Türkiye)5.Madencilik Kongresi / / J * *Mining Congress of Turkey,* Güyagüler,Ersayın3ilgen(etİ5)£>1997, ISBN 975-395-216-3

TREATMENT OF MINE WATER AT ASSAREL, BULGARIA

A Hadjiev
Department of Geochemistry, Geological Institute, 1113 Sofla, Bulgaria

P Hadjiev
Department of Mineral Processing, University of Mining and Geology, 1100 Sofia. Bulgaria

ABSTRACT: At the Assarel copper mine, some 90 kms away from Sofia, 42 dm per see waste mine water from excavations and mine tailings is entering the clean up facility This quantity is about two times above than the designed "one. Polyacrylamide flocculants with various ionic sizes were added to intensify the sedimentation of the lime treated sludge. The most effective action was observed when anionic flocculants were used, e g, P3-ferrocryl 8720 manufactured by Henkel Metallchemie, Austria The sediments of the water treatment facility, containing copper 2 88 pet, manganese I 0 pet and iron 5 13 pel, are dumped into the tailing pond of the mineral processing *plant A* variant is investigated for separately dumping of sediments after filtration dewatering

1. INTRODUCTION

The yield of copper ores, grading less than 0.5 pet, is organized by open-cast method at Assarel ShHC Collect waste mine waters are from excavations and overburden dump. Some laboratory (Zagorski et al, 1985) and industrial (Zagorski et al., 1989) scale researches are conducted to assess composition of the waste mine water and establish cost-effective clean up techniques Figure 1 shows the flowsheet of the designed and constructed by Balkan Consult Company water treatment facility It was dealing with up to 20 dm' per sec. overburden seepage at the beginning of operation This quantity increased up to 24 dm' per sec nowadays The water routed to a drainage gallery located under the pit is up to 18 dm^1 per sec Total quantity entering the cleaning facility is 42 dm per sec, while designed capacity is 20 dm' per sec. PcSO.i 7H,0 and cationic floceulant Macrofloc fKIO(S) aie added to intensify the sedimentation of line treated sludge As a result the amount of fornn-d sediments lose Meanwhile removing manganese ions reached belter extent and need to add sulfuric acid to decrease pU of the make-up water declined Usage of fcSO., 71I..0 leads to the increasing of sulfate ions More acceptable is a variant with appropriate llncculant and acid adjusting ofpH

Collected sediments from a water cleaning facility are dumped into tailing pond of the mineral processing plant They contain copper, iron, manganese and fine si^e particles Considering this they should be dumped separately

Some sedimentation and lillralion researches have done with pıodııcls from walei cleanm;.' lirdhlv *'M* Assarel mine to help choosing a cost-effective decision .

2 EXPERIMENTAL METHODS

The sample for sedimentation experiments was taken after lime treatment of mine water The pH of the mine liquor containing 2.577 g/dm' insoluble matters was 9 8. Table 1 performs the characteristics of flocculants P3-ferrocryl used İn the conducted tests.

Table 1 Characteristics of P3-ferrocryl flocculants

Flocculant N"	Molecular weight -	Chemical assay and ionic size
8720	6×10^6	Polyacrylamide, weak anionic
8723	$11\text{--}12 \times 10^6$	Polyacrylamide, strong anionic
8740	$5\text{--}6 \times 10^6$	Polyacrylamide, nonionic
8766	$5\text{--}6 \times 10^6$	Polyacryla nide, medium cationic

Tests were earned oui on samples of l0O0 cm^1 in measuring cylinders by Kynch method of analysis (Zmiarov et al) Comparison appraisal of P'-lenociyl flocculams was concluded using as a ciilciia term relative thickening aiea (m' *24* h/ion)

$$S \quad 695 \times T_p/H_0 \times C_0 \qquad (1)$$

when- I,, computed sell liny lime limn ihiekeniriü—•>ed i menial ion curve (min), I !„ lced suspension pole liciylii (mm). *(',,* concent! ntion of solid part IL les m feed suspension | y/dm')

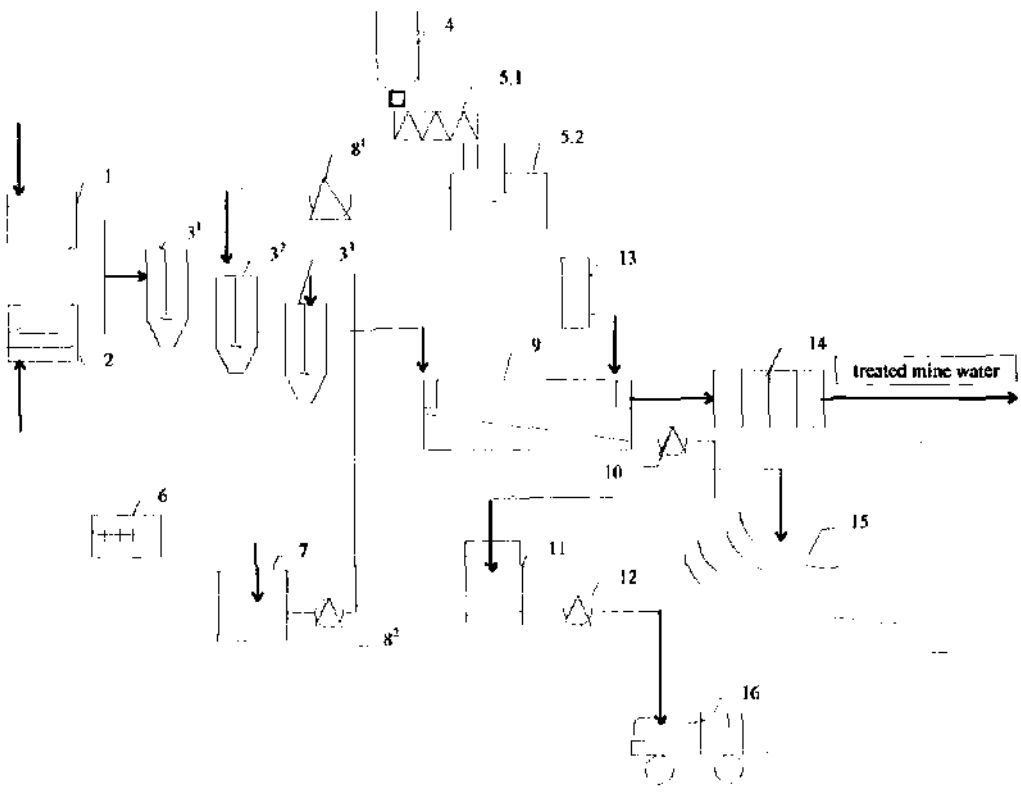

Figure 1. Flowsheet of the water treatment facility at mine Assarel: 1 and 2-water collecting shafts; 3^1, 3^2 and 3' -flash mixers; 4- hydrated lime holding tank; 5.1- hydrated lime screw feeder; 5,2- 5-7 pet lime milk preparation tank, 6-ttocculant pitch-paddle mixer; 7-0.1 pet flocculant solution preparation tank, 8 and 8 - dosing pumps; 9-horizontal settler; 10-two sludge transfer pumps, ll-sediment bin, 12-sediment pump; 13-sulfuric acid dosing vessel. I4-aeration flotation cells; 15-tarIing pond; 16-dumping track

Filtration experiments were simulated actual process of vertical and horizontal chamber design pressure filters Laboratory unit with 0 0167 m" filtration area, covered by a polypropylene filter cloth., İs used to perform tests. All tests are conducted under permanent differential pressure AP = 0.663 MPa created by compressed air. Relative capacity for pressure tiller with vertical chamber ($q_{„}$) set up was estimated at prolongation of auxiliary operations 45 min and for horizontal chamber(q_h) set up pressure filter 18 min

3 SHD1MHNTATION INVESTIGATIONS

The icsulls of the flocculant testwork selection are presented in fable 2 The dosage rate for all comparing flocculants is equal - 1 5 g/dm" The best performance was achieved with usage ol weak anionic Polyacrylamide tloccnlants Pi-lenocryl 8720 and Miiimalloc ï'--î

Table 2 Comparison appraisal of tested flocculants

Flocculant	Relative thickening area m^2.24 h/t
Blank	82 50
Magnafloc E-24	4,85
P3-ferrocryl 8720	481
P3-ferrocryl 8723	10.02
P3-ferrocryl 8740	4 93
P3-ièrrocryl 8766	8.67

Table 3 presents dala from worktest performed ranging the consuption of weak anionic and nonionic Polyacrylamide flocculants. The most cost-effective again is flocculant P'3-ferrocry) 8720. Considerable intensification improvement of sedimentation was noticed at dosage rate 0 5 g/dm^1 for all flocculants

It was laid down that sediment mud settled with difficulty The observation conducted through one

year ascertains that their fluidal characteristics do not change

Table 3 Scdimenlalion results ranging llocculant consuption

riocculant	Dosage rate g/dm'	Relative thickening area m' 24 h/t
Magnalloc E-24	0 5	6 40
	1 5	4 85
	3.0	3 85
P3-ferrocryl 8720	0 5	6 28
	I 5	481
	3 0	3 82
P3-ferrocryl 8740	0 5	7 32
	1 5	4 93
	3 0	4 08

4 FILTRATION INVESTIGATIONS

Filtration worktest were carried out to simulate the actual process of chamber design pressure filters The results of tests are shown in Table 4. The relative

Table 4 Results from filtration tests

Cake thickness mm	Cake residual moisture %	Relative filter capacity *kujm*^{l} h	
		Qv	qi.
10	83.08	2 16	464
13	84 00	2.63	5 35
16	84 27	3 42	6 22

capacity of pressuie filters was calculated vaiymg the space between the plates 1 he space of 20, 26 and 32 mm corresponds accoidinglv with cake thickness of 10, *1*1 and 16 mm The variation in relative capacity values could be explain wilh the piolongation differences of auxiliary opeiations. for the two types piessure tillers The high cake residual moisture is due lo the pi esence of hydioxide compounds within The same reason is loweiing the value of relative capacity Ne vet (In-less I he high peiceniage of moisture, produced cake can be trucked

5 RF.VII'WOI OPERATION OF 11II. CLEAN UP I'ACMJTY

The t|iiahly of cleaned up mine water is controlled by means of pH and assay of coppei, iion, manganese and sulfate ions Duimg a period *of W* days' opeıatioıı the following mean values aie delcımined pH S 2, (V 0 09mg/dm^{s} Mn' 0 0<W mg/dm , I ci,,,.,! 0 274 mg/dm", SO,' iM/niu/dm" As make-up reagents weak anionic polvaervlamide llocculant and sulfuric acid are put in practical use

Cleaned up water flows into (lie watercourse hydraulic system The results of analysis show that treated mine water meet the requirements of the Bulgarian Stale Standard for water capture into the second category basin Table 5 presents data about permitted limits and staled deviation foi supervising indexes of cleaned water As can be seen the deviations of sulfate ion concentration exceed 100% To reach the permitted limits of 300 mg/dm', treated water has to be diluted For the rest of supervising indexes deviations vary between 3 3 and 20 0 %

Table 5 Efficiency of purification of waste mine watet at Assarel ShHC

Index	Unit	Permitted limit	Deviation %
Active reaction	pII	6 0-8 5	16 66
Copper	mg/dm'	0 10	20 00
Manganese """	mg/dm'	0 30	10 00
Iron^{1}""^{1}	mg/dm"	1 50	3 30
Sulfate ions	mg/dm^{1}	300 00	100 00
Insoluble matters	mg/dm'	50.00	0 00

6 CONCLUSION

The quantity of waste mine water entering the clean up facility exceed about two times the projected one at open-cast of Assarel ShHC Usage of weak anionic Polyacrylamide floceuiants assists sedimentation of insoluble matters By their use, solids' content is lowered bellow 50 mg/dm^{1} in treated walei. while in the mud it is 51 gr/dm' The existing water treatment technology can not provide achievement of sulfate ion concent ration limit The mean values of the rest indexes aie in the pei milted limjisoJ'llic ifanda/d

file sediment iccovered liom a walei cleaning facility keeps for a long lime its fluidal characteiis'iies Cained oui investigations give the possibility lor dewatenng of refuse solids up to 84 % nioi:.liiie content The eake obtained from piessuie fillliiiiion contain about ^% coppei and could be liiiL'ked and dumped in bulk eondiiinit

RM FRI-NCES

/ayoiski, V el al 1085 Dclcimination of physical and chemical indexes of mine walei at Assaicl open cast *Mimio I k'lu Journal* (î) 2<>- Î2

/JI!',0!sl,i. V el ;il I'fS'J Cleanm;', nunc uaieis iiom Assaiel bed *Mimio I k'lu .lain mil* (i) S-I I

Zniiarov, Z and P Hadjiev 1978 Function and usage of reagents Magnafloc, Drymax and Antyprex *Riulodobtv Journal* (10) 26-28

Henkel Metallchemie 1996 Flockungs - Flockungshilfsmittel und Schlammkonditionıonıenıngsmıttel (I Teil) *Iethnische Information,* 1-12