EFFLUENT PURIFICATION IN AN ELECTROPLATING UNIT

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UDC 621.771.23:669.686.5:622.793.5

Softened water is used in No. 6 sheet mill at the Magnitogorsk Metallurgical Combine to prepare the degreasing and pickling solutions, the phenolsulfonate electrolyte, and the passivating solutions, as well as for washing the metal after each stage of processing. The effluents pass from the degreasing, pickling, and passivation baths to a neutralizing unit. The qualitative and quantitative characteristics of the alkaline washing effluents and the acid iron-bearing and chromium-bearing effluents are given in Table 1.

From the electroplating baths the effluents, which contain phenol and paraphenolsulfonic acid, pass at the rate of 50 m^3/h to a blast furnace slag granulation unit as makeup water. Effluent characteristics: pH = 8.7; phenols content up to 12 mg/liter (average 5 mg/liter).

The neutralization unit is built to a design produced by the All-Union Scientific Research and Design Institute for Gas and Effluent Purification and Secondary Energy Utilization in Ferrous Metallurgy and is designed to neutralize and purify alkaline, acid iron-bearing, and chromium-bearing effluents. The unit has an installation for thermal neutralization of spent alkaline solutions and the froth product from the flotation cell. A schematic diagram of alkaline and acid iron-bearing effluent purification is given in Fig. 1.

Blenders are provided for the acid and alkaline washing waters, to even out the concentrations of harmful substances in the effluents and to feed them evenly to the neutralizer. The alkaline washing effluents from the blender (two sections, each of 80 m^3) are transported by the ZK-9 pumps 2 to a through-flow type flotation cell, in which the emulsified substances and finely dispersed impurities are removed. The froth product which forms in the cell is broken down by a high-temperature steam coil and flows by gravity into a tank; it is then pumped by the ND-400/16 feeder pumps 10 to the fire neutralization installation.

A tank with V = 50 m^3 is provided to receive the spent alkaline solutions (46 m^3/h once a week); the solutions are transferred from this tank by feeder pumps 10 to the froth product tank and the mixture obtained is fed to the fire neutralization installation. The purified alkaline effluents flow from the flotation cell by gravity into the acid effluent blender (two sections of 80 m^3 each), into which the acid washing effluents are fed from the coating shop through a delivery pipe.

Pickling solutions at the rate of 0.18 m^3/h are also fed into the acid effluent blender by feeder pumps 10 from the tank provided to receive the spent solutions (30 m^3 once a week). These pickling solutions can be used for neutralizing chromium-bearing effluents.

The mixed acid iron-bearing and alkaline effluents are fed from the blender by 4Kh-12Ts-51 centrifugal pumps 11 to the vortex mixer, where milk of lime is added if necessary. The effluents pass from the vortex mixer into a reaction chamber 9 m in diameter to which compressed air is fed to convert bivalent iron to the trivalent form. The effluents are saturated with oxygen by means of a disperser.

From the reaction chamber the neutralized effluents are sent to a distribution chamber, into which milk of lime is fed from a Dimba-1 feeder automatically controlled by a sensor mounted in the chamber to bring the pH to 8-9. Polyacrylamide is fed into the dis-

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Magnitogorsk Metallurgical Combine. Translated from Metallurg, No. 12, pp. 36-37, December, 1975.

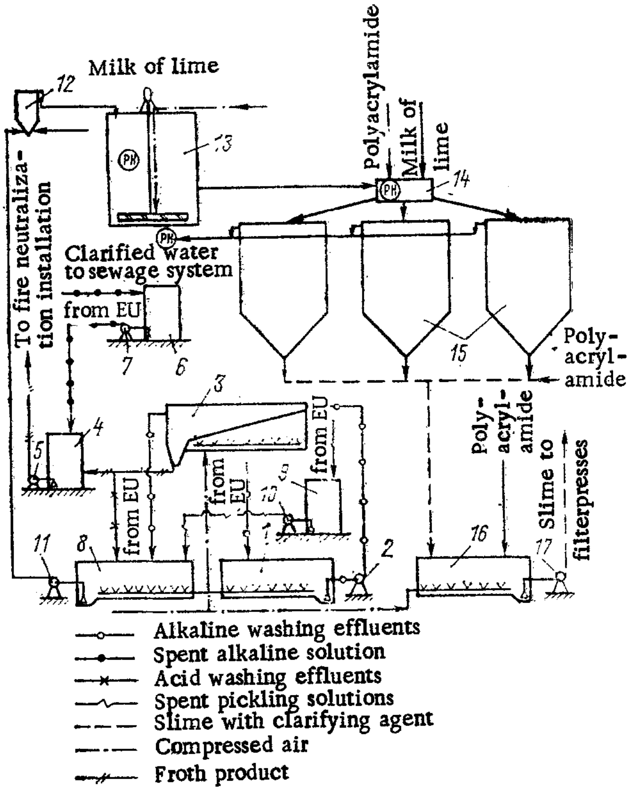

Fig. 1. Purification of alkaline and acid iron-bearing effluents: 1) alkaline effluent blender; 2, 11, and 17) centrifugal pump; 3) flotation cell; 4) froth product tank; 5, 7, and 10) feeder pumps; 6) tank for spent alkaline solutions; 8) acid effluent blender; 9) tank for spent pickling solutions; 12) vortex mixer; 13) reaction chamber with disperser; 14) distribution chamber; 15) clarifiers; 16) slime collector; NC) Neutralization controller; EU) electroplating unit.

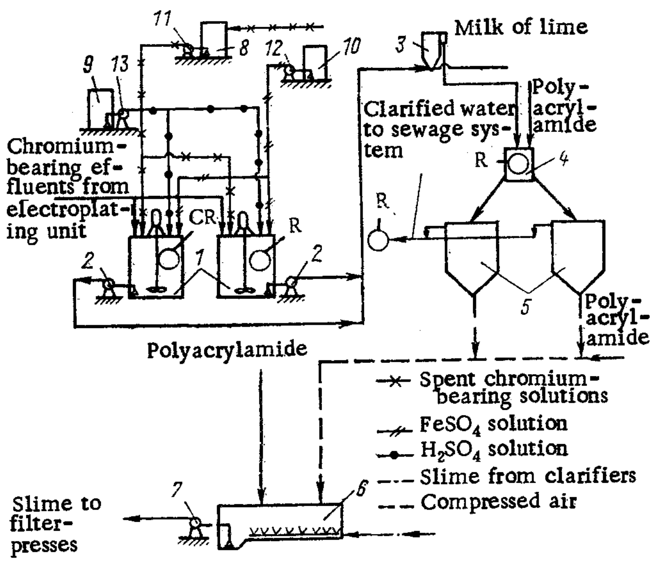

Fig. 2. Neutralization of chromium-bearing effluents: 1) reactor tank with paddle-type mixer; 2) pump; 3) vortex mixer; 4) distribution chamber; 5) clarifiers; 6) slime collector; 7) pump; 8) tank for spent chromium-bearing solutions; 9) tank for 10% H_2SO_4 solution; 10) tank for 10% $FeSO_4$ solution; 11-13) feeder pumps; CR) control relay; R) recorder.

TABLE 1. Qualitative and Quantitative Characteristics of Alkaline, Acid Iron-Bearing, and Chromium-Bearing Effluents

Effluents	Amount of effluent, m^3/h	Characteristics of effluents						
		pH	alkalinity, mg-eq/liter		Fe^{2+},	H_2SO_4		Cr^{6+},
			by phenolphthalein	total	mg/liter	mg-eq/liter	mg/liter	mg/liter
Alkaline	35	11,3	4,94	7,21	—	—	—	—
Acid iron-bearing	35	2,6	—	—	87,9	5,78	283	—
Chromium-bearing	20	7,8	—	—	—	—	—	40

tribution chamber to increase the speed of floc settlement. The neutralized effluents are distributed from the chamber to three clarifiers 9 m in diameter and then discharged into the industrial and storm water sewage system.

The slime which forms in the clarifiers is discharged along chutes into a slime collector which consists of two sections operating cyclically and independently of each other. Additional consolidation of the slime and discharge of the water which separates out take place in the slime collector; 0.2% polyacrylamide is fed into the slime collector to improve the filtering properties of the slime. The consolidated slime is then fed by pumps 17 along a delivery pipe to two filter presses for dewatering.

A schematic diagram of chromium-bearing effluent neutralization is given in Fig. 2. The chromium-bearing washing effluents are fed from the electroplating unit along a delivery pipe into two reactor tanks, each of 16 m^3 capacity. The spent chromium-bearing solutions are pumped along the same delivery pipe as necessary into a tank of 40 m^3 capacity, from which they are fed by the ND-630/10 feeder pumps 11 at the rate of 0.18 m^3/h into the reactor tanks for neutralization with the washing waters.

The process of neutralizing the chromium-bearing effluents takes place in the reactor tanks in an acid medium (10% solution of $FeSO_4$ and H_2SO_4) at pH = 2-3, by reduction of Cr^{6+} to Cr^{3+}.

After 20 min the effluents are transferred from the reactor tanks by the 4Kh-12K-2A pumps 2 to the vortex mixer, into which milk of lime is fed to neutralize the effluents to pH = 8-9, and from the mixer they pass through a distribution chamber into vertical settling tanks 4.5 m in diameter. To improve clarification of the effluents, polyacrylamide is fed into the distribution chamber which supplies the settling tanks. The neutralized effluents flow from the settling tanks by gravity into the industrial and storm water sewage system.

The slime from the settling tanks is discharged into a slime collector, to which air and polyacrylamide solution are fed to mix and consolidate the slime; it is then transported to filterpresses from the collectors by the 5F-6 pumps 7. The dewatered slime is then discharged by belt conveyor into a hopper, from which it is loaded by bucket crane into vehicles or rolling stock and dumped.