Materials of Conferences

PHYSICO CHEMICAL PROPERTIES OF MIXED OXIDE COPPER ORE OF KAZAKHSTAN

[1]Serikbayeva A.K., [2]Zhumashev K.,
[1]Janaliyeva N.S., [3]Berdikulova F.A.

[1]Caspian State University of Technologies and Engineering named after Sh. Esenov, Aktau, e-mail: akm_rgp@mail.ru;
[2]Chemical and Metallurgical Institute named after J. Abisheva, Karaganda;
[3]The national center on complex processing of mineral raw materials of Republic of Kazakhstan, Almaty

In this paper the characteristic of mixed copper ore and tailings in Kazakhstan. By mineralogical composition of waste are mainly represented by calcite, quartz, bornite, and with the inclusion of the individual grains, nedoizvlechennyh ore minerals (chalcopyrite and chalcocite). The chemical composition of the waste contained in these (in %): S_{obsch} = 2,5; $S_{sulfidn}$ = 0,9; Fetotal = 1,9; Cu = 0,15; Pb = 0,04; Zn = 0,03; Re = 0,61 g/t; Mo = traces.

Introduction. Analysis of technical and scientific literature shows that it is complex composition of the raw materials processed in the non-ferrous smelters as well as low content of commercial components in them causes the biggest volume of specific yield of wastes i.e. man-made mineral formation in the extractive industries [1]. That is why they are still accumulated and cause extremely high man-made loads on the environment.

Physical-chemical study of oxide copper ore and mill tailings is required to justify and select the suitable methods of experiments.

The ore tical justification for sulfurizing of oxide materials is based on physical-chemical properties of compounds under study, namely, oxide compounds of copper and rhenium in the study materials. Selection of the process terms, such as temperature, ratio and feed size etc., is also based on copper and rhenium speciation.

Materials and methods. We studied the chemical and phase composition of mixed oxidized copper ores and tailings.

X-ray spectrum analysis (definition of elemental composition and major phase), grain size analysis (definition of distribution of the main components on speciation class) were applied for identification of the source materials.

Results and discussion. The main components of the ores are copper and molybdenum. The copper content in the ores varies from the first tenths of a percent to as much, reaching a maximum of 4,1 %, molybdenum content of thousandths of up to 0,28 % [2]. Also copper and molybdenum ores has zinc, lead, gold, silver, selenium, tellurium, rhenium. These elements are found in the field of minerals in the form of its own or as admixtures isomorphic chalcopyrite, pyrite and molybdenite [3].

Physical-chemical properties (chemical and phase composition, thermal properties) of the materials were detected. Tails are basically small grey sand, containing more than 90 % particles of size less than 0,15 mm [4]. As per mineralogical composition these tails are mostly calcite, quartz and bornite with particular grains, underextracted ore minerals (chalcopyrite and chalcocite).

As per chemical composition, the considered tails contain the following (in %): S = 2,5; $S_{sulfide}$ = 0,9; Fe = 1,9; Cu = 0,15; Pb = 0,04; Zn = 0,03; Re = 0,61 g/t; Mo = show. Tails are not soluble in the water, non-inflammable, non-explosive.

The results of X-ray analysis of ore deposits Bozschakol Dzhezkazgan and again proves the literature data, the copper content ranges from 0,2–0,9 % oxygen and 50 % in the form of oxides (Table 1, 2).

Table 1

Results of X-ray spectrum analysis of the Bozschakol field ore

Number phase	O	Mg	Al	Si	K	Ca	Fe	Cu	Total
1	51,41	2,25	13,01	25,90	5,22	0,27	1,73	0,21	100,00
2	48,36	1,40	12,84	19,80	2,09	2,11	12,48	0,92	100,00
3	49,88	1,83	12,92	22,85	3,66	1,19	7,11	0,57	100,00

Table 2

Results of X-ray spectrum analysis of the Zhezkazgan mixed ore

Number phase	O	Na	Al	Si	K	Fe	Cu	Total
1	49,03	2,66	5,16	40,57	0,80	0,82	0,96	100,00
2	54,34	7,21	9,42	27,30	0,34	0,73	0,66	100,00
3	51,69	4,94	7,29	33,93	0,57	0,78	0,81	100,00

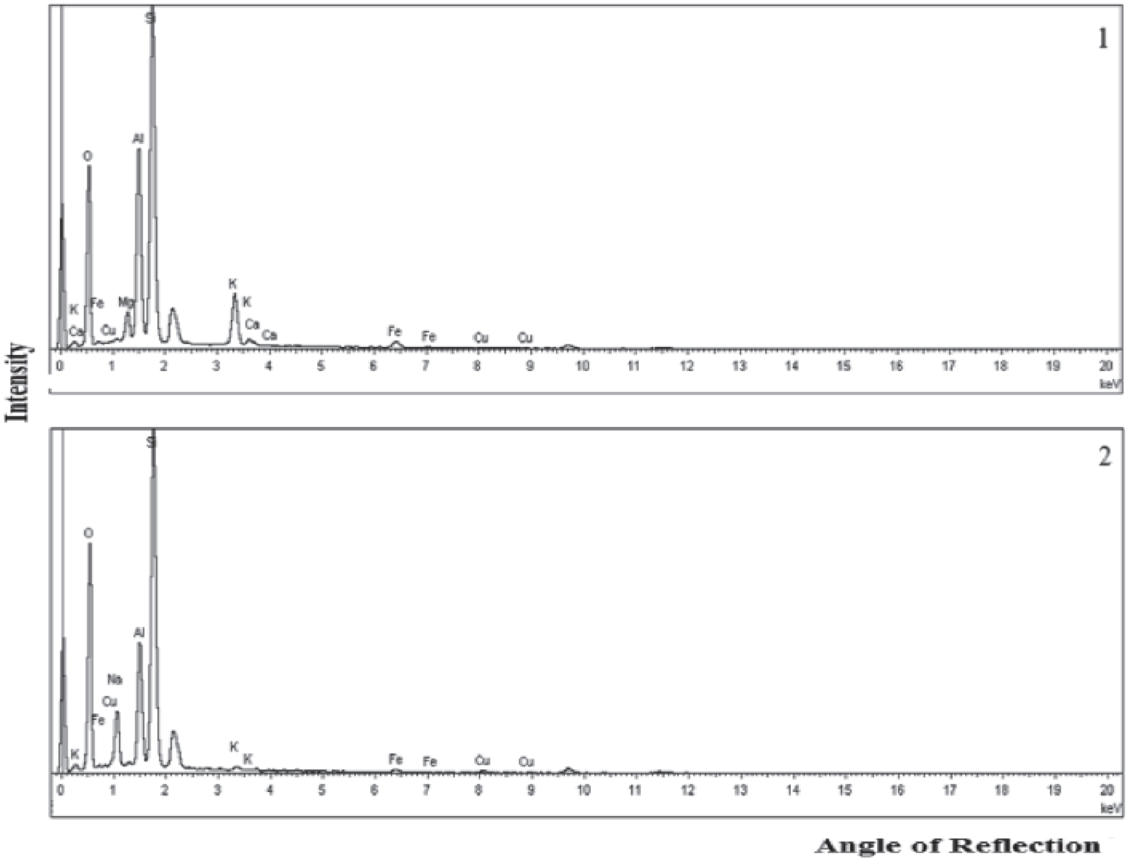

Fig. 1. Spectrum Analysis of Oxide Materials:
1 – Bozshakol oxide ore; 2 – Zhezkazgan mixe dore

Study of material composition of the source material with definition of chemical and grain size composition

Laboratory research was performed with ore sample [3]. The sample was selected and passed for full chemical and phase analysis for follow-up study. The results of phase analysis of oxide ore areshown in the Table 3; the results of the X-ray spectrum analysis are shown in the Table 1. Magnesium and calcium compounds in the source sample are shown in the Table 4.

Commercial components in the source material include copper in an amount of 0,96 % and silver – 10 g/t, and contain other chemical components (Table 4). Grain size distribution of the minerals is presented in the Table 5.

Table 3 shows that the highest copper content is in the class of –1 + 0, so the output is also more than in the rest of grain-size classes. Copper content starts increasing in the class of –25 + 10.

Mill tailing of copper oxide ore of the Zhezkazgan field represents small grey sand, containing more than 90 % particles of the size less than 0,15 mm [4]. As permineralogical composition the setails are mostly calcite, quartz and bornite with particular grains, underextracted ore minerals (chalcopyrite and chalcocite) (Fig. 2).

Table 3

Results of the phase analysis of oxide ore

Copper-total	Sulfates		Carbonates		Oxides, silicates		Secondary sulfides		Chalcopyrite	
	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.
1,00	< 0,2	–	0,35	35,00	0,12	12,0	0,47	47	< 0,2	6,0

Table 4

Magnesium and calcium compounds in the sample

Name	Abs.	Rel.
Calcium		
Sulfates	6,14	55,8
Carbonate	4,86	44,20
Total	11,00	100,00
Magnesium		
Carbonate	3,56	87,7
Oxides	0,5	12,3
Total	4,06	100,00

Table 5

Grain size distribution of main components on grain-size class

Grain-size class, mm	Output, %	Content		Extraction	
		Cu, %	Ag, g/t	Cu, %	Ag, g/t
+ 25	3,10	0,39	8,60	1,28	2,70
–25 + 10	16,99	0,87	3,60	15,52	6,12
–10 + 5	11,17	0,83	8,90	9,74	9,94
–5 + 3	9,32	0,88	9,0	8,61	8,40
–3 + 1	18,49	1,02	12,0	19,78	22,20
–1 + 0	40,93	1,05	11,5	45,07	47,10
S	100,00	0,96	10,0	100,00	100,0

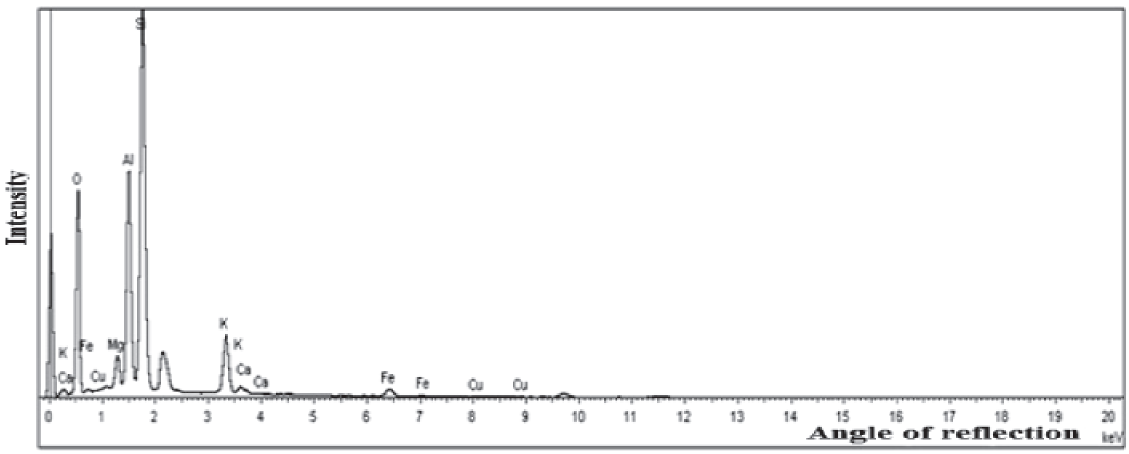

Fig. 2. Spectrum analysis of mill tailing

As per chemical composition, the considered tails contain the following (in %): $S_{ttl} = 2,5$; $S_{sulfide} = 0,9$; $Fe_{ttl} = 1,9$; Cu = 0,15; Pb = 0,04; Zn = 0,03; Re = 0,61 g/t; Mo = show. Tails are not soluble in the water, non-inflammable, non-explosive. Classof hazard – 3.

Milltailing after processing of copper lead ore of Ridder-Sokol, Tishinsk and Zhairem fields contains up to 0,01 % molybdenum. These man-made fields are basically sands with humidity of 20–35 % and volume weight of 2,75 t/m^3, containing (in %) Zn = 0,16; Pb = 0,063; Cu = 0,03; Bi = 0,004; Mo = 0,001; Mn = 0,07. Mill tailings are not soluble in water, non-inflammable, non-explosive. Class of hazard – 3. Chemical composition of the Zhezkazgan tailing is shown in the Table 6.

Table 6

Chemical composition of the Zhezkazgan mill tailings

Number phase	O	Na	Mg	Al	Si	K	Fe	Cu	Total
1	49,54	1,17	0,83	7,34	35,73	3,87	1,47	0,05	100,00
2	43,41	0,72	2,00	9,94	32,82	4,69	5,38	1,04	100,00
3	46,48	0,94	1,42	8,64	34,27	4,28	3,43	0,54	100,00

Conclusion

Thus, mill tailing of sulfide and oxide copper and copper lead ore contains significant amount of copper, lead, silver and rhenium.

The man-made fields are based on silicon oxide (up to 70 %). With this respect, it is necessary to develop the methods of milling and separation of rare metals into the separate concentrate.

The development of effective technology for processing of man-made fields allows decreasing ecological tailing loads and ensures extraction of rare and rare-earth metals from the tailings of mining and smelting enterprises.

Acknowledgment. Work performed as part of research grant funding the Ministry of Education and Science of the Republic of Kazakhstan on theme: «Investigation of physical and chemical laws of sulphidation rare metal containing technogenic materials with sulfur». Contract № 343 from 12.02.2015.

References

1. Aytzhanova D. Implementation of modern programs use industrial waste // Industry of Kazakhstan. – 2012. – № 3. – P. 23–24.

2. The copper deposit in Kazakhstan. Directory. – Almaty, 1997.

3. Poletaev A.I., Kalmykov T.V. et al. Report on “mineralogical and petrographic and morpho-structural especially molybdenum- copper deposit Aktogay” . – Alma-Ata, 1979. – Vol. 2.

4. Krivtsov A.I., Bogdanov Y. and others. copper deposit The types and conditions of formation – M., Nedra, 1987. – 197 p.

The work is submitted to the International Scientific Conference «Priority areas of science, technology and engineering», Netherlands (Amsterdam) October, 24–30, 2015, came to the editorial office on 09.10.2015