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WASTEWATER TREATMENT OF HYDROMETALLURGICAL PRODUCTIONS

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ABSTRACT
Methods of physicochemical analysis of the composition of industrial effluents and the use of sorption materials obtained on the basis of compositions of various chemical reagents with local minerals have been developed. The physico-chemical and mechanical properties of the newly obtained composite materials were studied. Waste water samples from a hydrometallurgical plant were used as experimental objects.

KEYWORDS: ***waste water, activated carbon, liquid glass, ion exchange, coagulation, flotation, sorbent, colloidal solutions.***

INTRODUCTION

Water is our most precious natural resource. Water is of great importance in industrial production. It plays a vital role in all hydrometallurgical processes. The demand for water is enormous and increasing every year. Metallurgy uses a lot of water. Most of the water, after being used for domestic purposes, is returned to water bodies in the form of wastewater.

The protection of water resources from depletion and pollution and their rational use for the needs of the mining industry is one of the most important problems that needs to be solved urgently. Due to the expansion of gold ore processing in hydrometallurgical plants and the acute shortage of process water in Uzbekistan, there is an urgent need to find a solution and apply water-saving technologies in gold hydrometallurgy. One of these opportunities is to assess the physical and chemical composition of water and the possibility of its use in gold hydrometallurgy. Historically, water quality has not been considered in the development of process flowsheets for hydrometallurgical plants. In the vast majority of cases, potable and even industrial water satisfied the technologists, and used water was simply discharged into reservoirs. It is only in recent years that they have begun to send this water to treatment plants and into circulation.

METHODOLOGY

The aim of this work is to study the chemical composition of water in samples taken from the technological scheme (after grinding, thickening, gravity, flotation, bio-oxidation of concentrates, sorption leaching of ores and concentrates, etc.).

The determination of the content of chemical substances in water samples taken from the technological scheme was carried out by photocolorimetric, titrimetric, gravimetric and atomic absorption methods.

RESULTS AND DISCUSSION

In the course of laboratory testing of the above samples it was found that V-5000 m3 calcium - 434 mg/l, magnesium - 456 mg/l, sodium - 406 mg/l, chlorine - 648 mg/l, bicarbonate - 189.1 mg/l, sulphate - 3.24 g/l, suspended solids - 0.05 g/l.

From the quantitative value of the ions we can conclude that the water is very hard in all samples. As can be seen from these values, the total hardness of the wastewater is very high and it forms more stable colloidal solutions.

In addition to these ions, the wastewater also contains heavy metal ions such as Fe, Cu, Zn, Pb, Mn, Ni, Co, Cr, Al. The content of these ions is much higher in the samples taken from the filtrate of the cinder workshop: Fe (19.04 mg/l), Cu (19.7 mg/l), Zn (1.47 mg/l), Pb (0.19 mg/l), Mn (0.06 mg/l), Ni (1.8 mg/l), Co (0.3 mg/l), Cr (0.03 mg/l), Al (10.0 mg/l).

The content of anions in this sample is also higher than in other samples. There is a high content of silica ions - 29.9 mg/l, carbonate - 66 mg/l, nitrite - 0.69 mg/l, nitrate - 15.6 mg/l, thiocyanate - 938 mg/l and arsenic - 11.8 mg/l. This can be explained by the fact that during the incineration the residual masses completely decompose the ore rock, as a result of which the elements contained in the ore go into solution as ions, the environment has a pH value of 8.8, slightly alkaline.
The content of some ions differs from V-5000 m3 in samples of circulating water No. 2 of the workshop: carbonate - 114 mg/l, bicarbonate ion is absent, nitrate - 19.0 mg/l, thiocyanate - 87 mg/l and arsenic - 2.2 mg/l. The pH of the environment is 10.4, very alkaline. (Table 1)

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1 – Table.
Results of Chemical Analysis of Wastewater Sample

T/r	Sample name	pH	SiO_2	Ca	Mg	Na	K	Fe_{um}	Cu	Zn	Pb
			mg/dm³								
1	Water from V-5000m³	7,6	1,56	434	456	406	93,5	<0,05	0,02	0,21	0,14
2	Roasting plant filtrate	8,8	29,9	1012	61	201	79,3	19,04	19,7	1,47	0,19
3	Recycled water No. 2	10,4	9,9	336	18	452	124	<0,05	0,02	0,07	0,12

1.1 – таблица.

T/r	Sample name	Al	Cl	CO_3	HCO_3	NO_2	NO_3	SCN	As	SO_4	dry residue
		mg/dm³								g/dm³	
1	Water from V-5000m³	<10,0	648	отс	189,1	0,16	5,93	9,7	0,32	3,24	5,5
2	Roasting plant filtrate	<10,0	3013	66	268,4	0,69	15,6	938	11,8	4,27	9,5
3	Recycled water No. 2	<10,0	669	114	отс	0,18	19,0	87	2,2	1,89	2,4

The coagulation and precipitation method was used to purify the effluent from these samples. On the basis of these analyses, appropriate reagents and optimal pH values were selected. From each sample, 500 ml of water was taken into flasks (V = 1000 ml) and sodium carbonate was added in the calculated amount so that the pH of the solution reached 10-11. Then the coagulant was added while stirring gradually, and after some time (30 min.) the formation of flakes began. For a good precipitation, we add a diluted polyelectrolyte solution to the precipitated solution, so that after a while the flake sticks together and turns into large masses that are well precipitated. The precipitate is separated from the solution by filtration and an aliquot is analysed for ionic content.

For water purification, chemical purification methods are necessary: coagulation with aluminium and iron sulphate:

$$Fe_2(SO_4)_3 + 2H_2O \leftrightarrow Fe_2(OH)_2(SO_4)_2 + H_2SO_4$$
$$Fe_2(OH)_2(SO_4)_2 + 2H_2O \leftrightarrow Fe_2(OH)_4SO_4 + H_2SO_4$$
$$Fe_2(OH)_4SO_4 + 2H_2O \leftrightarrow Fe_2(OH)_6 + H_2SO_4$$

The resulting iron hydrosulphates and hydroxides act as coagulants for wastewater impurities. The same reaction is observed when aluminium sulphate is used as a coagulant:

$$Al_2(SO_4)_3 + 2H_2O \leftrightarrow Al_2(OH)_2(SO_4)_2 + H_2SO_4$$
$$Al_2(OH)_2(SO_4)_2 + 2H_2O \leftrightarrow Al_2(OH)_4SO_4 + H_2SO_4$$
$$Al_2(OH)_4SO_4 + 2H_2O \leftrightarrow Al_2(OH)_6 + H_2SO_4$$

During precipitation, Fe2(OH)6 or Al2(OH)6 sorbs calcium, magnesium, carbonate, sulphate and heavy metal ions into its pores and coagulates them.

As it can be seen from Table 3, after cleaning the content of ions decreases sharply according to the order of samples in the table: calcium - 8 mg/l, 32.1 mg/l, 16 mg/l; magnesium - 3 mg/l, 68.1 mg/l, 7 mg/l; chlorine - 248.2 mg/l, 531.7 g/l, 194.9 mg/l; sulphate - 1.4 g/l, 3.7 g/l, 1.78 g/l. The content of carbonate ions - 264 mg/l, 500 mg/l, 600 mg/l, bicarbonate - 244 mg/l, 97.6 mg/l, 902.8 mg/l is higher than in the original wastewater. This is explained by the fact that the addition of sodium carbonate increases the content of these ions; to eliminate them we use other precipitation methods.

2 – Table
Analysis Results After Chemical Cleaning

T/r	Sample name	pH	SiO_2	Ca	Mg	Cl	CO_3	HCO_3	SO_4
			mg/dm³						g/dm³
1	Water from V-5000m³	11,4	1,4	8	3	248,2	264	244	1,4
2	Roasting plant filtrate	11,8	17,4	32,1	68,1	531,7	504	97,6	3,7
3	Recycled water No. 2	11,5	2,5	16	7	194,9	600	902,8	1,78

CONCLUSIONS

Thus, with the treatment methods we have developed, it is possible to purify hydrometallurgical effluents and reduce the total hardness.

1. The chemical composition of the industrial effluents was studied and analysed.
2. A treatment process has been developed to reduce the hardness of the effluent.

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