Implementation of Filtration Cake Recovery Process

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Abstract

The filtration cake slurry generated during security filtration is usually pumped into the red mud washer for separation. The liquid is recovered, and the solid is discharged as waste. According to the analysis of chemical composition and mineral composition of filtration cake in filtration cake slurry, it is found that it contains Al_2O_3, CaO, $3CaO \times Al_2O_3$, which is a high-quality additive in alumina production. Recycling of the filtration cake can reduce the unit consumption of alumina and lime and reduce red mud emissions. It is currently one of the important research directions for energy conservation and consumption reduction in alumina production. This article discusses the recovery path of filtration cake, search for a separation method for filtration cake slurry by experiments, and the addition of thickened filtration cake as an additive to the pre-desilication process. The thickened filtration cake can also be dealuminated, pressure filtered, and returned to the pre-desilication process. The recycling of filtration cake is realized through the above process.

Key words: Filtration cake, Recovery, Reparation, Dealumination, Pressure filtration.

1. Introduction

At present, lime milk is commonly used as a filter aid in the security filtration process of alumina production. The solid content of lime milk is 180–250 g/L, and the addition amount is 0.3 %–0.5 % by volume. Before addition, unpolished pregnant liquor is added at a volume of approximately 1:1 for reaction. A fully automatic Kelly filter is used for security filtration operation. When the Kelly filter is depressurized and sludge is discharged, pregnant liquor from the high-level tank is used to backwash the filtration cloth, and then enters the filtration slug slurry tank. The slurry with a solid content of 30-100 g/L is then sent to the dilution tank. The pregnant liquor (filtrate) in the slurry is recovered, and the solid in the slurry - the filtration cake - is discharged with the red mud [1]. The chemical composition of the filtration cake is shown in Table 1.

Table 1. Chemical composition (%) of filtration cake from a certain factory.

Al_2O_3	SiO_2	Fe_2O_3	TiO_2	K_2O	Na_2O	CaO	MgO	L.O.I.	Other
27.98	6.21	1.86	1.39	0.55	2.27	34.17	0.64	24.87	0.06

As seen from Table 1, the main components of the filtration cake are aluminum oxide and calcium oxide, and the A/S is 4.5, which has recycling value.

The recovery of alumina and calcium aluminates can not only reduce the consumption and recovery of alumina, but also reduce the production of red mud, which has good economic and social benefits.

2. Red Mud Separation and Settling Experiment

The experimental material is filtration slug slurry from two alumina refineries.

a. Tools used: 2500 mLsettling tubes, 2.5 mL and 5 mL needle syringes, stirrers, and stopwatches.

b. Additives X and Y: Prepared to a concentration of 3 %.

The experiment proved that the addition amount increased from 50 g/t dry mud to 100 g/t dry mud. Two additives X and Y were used to test separately where X had a poor effect, while Y had a good effect. The addition amount of 60–80 g/t dry mud was better, and the supernatant was clear, while almost no separation was observed without the addition of additives.

When the dosage of the Y additive was 50 g/t dry mud and 100 g/t dry mud, the effect was good, and the flocs were large. The compression effect was good at 1 min 16 s and 1 min 10 s respectively, with liquid-solid (L/S) weight ratio of 2:3. The supernatant is clear as shown in Figure 1. The experiment data are shown in Table 2.

Table 2. Experimental data.

Additive	Concentration	Additive amount	Settling time	Mud layer volume (5 min)	Settling velocity
		g/t dry mud	s	mL	m/h
X	0.30 %	50.88	296	142	0.51
		59.36	263	145	0.57
		69.53	220	155	0.69
		79.71	201	138	0.75
		89.88	192	150	0.79
		101.75	220	150	0.69
Y	0.30 %	50.88	76	58	1.99
		59.36	75	55	2.02
		69.53	73	64	2.07
		79.71	71	73	2.13
		89.88	77	68	1.96
		101.75	70	70	2.16

Figure 1. Effect diagram of additive Y (not added on the right side).

$$8845.85 \times 55 \div 1\,000\,000 = 0.48 \text{ MUSD} \quad (11)$$

Recycling this portion of alumina will increase costs (total alumina production cost - bauxite cost) as shown in Equation 12:

$$6475.39 \times (362 - 104) \div 1\,000\,000 = 1.67 \text{ MUSD} \quad (12)$$

Total annual profit as shown in Equation 13:

$$2.64 + 0.48 - 1.67 = 1.45 \text{ MUSD} \quad (13)$$

7. Conclusion

For the recovery of filtration cake, this article discusses two schemes. Plan 1 involves liquid-solid settling separation of filtration slug slurry, with the liquid phase returning to the unpolished pregnant liquor tank and the underflow containing the liquor being back washed into the pre-desilication system with cycling liquor. In Plan 2, the underflow of Plan 1 is separated and then dealuminated to increase the molecular ratio and reduce the impact of liquor contained on pre-desilication system. Both schemes have effectively recovered the solid phase of the filtration cake. Plan 1 has a simple process and strong feasibility for implementation; Plan 2 has a more complex process, but it can reduce the impact of liquor contained on pre-desilication system.

8. References

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