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ENHANCEMENT OF MECHANICAL WASTEWATER TREATMENT IN THE PETROLEUM REFINING INDUSTRY

The results of full-scale studies on the treatment of petroleum refinery wastes with the addition of chemicals are given. Aluminium sulphate and cationic flocculant VPK-101 have been used as chemicals. It has been shown that the concentrations of petroleum products and coarse dispersed matter are reduced by 75–80% and 71–92%, respectively.

Mechanical treatment methods such as sedimentation and pressure flotation play an important part in the treatment of petroleum refinery wastes (PROSKURYAKOV and SCHMIDT [1]). In these processes, considered as a primary treatment, coarse dispersed matter, emulsified oil substances and colloidal solids affecting significantly the operation of the biological system and the treatment system as a whole are removed.

As the majority of the existing full-scale flotation facilities operate according to schemes in which chemicals are added to wastes before they enter the saturation tank or the pump, the study on the effective applicability of chemicals in such schemes is of practical concern.

The studies were performed on a 600 m^3/h full scale flotation unit. The unit consists of a typical radial flotation chamber of a diameter of 15 m, a saturation tank of barbotage type in which wastes are saturated with air, a chamber of "tube in tube" type for mixing wastewater with an effluent from a saturator, and a pump. Air is supplied by an ejector. A pressure of 400 KPa is maintained in a saturation tank. Fifty percent of treated wastewater is saturated with dissolved air. Chemical (aluminum sulfate) is introduced into the suction end of the pump ahead of the saturator. Aluminium sulfate in dosages of 75 to 120 mg/dm^3 and VPK-101 flocculant have been tested. The wastes after having passed through mechanical treatment facilities, including grit tanks, oil intercepters, and ponds for additional sedimentation were treated by flotation.

From the obtained data it is evident that removal efficiencies achiveed by pressure flotation with the addition of aluminium sulfate are 37%–80% for SS (initial concentration

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Table

Efficiency of treatment of wastewater from petroleum refining industry in a full-scale flotation unit
Sprawność oczyszczania ścieków z rafinerii ropy w urządzeniu flotacyjnym naturalnej wielkości

Chemicals	Dose	Characteristics of wastewater						Treatment efficiency, %		
		Suspended solids, mg/dm³		COD mg O_2/dm³		Petroleum products, mg/dm³		Suspended solids	COD	Petroleum products
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment			
1	2	3	4	5	6	7	8	9	10	11
	75	96	33	327	225	41	16.3	66	31	60
	75	75	34	354	212	52	18	55	40.1	65
$Al_2(SO_4)_3$	75	85	25	362	216	50.8	11.3	71	40	78
	75	94	22	319	162	37,5	9.1	77	49	76
	100	—	—	221	106	63.4	11	—	52	82.5
	100	—	—	—	—	50	18	—	—	65
	100	—	—	245	107.5	67	29	—		57
	100	—	—	442	185	28	11	—	58	61
	120	48	9.5	197	150.5	30	2.0	80	24	93
	120	54	34	155	97	26	7.0	37	37	73
	120	23	—	—	—	37.5	11	—	—	71
VPK-101	3.0	24	39	177	129	56.6	—	—	27	—
	6.4	59	17	181	155	86	19	71	70	78
	5.0	80	10	180	64.6	96	22	87.5	64	77
	5.6	64	13	198	—	77	19	80	—	75
	9.5	17	1.3	293	170	29.5	4	92	42	86
	4.5	12.5	12.8	304	189	36.5	8.0	—	39	78
	13	8	19.4	281	170	49	9	—	39	81
	17	17.0	5.0	316	177	39	27	71	44	31

of Co = 23–100 mg/dm^3) and 57%–93% for oil substances (initial concentration of Co = 25–70 mg/dm^3). The COD value is reduced by 24%–58% (initial COD = 155–422 mg/dm^3).

The results obtained from full-scale studies of flotation with the addition of 2–15 mg of VPK-101 flocculant/dm^3 show that the optimum doses of a flocculant range from 5–10 mg/dm^3, being thus one tenth–one fifteenth of that for an inorganic coagulant. Under the optimum operating conditions, the removal efficiencies achieved by the flotation process are 71%–92% (initial concentration = 17–80 mg/dm^3) for suspended solids and 75%–85% for oil substances (initial concentrations = 30–100 mg/dm^3). Simultaneously, the COD value is reduced by 39%–70% (initial concentration = 180–293 mg O_2/dm^3).

While carriyng out full scale studies, investigators have found that moisture content of foam produced during flotation treatment of wastes is reduced from 94% (when aluminium sulfate is added as a coagulant) to 88%–91% if VPK-101 flocculant is employed.

Comparative analysis of the data obtained shows that petroleum refinery wastes can be treated effectively by using VPK-101 flocculant.

Thus, the results of pilot and full-scale studies confirm the usability of flocculants in intensification of mechanical treatment of petroleum refinery wastes.

REFERENCES

[1] Proskuryakov V. A., Schmidt L. A., *Treatment of chemical industry wastewaters*, "Chimiya" Publishing House, L., pp. 158–200, 1977.

ROZSZERZENIE MECHANICZNEJ OBRÓBKI ŚCIEKÓW W PRZEMYŚLE PETROCHEMICZNYM

Przedstawiono w skali przemysłowej wyniki badań nad wykorzystaniem flokuantów w oczyszczaniu ścieków z rafinerii petrochemicznych. Zastosowano siarczan glinu i kationowy polielektrolit VPK–101, usuwając ze ścieków 75–80% odpadowych produktów petrochemicznych i 71–92% zawiesin.

AUSDEHNUNG DER MECHANISCHEN ABWASSERREINIGUNG IN DER PETROCHEMISCHEN INDUSTRIE

Beschrieben werden die Ergebnisse der Anwendung von Fäll- und Flockungsmitteln bei der Reinigung der Abwässer aus Erdölraffinerien. Verwendet wurde Aluminiumsulfat und ein kationenaktives Flockungsmittel VPK-101. Die Abnahme von 75–80% der petrochemischen Abfallstoffe und 71–92% Schwebestoffe war das Ergebnis.

РАСШИРЕНИЕ МЕХАНИЧЕСКОЙ ОБРАБОТКИ СТОЧНЫХ ВОД В НЕФТЕХИМИЧЕСКОЙ ПРОМЫШЛЕННОСТИ

Представлены результаты испытаний в промышленном масштабе по использованию флокулянтов в очистке сточных вод нефтехимической промышленности. Применён сульфат алюминия и катионный полиэлектролит VPK-101, удаляя из сточных вод 75–80% отходных нефтехимических продуктов и 71–92% суспензий.