

Study on Beneficiation of a Refractory Low Grade Oxidized Zinc Ore

Pengfei Zhang^{1,2,a}, Haiyun Xie^{1,2,b}, Chao Ding^{1,c}, Likun Gao^{1,2,d}, Xiong Tong^{1,2,e}

(1. Faculty of Land Resource Engineering, Kunming University of Science and Technology Kunming 650093, China

2. State Key Laboratory of Complex Nonferrous Metal Resource Clean Utilization, Kunming 650093, China)

^aEmail:1540028565@qq.com, ^bEmail:xie-haiyun@163.com, ^cEmail:1053981006@qq.com,

^dEmail:likun_gao@126.com, ^eEmail:xiongtong2000@yahoo.com

Key words: low-grade oxidized zinc ore; flotation; sulfurization-amination

Abstract: A low grade oxidized zinc mine of Lan ping contains 6.52% Zn with a high ratio of oxidized zinc ores and a little sulfide minerals. In order to utilize this kind of ore, the test treats oxidized zinc ore as a kind of valuable mineral and an experimental study on beneficiation is carried out in which the process flow-sheets of sulfurization-amination is used. A good technical index with 45.28% of zinc concentrate at a Zn recovery of 71.45% is achieved.

Introduction

Lanping zinc oxide ore in Yunnan province is the largest zinc oxide deposits proved reserves in China at present, With characteristics of a high ratio of oxidized and fine disseminated extent, it has great difficulty for mineral processing^[1]. A large number of low grade zinc oxide ore has been unable to use. Flotation method plays an important role in the treatment of zinc oxide ore in industrial production^[2]. To improve the grade and recovery of zinc are still problems in the separation of zinc oxide ore. According to the analysis of related literature at home and abroad, this paper makes an experimental study on beneficiation of a low grade oxidized zinc ore in Lanping with sulfurization-amination, being of great practical significance for improving the utilization rate of zinc resources.

Material and method

Material

The material used in the study is taken from Lanping in Yunnan. Multi-element analysis results of crude ore are shown in table 1, Analysis results of zinc phase are shown in table 3.

Table 1 Multi-element analysis results of crude ore/%

Element	Zn	Pb	S	Fe	SiO ₂	CaO	MgO	Al ₂ O ₃
Content	6.52	0.63	1.54	5.56	25.78	22.43	1.65	2.43

Table 2 Analysis results of zinc phase/%

Zinc phase	Carbonate	Silicate	Sulfide	ferrite and other zinc	Total zinc
Zn content	3.45	2.72	0.27	0.083	6.52
Distribution	52.91	41.71	4.11	1.27	100.00

As can be seen from the table 1 and 2: The characteristics of zinc ore include low grade, high oxidation

rate. the grade of zinc is 6.52%, oxidation rate is 92.17%.The content of gangue mineral is high, and the total content of CaO and MgO is 24.08% in alkaline gangue, the content of SiO₂ is 25.78%.Apparently, the ore is a refractory low grade oxidized zinc ore.

Method

In zinc oxide mineral sorting, the method of sulfurization-amination has a significant effect [3], and the method is used in this study for treating oxidized zinc ore in Lanping. In this paper, the flotation reagents include pH regulator, dispersant which is sodium carbonate, inhibitor that are sodium hexametaphosphate and sodium silicate, vulcanizing agent which is sodium sulfide, and flotation collector that is octadecylamine. The equipment include XMQ - 240 *90, cone ball mill, the XFD single groove flotation machine (0.75 L and 1L), sieve set and DL - 5 C disk vacuum filter.

Test results and discussions

Grinding fineness and the dosage of reagents tests in the roughing

In the flotation of low grade zinc oxide ore, the grinding fineness is an important influencing factors, the proper dosage of reagents is crucial to the promotion of flotation index. In this part, conditions tests about grinding fineness and the dosage of flotation reagents are conducted, flow-sheets of condition test are shown in Fig.1.

Grinding fineness test

To determine the best grinding fineness of dressing experiment, grinding fineness test is done. The concentration of grinding was 65%, The dosage of various reagents as follows: Na₂CO₃ (1300g/t), Na₂SiO₃ (400g/t), Na₆O₁₈P₆ (250g/t), Na₂S (7000g/t), octadecylamine (400g/t), 2[#]oil (10g/t). flow-sheets of test are shown in Fig.1, Results of grinding fineness test are shown in table 3.

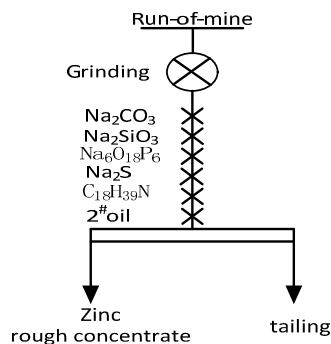


Table3 Results of grinding fineness test/%

-0.074mm/%	γ /%	β /%	ε /%
69.97	17.07	14.68	38.43
80.34	16.91	15.45	40.06
89.78	15.58	17.97	42.94
99.02	17.47	15.34	41.12

Fig.1 flow-sheets of condition test

According to the results in table 3 can be concluded that: with the increase of the content of -0.074 mm, the grade and recovery of zinc firstly increase then decrease, when the content of -0.074 mm is 89.78%, the grade of zinc is 17.97%, the recovery rate of zinc was 42.94%. By contrast, the grade and the recovery of zinc is the best index, so the best grinding fineness is that "-0.074 mm occupies 89.78%".

The dosage of Na₂CO₃ test

Changeless conditions are 450 g/t (Na₂SiO₃), 250 g/t (Na₆O₁₈P₆), 7000g/t (Na₂S), 400 g/t (C₁₈H₃₉N) and 10 g/t (2[#] oil). flow-sheets of test are shown in Fig.1, The influence of dosage of sodium carbonate on the flotation indexes of zinc concentrate are shown in Table 4. According to the results in Table 4 can be concluded that: with the increase of the dosage of Na₂CO₃, the grade and recovery of zinc firstly increase then decrease, When the best dosage of Na₂CO₃ is 1500g/t, the grade of zinc is 9.46%, the recovery rate of zinc reached 88.24%.

The dosage of Na₂SiO₃ and Na₆O₁₈P₆ test

The dosage of Na₂SiO₃ and Na₆O₁₈P₆ as follows: A(300g/t+100g/t), B(400g/t+150g/t), C(500g/t+200g/t), D(600g/t+250g/t), E(700g/t+300g/t). Other conditions are 1500g/t (Na₂CO₃), 7000g/t (Na₂S), 400g/t

(C₁₈H₃₉N), 10g/t (2 # oil) . Flow-sheets of test are shown in Fig.1, The results are shown in Table 5 and it shows that the grade and recovery rate of zinc firstly increase then decrease with the increase of Na₂SiO₃ and Na₆O₁₈P₆. It can be seen that the best dosage of Na₂SiO₃ and Na₆O₁₈P₆ is C (500g /t + 200g/t).

The dosage of Na₂S test

Sodium sulfide has activation properties for zinc oxide ore in sulfurization-aminatio,The different dosage affects the flotation index.Changeless conditions are 1500g/t(Na₂CO₃), 500g/t(Na₂SiO₃), 200g/t(Na₆O₁₈P₆), 400 g/t(C₁₈H₃₉N), 10g/t (2 # oil),flow-sheets of test are shown in Fig.1,Results in the dosage of Na₂S test are

Na ₂ CO ₃ (g/t)	β /%	ε /%
500	17.03	85.21
1000	17.81	86.27
1500	19.46	88.24
2000	18.32	84.65
2500	17.96	83.92

Table 4 Results in the dosage of Na₂CO₃

Na ₂ SiO ₃ / Na ₆ O ₁₈ P ₆ (g/t)	β /%	ε /%
A	14.83	80.25
B	15.76	82.14
C	18.26	83.44
D	17.81	79.52
E	16.51	75.62

Table5 Results in the dosage of Na₂SiO₃ and Na₆O₁₈P₆ test

shown in Table 6 and it shows that the grade and recovery rate of zinc firstly increase then decrease with the increase of Na₂S,When Na₂S is 8000 g/t, the grade of zinc was 18.26%, the recovery rate of zinc is 81.03%, By contrast, 8000 g/t is the best dosage of sodium sulfide.

Na ₂ S/(g/t)	β /%	ε /%
4000	15.36	65.52
6000	17.43	78.61
8000	18.26	81.03
10000	17.51	79.02
12000	16.78	72.45

Table 6 Results in the dosage of Na₂S test

C ₁₈ H ₃₉ N /(g/t)	β /%	ε /%
300	17.28	62.35
400	18.32	65.13
500	18.97	82.84
600	19.03	70.22
700	18.25	64.53

Table 7 Results in the dosage of C₁₈H₃₉N test

The dosage of octadecylamine test

C₁₈H₃₉N is used as zinc oxide mineral collector in the test.Changeless conditions are 1500g/t(Na₂CO₃),500g/t (Na₂SiO₃),200g/t (Na₆O₁₈P₆),8000g/t (Na₂S),10g/t (2# oil) .flow-sheets of test are shown in Fig.1,Results in the dosage of C₁₈H₃₉N test are shown in Table 7 and it shows that the grade and recovery of zinc firstly increase then decrease with the increase of the dosage of C₁₈H₃₉N, when the dosage of the C₁₈H₃₉N is 500g/t, the grade of zinc is 18.97%, the recovery of zinc is 82.84%, when the dosage of C₁₈H₃₉N is 600g/t, although the grade of zinc is 19.03%, the recovery of zinc is only 70.22%.the test can confirm that the best dosage of C₁₈H₃₉N is 500 g/t.

Open circuit test

This study makes aopen circuit test which is first roughing separation,three times concentrations, double scavengings.flow-sheets of test are shown in Fig.2,Results of open circuit test are shown in Table 8 and it shows that the grade of zinc concentrate can reach 46.20%, the recovery of zinc concentrate can reach 59.40%.

Closed circuit test

This study makes a closed-circuit test which is the first roughing separation, three

times concentrations, double scavengings. flow-sheets of closed-circuit test is showed in Fig.3 .Results of closed-circuit test are shown in Table 9 and it shows that the yield of zinc concentrate is 10.29%,the grade of zinc is 45.28%, the recovery of zinc reaches 71.45% , it is confirmed that the technological conditions and the process scheme which are decided by the test can recover zinc mineral from low grade zinc oxide ore better.

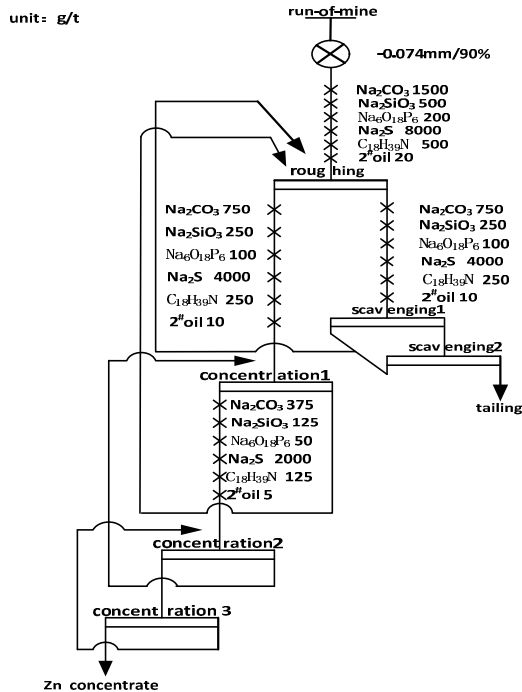


Fig.3 flow-sheets of closed-circuit test

Table 8 Results of open circuit test/%

Product name	γ /%	β /%	ϵ /%
Zn concentrate	6.75	46.20	48.50
Middling 1	5.67	3.51	3.10
Middling 2	0.84	14.06	1.84
Middling 3	0.86	9.67	1.29
Middling 4	11.76	22.29	40.77
Middling 5	8.12	3.93	4.96
Tailing	66.00	1.53	15.84
Summation	100.0		100.00
Run-of-mine	100.0	6.43	100.00

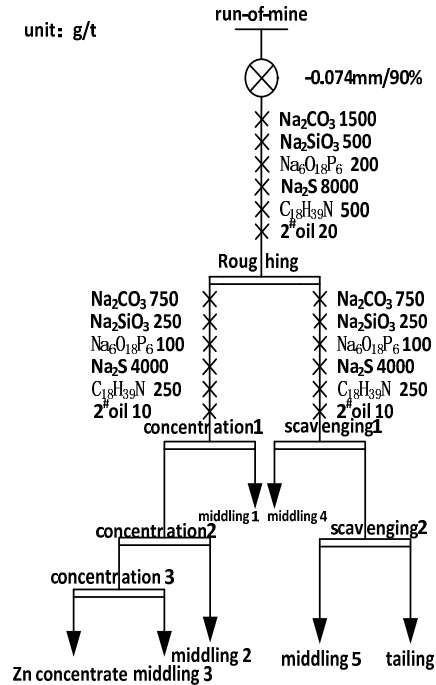


Fig.2 flow-sheets of open circuit test

Table 9 Results of closed-circuit test/%

Product name	γ /%	β /%	ϵ /%
Zn concentrate	10.29	45.28	71.45
Tailing	89.71	2.07	28.55
Run-of-mine	100	6.52	100

Conclusions

Mainly containing zinc, Lanping low grade zinc oxide ore is a kind of ore difficult to complete separation with high oxidation rate and gangue mineral. The test processings run-of-mine with the method of sulfurization-amination so that gains the better index that the yield of zinc concentrate is 10.29%, the grade of zinc is 45.28%, the recovery of zinc is 71.45%.

Acknowledgements

This work was financially supported by the Natural Science Foundation of China (Grant No.51464030).

References

- [1]XinpingZhang,XiuyingZhou,ShuqiuWang, etc. Study on new technology about the flotation of Lanping lead-zinc oxide ore [J].Mining and Metallurgy.1995(3):38-43.
- [2] Yan Song , Quanjun Liu, Fuqiang Chang.Flotation present situation and research progress of zinc oxide ore [J]. Mining and Metallurgy .2012, 21(2) : 19-22.
- [3]YushuangZhu, JianguangZhu.The chemical principle of flotation reagents[M]. Central South University press,2013.