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Preliminary Study on Floatation of Flotation Column for Ertang Coal Slime

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Abstract: In order to improve the flotation efficiency of high ash fine coal slime, flotation column was used to study the flotation of slime in Ertang Coal Preparation Plant. Firstly, industrial analysis and sieving test of the floating slime were carried out. The results show that the flotation efficiency is the best when the collector dosage is 400g / t and the amount of foaming agent is 600g / t, that is, the ratio of collector to foaming agent is 2: 3. In the premise to meet the requirements of coal ash, usually pulp concentration should be controlled as much as 60g / L below, in order to achieve the ideal sorting effect. The final index: 80.06% for clean coal production rate and 61.42% for perfect index flotation.

Keywords: Flotation Column, Collector, Foaming Agent

1. Introduction

Now in the flotation process, separation of slime flotation effect is not very ideal, causing great waste of resources. In order to solve the technical problems of high-ash fine-grained coal flotation, the researchers have been exploring and testing for many years [1, 2]. The application of flotation column technology to high-ash fine-grained coal flotation has a significant effect on improving the recovery of flotation concentrate and reducing the ash content of fine coal [3]. And the flotation column has a mild clean, green, non-toxic harmless, etc., in full compliance with the national energy-saving emission reduction and low-carbon economy trend [4, 5].

In the flotation process of flotation column, the dispersion of the microbubbles is higher than that of the conventional jet and mechanical agitation type flotation machine, and there are more micro bubbles. The flotation column can produce more gas-liquid interface under the same air-filled condition, and the probability of colliding with the mineral particles in the slurry is greater. And so that flotation column can reduce the pollution of high ash fine mud to clean coal. Flotation column combines the advantages of flotation and gravity separation, greatly improving the sorting effect [6]. The flotation stage of flotation column can ensure slime selectivity, and gravity centrifugal force field can improve the recovery rate of coal slime. This not only increases the amount of processing, but also improve the clean coal yield. At the top of the flotation column is provided with the water flushing device, which can make some high ash slime entrained on bubbles sink with the flushing water, no pollution to the clean coal. This will help improve the accuracy of sorting, and thus produce low ash clean coal [7, 8].

2. Experimental Materials Analyzer

2.1. Industrial Analysis of Coal Sample

Table 1. *Results of industry analysis.*

M_{ad}/%	A_{ad}/%	V_{ad}/%	FC_{ad}/%	A_d/%	V_d/%	V_{daf}/%	FC_d/%
1.57	27.29	18.09	50.06	30.56	18.12	26.21	50.86

2.2. Screening Test

According to the national standard "People's Republic of China coal screening test method" (GB/T477-2008) regulations, respectively using 0.50mm, 0.25mm, 0.125mm, 0.074mm and 0.045 mm standard sieve test samples of prepared by particle size analysis. Results are shown in table 2.

Table 2. *Experimental results of coal sample screening.*

grain size /mm	yield /%	ash /%	sieve accumulation		under the screen accumulation	
			yield /%	ash /%	yield /%	ash /%
0.50-0.25	31.77	24.69	31.77	24.69	100	36.43
0.25-0.125	24.06	25.98	55.83	25.24	68.23	40.01
0.125-0.074	21.58	27.06	77.41	25.75	44.17	43.91
0.074-0.045	19.16	29.84	96.47	26.56	22.59	47.92
<0.045	3.43	34.63	100	26.84	3.43	55.79
total	100	26.83				

Table 2 shows that the comprehensive ash content of the coal sample is 26.83%, which belongs to the medium-ash slime, which is close to the index of high-ash slime. The yield of 0.074-0.045mm grain size is 19.16%, and the ash content is 29.84%. The yield of 0.50-0.25mm grain size is 31.77%, and the ash content is 24.69%. The cumulative yield of -0.074 mm is 22.59%, and the cumulative ash content is up to 47.92%. The ash content of each grain size gradually increased with the decrease of particle size. The ash content of -0.045mm particles is 34.63%, which indicates that the coal sample contains a large amount of high ash fine mud. In the flotation process, part of the high-ash fine mud due to its own nature or other factors prone to entrainment with concentrate foam layer into the clean coal, causing pollution of the coal, affecting the overall flotation effect [9, 10].

2.3. Determination of Contact Angle of Coal Sample

The wetting contact angle of an object is related to the degree of difficulty of wetting the surface of the object. The larger the contact angle, the stronger the hydrophobicity of mineral surface.

Table 3. *Contact angle measurement.*

Grain size /mm	Wetting Contact angle / °						Average/ °
0.50-0.25	96.44	95.78	95.63	96.12	96.89	96.47	96.22
0.25-0.125	87.59	88.42	88.01	88.34	87.94	87.60	87.98
0.125-0.074	65.34	65.97	64.92	65.01	65.37	64.96	65.26
0.074-0.045	40.12	39.33	40.37	39.69	39.87	39.54	39.82
-0.045	36.03	35.87	36.22	36.14	35.91	35.67	35.97

Table 3 shows that the surface wettability of each size of slime size is different. With the decrease of grain size, the hydrophobicity of slime becomes smaller and smaller. Therefore, it can be seen that as the particle size decreases, the floatability of slime decreases.

3. Results and Discussion

Compared with the traditional foaming device, the external bubble generator of the flotation column has the advantages of no need of aeration and obvious energy saving effect. In order to optimize the flotation effect and the greatest degree of saving flotation agent dosage, the main purpose of the pharmaceutical level test is to determine the flotation agent dosage and dosage ratio on the flotation effect, and obtain the best dosage in the flotation.

3.1. The Required Equipment of Test

(1) 8 small plastic pots, 2 large plastic pots;(2) kerosene 500mL, the second oil 500mL;(3) the laboratory use of microbubble flotation column (type: FCSMC-50 static flow micro-bubble flotation column); (4) two 0.25cm diameter syringes;(5) 16 gray discs;(6) 1 muffle furnace.

3.2. Selection of Experimental Parameters

Kerosene as collector, No. 2 oil as foaming agent, foam layer of 16cm, pulp concentration of 60g / L, Collector dosage: 200g/t, 400g/t, 600g/t, the amount of foaming agent: 300g/t, 400g/t, 500g/t, 600g/t. And through the multi-factor-by-item test, to explore the impact of dosage on the yield of clean coal and ash indicators. Other parameters fixed: feed pump flow rate of 0.7L / min, tailings pump flow rate of 0.5L / min, circulation pump flow rate of 1.90L / min.

3.3. Analysis of Results

Table 4 - Table 6 shows the results of the exploratory test for the level of the drug.

Table 4. *Flotation results at 200 g / t collector.*

collector dosage /	dosage of foaming agent /	yield of clean coal /	ash of clean coal /	improved floatation index /
$g \cdot t^{-1}$	$g \cdot t^{-1}$	%	%	%
200	300	68.41	12.33	53.13
200	400	70.20	12.78	52.95
200	500	72.14	12.96	53.77
200	600	78.30	13.21	57.39

Table 4 shows that when the amount of collector is constant (200 g / t), with the increase of the amount of foaming agent, the yield of clean coal and flotation optimization index are increased. The maximum yield of clean coal is 78.30%, and the maximum flotation index is 57.39%.

Table 5. *Flotation results at 400 g / t collector.*

collector dosage /	dosage of foaming agent /	yield of clean coal /	ash of clean coal /	improved floatation index /
g·t-1	g·t-1	%	%	%
400	300	48. 90	13.41	35.36
400	400	69. 68	12.27	52.95
400	500	75. 19	12.42	54.32
400	600	80. 06	12.52	61.42

Table 5 shows that when the amount of collector is constant (400 g / t), with the increase of the amount of foaming agent, the yield of clean coal and flotation optimization index are increased. The maximum yield of clean coal is 80.06%, and the maximum flotation index is 61.42%.

Table 6. *Flotation results at 600 g / t collector.*

collector dosage /	dosage of foaming agent /	yield of clean coal /	ash of clean coal /	improved floatation index /
g·t-1	g·t-1	%	%	%
600	300	56. 88	13.74	40.19
600	400	67. 55	12.76	50.89
600	500	72. 79	13.23	53.28
600	600	76. 11	13.35	55.26

Table 6 shows that when the amount of collector is constant (600 g / t), with the increase of the amount of foaming agent, the yield of clean coal and flotation optimization index are increased. The maximum yield of clean coal is 76.11%, and the maximum flotation index is55.26%.

4. Discussion of Results

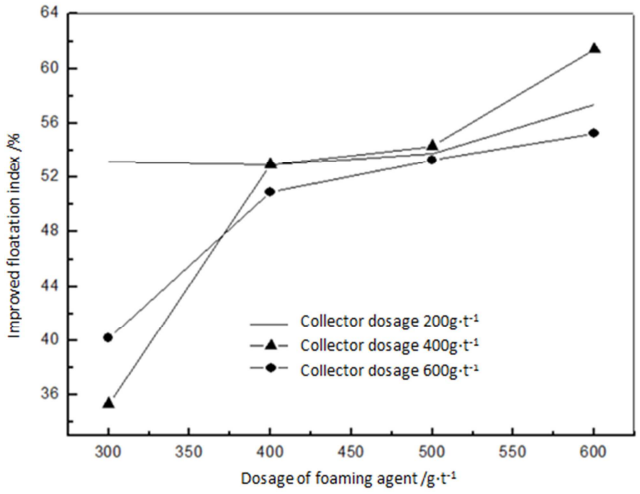

Figure 1. *Improvement index of flotation under different reagent ratio.*

It can be seen from Figure 1, when the amount of collector is constant, with the increase of the amount of foaming agent, the yield of refined coal and the flotation optimization index all increase. When the amount of foaming agent is constant, the ash content of the clean coal gradually increases with the increase of collector amount. Taking the collector dosage of 400g/t as an example, when the amount of foaming agent was 300g/t, 400g/t, 500g/t, 600g/t, the flotation indexes were respectively 35.36%, 52.95%, 54.32%, and 61.42%. On the whole, the amount of collector and foaming agent will influence the flotation effect. Appropriate increase of collector can enhance the collection performance of coal particle surface and improve its selectivity, to a certain extent, which improve the adsorption of coal bubbles, reducing fine mud entrainment pollution. Excessive collector will affect the flotation effect of coal by causing bubbles too thin sticky, poor mobility of foam layer, decreased coal yield. Appropriate increase of the amount of the foaming agent can improve the stability of the bubble and prevent the bubble merger. But excessive foaming agent will make the bubble empty, aggravating slime entrainment and leading to high ash content. Therefore, when the amount of collector is 400g / t and the amount of foaming agent is 600g / t, the effect of coal flotation is the best.

5. Conclusion

The amount of collector and foaming agent will have an impact on the flotation effect. In general, when the dose is too small, the amount of floating coal is low. When the amount of collector increases, it can enhance the coal particle surface collection performance, improve selectivity, to a certain extent, improve the adsorption of coal bubbles, reduce fine mud entrainment pollution.

However, excessive collector will cause bubbles too thin sticky, foam layer of poor mobility, decreased coal yield, affecting the flotation effect of coal slime. Appropriate increase in the amount of foam agent can improve the stability of the bubble to prevent the bubble merger. But excessive foaming agent, so that the bubble will be empty, the flow rate increases, increasing the slime entrainment, resulting clean coal in high ash content. Therefore, when the amount of collector is 400g / t and the amount of foaming agent is 600g / t, the effect of coal flotation is the best.

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