The effect of mixed collectors in the rougher flotation of sungun copper

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Abstract: The use of mixtures of collectors has long been recognised in plant practice and has been shown to enhance flotation performance. These benefits have been reported for a wide range of collector mixtures (anionic, cationic and non-ionic) and include lower dosage requirements, improved selectivity and rates and extents of recovery and an increase in the recovery of coarse particles. Thus, knowing about these interactions can help to improve the present situation greatly. The goal of the present research is to study the effect of the composition of the collector on copper and iron recovery from porphyry ore. In this research the performance of collectors has been investigated in Pure and in the mixture form. To do so, we have used the collectors of Xanthates, dithiophosphates and thionocarbamates. The results of combination of the collectors showed that the best Cu recovery has been achieved with %92.20 in the compositions of the collectors of SIPX with SIBDTM (a mixture of mercapto benzothiazole and dithiophosphate), But the best Cu grade was achieved with %7.58 in the composition of potassium amyl Xanthate with Diisopropyl thionocarbamate.

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1. Introduction

Floatation is one of the methods used widely the separation of sulfide minerals from the other minerals [1]. This method has made it possible to utilize ores with very little grade [1]. This method has been used to extraction copper sulfide minerals for more than a century. Now, more than %90 of the basic metal sulfides such as copper, zinc, lead … are made Concentration by using floatation method [2]. We can mention collectors and frothers from reagent chemicals which are used for floating the valuable particles in floatation. These reagent chemicals can be added in different stages of the operations and surely the time and location of this adding affects the efficiency of the operation [3].

Thiol collectors are used in the froth flotation of copper sulphide ores. The xanthates, dithiophosphates and dithiocarbamates are classes of thiol collectors that each form different surface products on different copper sulphide minerals. It has been shown that the use of mixtures of thiol collectors can have benefits over the use of pure collectors [4]. Choosing an appropriate frother is one of the most important issues in floatation of sulfide copper minerals [5]. Usually a frother does not have enough power to float the thick particles or it does not operate selectively to float the tiny copper particles [6]. The frothers, such as methyl isobutyl carbonyl, TEB (alkoxy paraffin and pine oil), Dow 250, HP700 and HP600 (alcohols in amine oxide) are typically used in the flotation of porphyry copper and copper molybdenum ores [6].

Using the mixtures of collectors can result in more convergence compared to single collectors [7], [8]. Hunson & et al (1988) used feud collectors' composition for copper quarry [8]. Adoknis & et al (1992) utilized the composition of sodium isobutyl ditiophosphate as the weaker collector (more ready for choosing) and isopropyl sodium xanthate as the stronger collector for floatation of chalcopyrite [9]. Some advantages of using the composition of the collectors can be summarized as follows: more stable lather, better distribution on the quarry's surface and the stronger bond between quarry and bulb [10].

2. Experimental

2.1. Material

To do the floatation studies 400 kilograms of copper ore sample was prepared from Sungun mine located in northwest Iran. Studying XRD showed that of chalcosite is Copper critical mineral. The ore sample contained chalcosite, chovolite, chalcopyrite, bornite, pyrite, quartz, and molybdenite, respectively. In all gradation limits, chalcosite has been the most frequent copper mineral and it has been scattered as tiny particles among gang minerals. According to chemical analysis the copper grade in sample was equal to %0.65, in oxide copper it was %0.05 and in iron it has been %2.80.

2.2.Reagents

The collectors used in the present research were mostly produced by Cytec Company. But thionocarbamate was produced by Flomin Company. They are presented in table 1 xanthates were presented in the form of powder but

Dithiophosphates and thionocarbamates were presented in the fluid form.

Table 1: Collectors used in study

Chain Length	Abbreviation
Xanthates	
Sodium Isopropyl	SIPX
potassium amyl	PAX
Dithiophosphates	
Diisobutyl	SIBDTP
Diisobutyl and Mercaptobenzothiazole	SIBDTM
Dialkyl dithiocarbamates	
Diisopropyl	SIPDTC

2. Methods

After three stages of grinding by jaw and roll crushers and ball mill, a sample with K_{80} = 80 micron was prepared. The floatation cell of 2/7 liters of Denver was used. The impeller speed is 1250 r/min. 1175 grams of the sample prepared was mixed with 580 cm^2 water. The slurry of the mill was moved to floatation cell and it was solid concentration to %34 by adding water. PH was adjusted by the lime to be 11 before adding the reagent. By starting the work done by the impeller (speed of 1250 rpm) the reagents chemical were added to the slurry in the intended times and the entrance tap of the air is kept open to make the particles containing copper minerals float. The frothers used in the present research were isobutyl carbonyl and polypropylene glycol which were added with dosages of 5 g/t and 10 g/t, respectively. The floating concentrate in the surface of the slurry is collected during 16 minutes and in four different stages (2.50 minutes in first stage, 2.50 minutes in second stage, 5.20 minutes in third stage, and 5.20 minutes in fourth stage) separately. The distribution percentage of the reagents in four stages was (%30-%30-%25-%15). The froth and tailing were collected separately, filtered and analyzed for copper grade and recovery calculations.

3. Results and discussion

3-1. pure collectors:

Table 2 show the amount of recovery of metals such as Cu, oxide copper and iron in the dosage of 40g/t in the presence of different collectors. As it can be seen, the maximum Cu and Fe recovery were achieved after 16 minutes scorification in the presence of the collector PAX. This can be due to the high capability of this collector in floating the coarse particles.

Table2: Mass recoveries (after 16min) using SIPX, PAX, SIBDTP and SIPDTC.

Collector	Mass recovery (%)		
	Cu (%)	Cuo (%)	Fe(%)
SIPX	83.32	76.70	70.98
PAX	85.40	74.14	74.28
SIBDTP	79.98	49.60	19.55
SIPDTC	76.10	72.24	20.13

Fig. 1 shows the results of Cu metallurgy calculations in the presence of different collectors. The results show that by reducing Cu recovery its concentrate grade will increase and the maximum Cu grade was achieved in the presence of the collector SIPDTC and this is due to the high level of selectivity of this collector. It should be noted that the maximum efficiency separation for Cu has been achieved in the presence of the collector SIPX.

Fig. 2 shows the results of iron metallurgy calculations in the presence of different collectors. The results show that the maximum Fe grade has been achieved presence of the collector PAX. This can be due to the locking of minerals copper with gangue minerals such as pyrite and also collectors in Xanthate group (especially PAX) are strong.

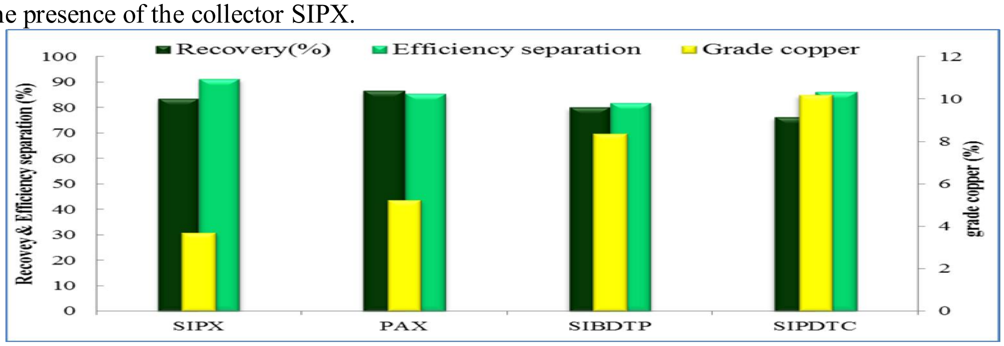

Fig.1. The results of Cu metallurgy calculations in the presence of pure collectors

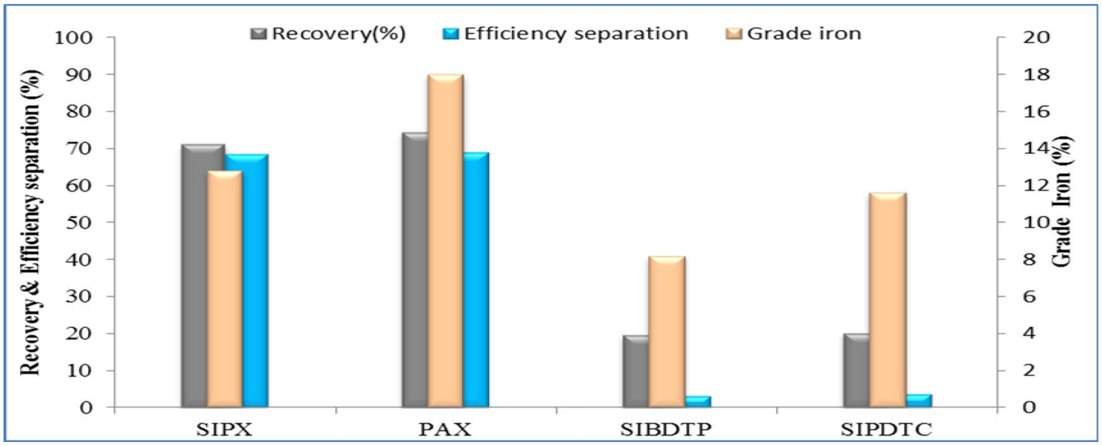

Fig.2. The results of Fe metallurgy calculations in the presence of pure collectors

3.2. Mixture of collectors

Xanthates are collectors which are usually used in floatation of sulfide minerals. Since Xanthates are strong collectors but they have low levels of selectivity, here we have used the collectors SIPX and PAX with a dosage of 15 g/t as the primary collectors and the collectors SIBDTP, SIPDTC, and SIBDTM were used as the secondary collectors with a dosage of 25 g/t.

3.2.1. SIPX with other collectors

Fig. 3 shows Cu recovery as a function of floatation time by using the mixture of SIPX with other collectors. The results show that using the mixture of collectors increases the surface absorption on the mineral and it resulted in increasing the hydrophobicity surface of the mineral and the maximum Cu recovery has been achieved in the mixture of the collectors SIPX and SIBDTM. Also the minimum Cu recovery and the maximum Cu grade has occurred in the mixture of the collectors SIPX and SIBDTC.

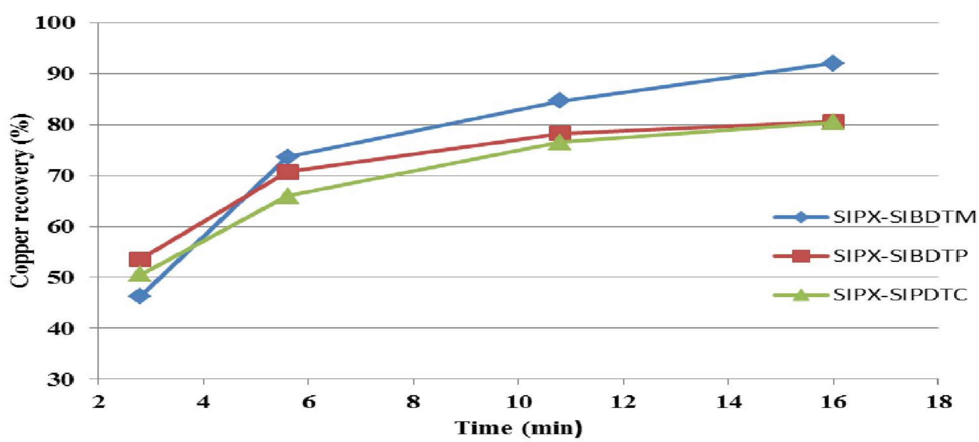

Fig.3. Cu recovery as a function of floatation time by using the mixture of SIPX with other collectors.

Fig. 4 shows the grade Cu as a function of recovery by using the mixture of SIPX with other collectors. The results show that the minimum Cu Grade has been achieved in the presence of the mixture of the collectors of SIPX and SIBDTM. The maximum grade in the whole stages has been achieved in the presence of the mixture of SIPX and SIBDTC collectors. This showed that the mixture has a high degree of selectivity.

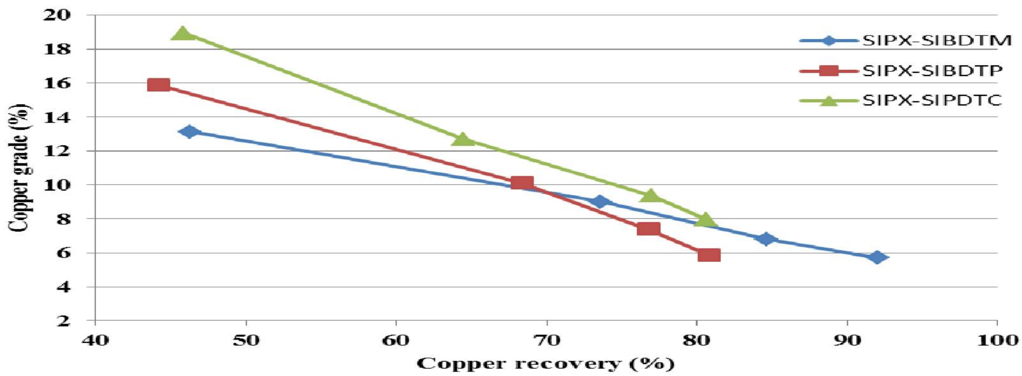

Fig.4. Cu grade as a function of recovery by using the mixture of SIPX with other collectors.

3.2.2. PAX with other collectors:

Fig.5 shows the results of Cu recovery for PAX. The results show that in this state the maximum Cu recovery has been achieved in the presence of the mixture of the collectors PAX and SIBDTM. Fig.6 shows the grade Cu as a function of recovery by using the mixture of PAX with other collectors. The results show that the maximum Cu grade has been achieved in the presence of the mixture of the collectors of PAX and SIPDTC.

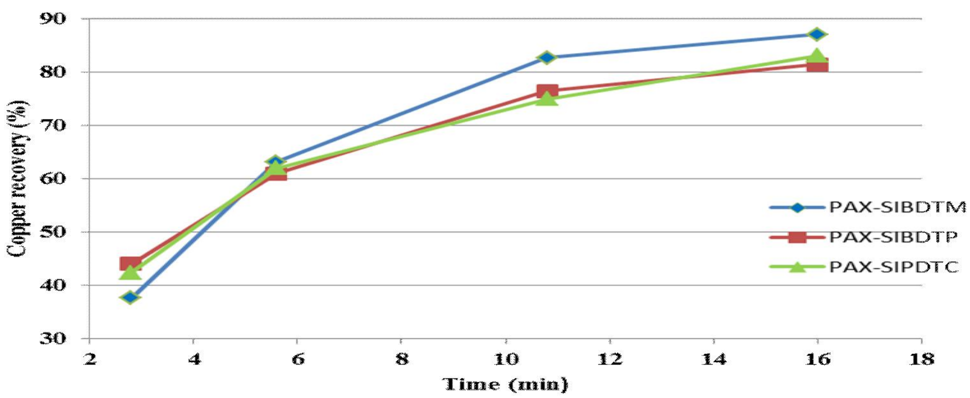

Figure 5. Cu recovery as a function of floatation time by using the mixture of PAX with other collectors.

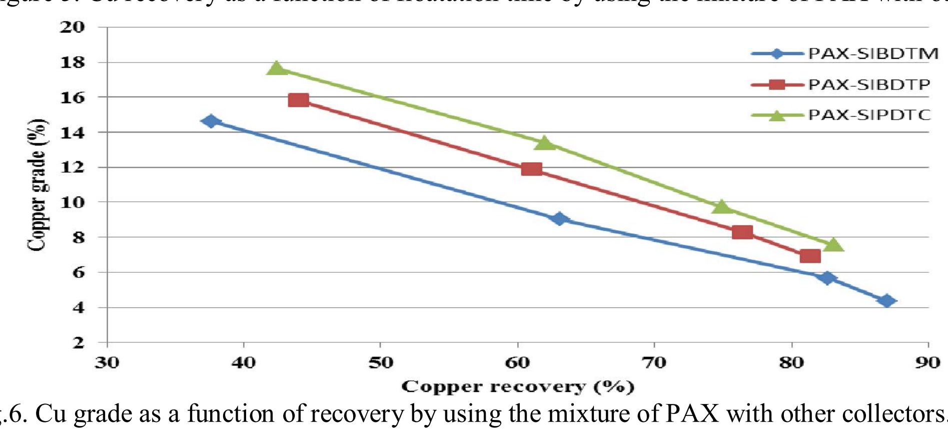

Fig.6. Cu grade as a function of recovery by using the mixture of PAX with other collectors.

Fe recovery which is mainly a result of transferring pyrite into the concentrate shows that the process is selective. Fig.7 shows Fe recovery as a function of floatation time by using the mixture of collectors. The results show that the maximum Fe recovery has been achieved in the presence of the mixture of the collectors PAX and SIBDTM. Regarding the low level of Cu grade in this mixture, we can conclude that in this mixture a considerable part of the pyrite has been transferred into the concentrate. Also the least Fe recovery has been achieved in the mixture of the collectors PAX and SIBDTP. It showed the considerable part of the pyrite has been transferred into the tailing.

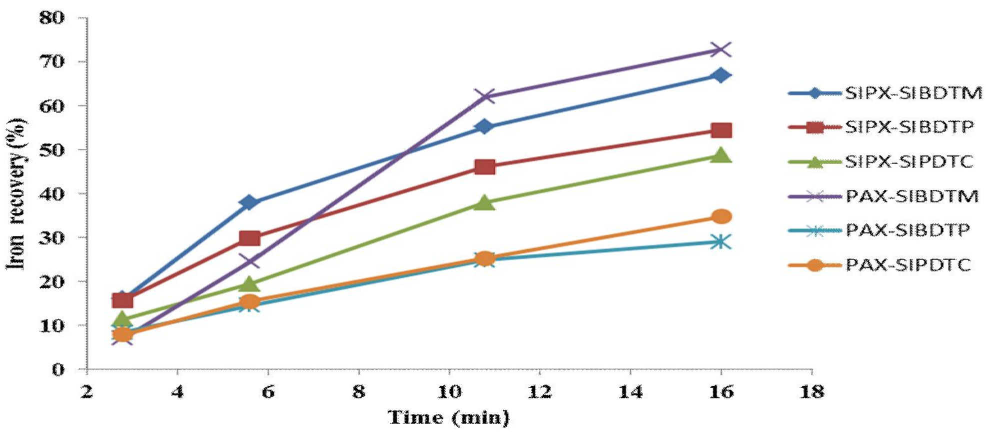

Fig. 7. Fe recovery as a function of floatation time by using the mixture of collectors

4. Conclusions:

In the present research Cu and Fe recovery were investigated in the presence of collectors in individual and in integrative forms. Testing with Pure collectors showed that the maximum Cu and Fe recovery was achieved in the presence of the collector PAX. The results showed that using the mixture of the collectors will result in increasing the selectivity of performances by the collectors. Also the best Cu recovery (%92.20) was achieved in the mixture of the collectors SIPX and SIBDTM, but Fe recovery was %66.95 in this mixture. Also the best Cu grade (%7.58) was achieved in the mixture of the collectors PAX and SIBDTC. In this case Cu recovery was %83.07. The best Fe recovery (%72.78) was achieved in the mixture of the collectors PAX and SIBDTM. In this condition, Cu recovery and grade were %87.04 and %4.34, respectively.

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Reference

1. Khmeleva, T.N.; Skinner, W.; Beattie, D.A.; Georgiev, T.V.; "The Effect of Sulphite on The Xanthate-Induced Flotation of Copper-Activated Pyrite", Physicochem. Prob. Of Min. Proc., 36, pp 185-195, 2002.
2. B. Rezaei; Flotation, Hormozgan pub (1995). Iran
3. Vazifeh, Y.; Jorjani, E.; Bagherian, A.; “Optimization of reagent dosage for copper flotation using statistical technique” , Transactions of Nonferrous Metals Society of China, vol. 20, p.p. 2371-2378 , 2010.
4. Hangone, G.; Bradshaw, D.; Ekmekci, Z.; "Flotation of a copper sulphide ore from Okiep using thiol collectors and their mixtures", The Journal of The South African Institute of Mining and Metallurgy, Volume 105, pp199-206 , 2005.
5. Bulatovic, M.; Handbook of Flotation Reagents: Chemistry Theory and Practice, vol. 1: Flotation of Sulfide Ores, first edition, Elsevier Science, The Netherlands, 2007.
6. Cases, J.M.; Kongolo, M.; de Donato, P.; Michot, L.J.; Erre, R.; "Interaction between finely ground pyrite and potassium amyl xanthate in flotation: 1 Influence of alkaline grinding", Int. J. Min. Proc. 38, 267–299, 1993.
7. Lotter, N. O.; Bradshaw, D. J.; “The formulation and use of mixed collectors in sulphide flotation”, Minerals Engineering, vol. 1, p.p. 945-951, 2010.
8. Hanson, J.S., Barbaro, M., Fuerstenau, D.W., Marbini, A. and Barbucci, R. Interaction of glycine and a glycine-based polymer with xanthate in relation to the flotation of sulphide minerals. Int. J. Miner. Process., vol. 123. 1988. pp. 123–135.
9. ADKINS, S.J. and PEARSE, M.J. The influence of collector chemistry on the kinetics and selectivity in base metal sulphide flotation. Miner. Engng., vol. 5, nos. 3-5, 1992. pp. 295–310.
10. D.J. Bradshaw, P.J. Harris, and C.T. O’Connor, Synergistic interactions between reagents in sulphide flotation, The Journal of The South African Institute of Mining and Metallurgy, July 1998.

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