste - weak-saline, colour - colorless, odour - odourless, sediment - without sediment, change when standing - does not change.

Experimental Method

We have also studied the rigidity of Kuymazar water. To determine the stiffness by 10 ml of water, 1 drop of 25% ammonia liquid is added, after which 1-2 drops of indicator are added, after shaking the flask for titration are inserted into the magnetic mixer, Each droplet is struck in the flask and the droplet is stopped in the flask until it turns from reddish to blue. The results of the research carried out to reduce the rigidity of Kuymazar water by reagent method are listed in table 5.

5 table: Reducing Kuymazarki Water Hardness

Na_3PO_4(water rigidity 47 mg-E/L)

№	Amount of water, ml	Na_3PO_4, mg	Water Rigidity N_2 (Ml. eq./l)
1	10	0,01	24
2	10	0,03	21
3	10	0,05	16
4	10	0,07	7
5	10	0,08	5
6	10	0,1	2
7	10	0,2	2

Table 5 shows that when a reagent is added Na_3PO_4 0,01 mg water hardness is reduced to 24 mg-eq/l and when a reagent is added to 0.03 mg, the hardness is reduced to 21 mg-eq/l. The further addition of a reagent from 0.05 to 0.08 mg of water is reduced from 16 mg-equine/l to 5 mg-eq/l. When the reagent is added 0.1 and 0.2 mg, the water hardness is reduced to 2 mg-equivalent/l. We have chosen the optimal options for reagent additive 0.1 mg .

Thus, the physico-chemical properties of the Kuymazar waters show that the water in question is not suitable for human use because the water was 47 mg-equine/l rigidity and according to the standard the water rigidity should not exceed 7 mg-leq/l and it is not possible to use this water to cool hydrocarbons in the refinery without cleaning it of mechanical impurities and without softening. In order to solve this problem, it is advisable to reduce water by a reagent method.

An experimental glass unit has been assembled to study the hydrodynamics of the process of softening and the preliminary removal of mechanical impurities from circulating water, (Figure 2).

The apparatus comprises a septic tank 1 for protecting circulating water, a filter 2 for separating fine particulates from mechanical impurities, a container with a mixer 3 for mixing technical water with reagents, and pumps *4.5.6* for supplying liquid, and also equipped with bolts *7, 8, 9* for regulating the liquid flow.

Results and Discussion

The plant operates as follows: water is supplied to the septic tank 1, with the aid of pump 4 for the deposition of coarse solids of mechanical impurities in the gravitational field, the inlet untreated flow in the system is regulated by a latch 7, After which the purified water from the particulates enters filter 2 via pump 5 to purify the fine particulates, the purified water is supplied with pump 6 in the tank with mixer 3 to soften the technical water by various reagents.

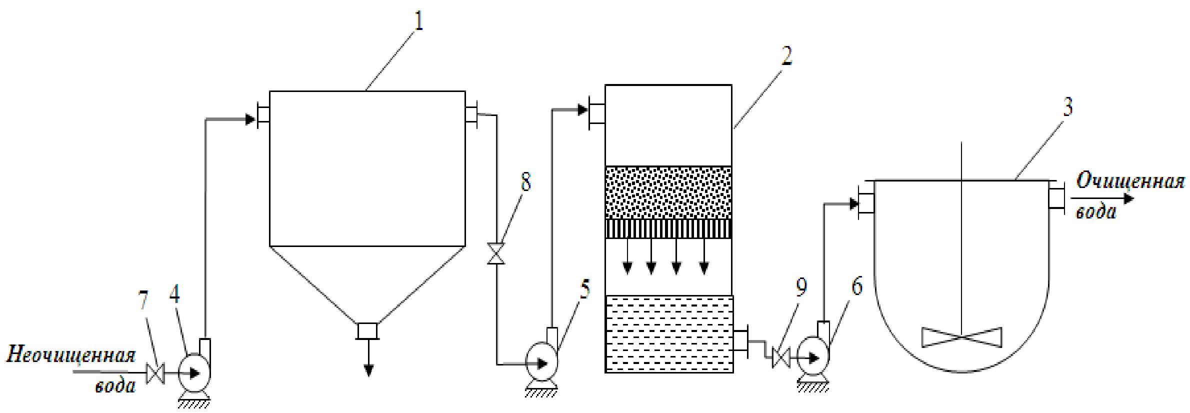

Figure 2. Laboratory apparatus for softening and removing mechanical impurities from hard water: 1 is a septic tank; 2 is a filter for dividing a suspension; 3 is a container with a mixer for mixing technical water with reagents; 4.5.6 are pumps for transferring liquid; 7.8.9 are valves for regulating the flow.

We have also determined the concentrations of mechanical impurities and their dispersion by a sitter method. A traditional method for controlling uniformity and dispersion of bulk and powder materials is screening. This type of analysis is regulated by GOST 6613-86, GOST 3584-5. The essence of the method is that the powder is sifted through a sieve, with different cell sizes, arranged consecutively above each other. At the top there is a sieve with the largest cell, then the cell size of the sieve decreases successively. Screen analysis makes it possible to determine the size of particles, to separate the particles of different sizes from each other and to calculate the numerical ratio of particles of different dispersion [5.6.7]. The results of the research are shown in table 6.

6 table: Particulate matter composition of mechanical impurities Quaymaking waters

Particle size, µm	<0,25	0,5-0,25	0,5-1,0	1,0-2,0	2,0-3,0	3,0-5,0	5,0-10	10-20	20-50	Σ
In %	24,3	16,9	14,4	11,6	9,4	7,3	6,8	5,4	3,9	100

Table 6 shows that the concentration of particulate matter of mechanical impurities of 20-50 µm in circulating water is 3.9%, 10-20 µm of particles 5.4%, 5-10 µm of particles 6.8%, further reduction of particle size of mechanical impurities to 0.25 µm its concentration increases to 24.3 % i.e. as the particle size decreases, the concentration gradually increases. Fine particulate matter is almost not deposited because of its invisible resistance to the medium, so coagulation or aggregation of fine particulate matter is advisable to intensify the cleaning process.

Conclusions

Thus, the Kuymazar water under investigation is a mixture of fine particulate matter (<0,25÷50 mkm) and high hardness 47 mg-eq/L, fine particulate matter in low turbulent conditions of movement within the apparatus is not very coupled to each other and is almost not precipitated due to the invisible resistance to the medium. The results of the determination of the elemental composition of Tudakulskaya Water prove that the content of Hg is – 0,0000063 mg/l, content of Ai is – 0,030 mg/l, *As*-0,0035 mg/l, *Be* – 0,000004 mg/l, *Mo – 0,0075 mg/l, Mn – 0,0059* mg/l, *Pb* – 0,0001 mg/l, *Ni* – 0,0029 mg/l, *Se* – 0,0066 mg/l, *Cu* – 0,010 mg/l, *Zn* – 0,0037 mg/l, *Cd* – 0,000031 mg/l, *Sr* – 3,4 mg/l.

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