Imam Khomeini International University
Vol. 4, No. 1, Spring 2019, pp. 28-29

نشریه مهندسی منابع معدنی
Journal of Mineral Resources Engineering (JMRE)

DOI: 10.30479/jmre.2019.9394.1176

Investigation Of Iron Removal In 0-3 Mm Processing Circuit Of Semirom Fireclay Plant

Samadzadeh Yazdi M.R.[1,2*], Firoozi A.[3]

1- Assistant Professor, Mining and Metallurgical Engineering Department, Yazd University, Yazd, Iran
2- Assistant Professor, Mining Technologies Research Center, Yazd University, Yazd, Iran
Samadzadehyazdi@yazd.ac.ir
3- M.Sc, Mineral Processing, Mining and Metallurgical Engineering Department, Yazd University, Yazd, Iran
a.firouzi1368@gmail.com

(Received: 30 Sep. 2018, Accepted: 02 Feb. 2019)

Abstract: In this research, the monitoring and modification of the 0-3 mm processing circuit of the Semirom fireclay factory were investigated. The characterization results show kaolinite is the main mineral, while hematite and goethite are the iron minerals. Study of the polished sections and freedom analysis demonstrated that most of the hematite had been oxidized to goethite and spread in kaolinite particles. This circuit was monitored by sampling from different streams. The effect of parameters including feed rate, separator speed, and particle size, on iron removal, was investigated using a dry drum separator. Experiments with a roller separator with a magnetic field intensity of 10 kilogauss were performed to measure the possibility of further iron removal. According to the results of the experiments and the monitoring of the circuit, a new flowsheet was proposed by adding the roller separators to process the tailing of the first series of the plant separators as well as the final product, which allows the reduction of Fe2O3 grade to less than 1% and 5% increase in recovery in the final product.

Keywords: Kaolinite, Semirom fireclay, Magnetic separation, Drum separator, Roller separator, Iron removal.

INTRODUCTION

The Semirum fireclay deposit is located on the road of Semirom to Yasouj in Isfahan province, Iran, with a reserve of about 6 million tons. The processing factory removes iron impurities from kaolinite by drum electromagnetic separators. This factory processes the material in three separate lines of 0-3, 3-6 and 6-12 mm and by means of three consecutive magnetic separation stages. The current factory product contains around 2 percent iron, which limited its use in fireclay industry. In this research, investigation of affecting parameters on the magnetic separation of iron minerals was performed and a new flowsheet modification considering permanent roller magnetic separators was proposed.

METHODS

Representative fireclay samples were taken from different streams of the processing circuit for ten days. These samples were used to calculate the solid material rates and also other needed specifications. The iron content of the samples was analyzed by the calibrated XRF method. Mineralogy of the samples and freedom analysis were investigated by XRD along with the microscopic study of polished sections. Magnetic separation tests were performed by industrial-scale drum and roll magnetic separators with a magnetic field intensity of 10 kilogauss. Affecting parameters including feed rate, rotation speed, and particle size were investigated in both drum and roll separators.

FINDINGS AND ARGUMENT

The results of XRF analysis revealed that Al_2O_3, SiO_2 and Fe_2O_3 grades as 35, 36 and 15 percent, respectively. The main mineral was kaolinite while hematite and a small amount of quartz were also detected by XRD. Particle size analysis of the plant feed showed that 80 percent of the particles are smaller than 6.4 mm and 56 percent smaller than 3 mm. Microscopic study of polished sections confirmed vast metamorphosis of hematite to goethite. The current operation of the processing line of 0-3 mm particles (18 separators) produces 6.6 tons per hour of fireclay with iron content of less than 2%. The first six separators produce 4.8 tons per hour of tailing containing fine kaolinite particles which were not being separated due to their negligible mass.

Magnetic separation tests with drum separators conducted three times on each sample to evaluate the effect of operating parameters on the iron removal [1,2]. By increasing the feed rate, the separation efficiency decreased because of the formation of a thick layer of particles on the drum. Faster rotation of the drum caused further throw of particles, leading to higher product recovery and iron content. The results showed a higher negative effect of low rotation speed for fine particles smaller than 0.5 mm. These understandings of the parameter effects can be used to tune up the processing circuit for more efficient iron removal.

Roll magnetic separator was used to process the tailing of the first six drum separators. Results showed that after three separation stage, ten percent (0.48 tons per hour) is recoverable as a product with iron content of less than 2%. A different mechanism of separation in roll separators [3] made the possibility of recovering fine kaolinite particles. Separation tests with roll separators of the plant final product (1.26% iron) resulted in a product with 0.6% iron. This product can be used more desirable in fireclay industry. According to the results of this research, some modifications for the current process circuit was proposed.

CONCLUSIONS

This research clarified the effect of parameters on the separation of hematite and goethite from kaolinite by industrial electromagnetic drum separators. Drum rotation speed and the feed rate were found to have interaction effects on the separation of iron minerals, especially fine particles. The permanent Roll magnetic separator was approved to recover the kaolinite particles from tails and also purifying the final product. Proposed modifications made the possibility of recovering 0.48 tons per hour of kaolinite from tailings and the production of a final product with 0.6% iron content.

REFERENCES

[1] Tripathy, S. K., Singh, V., Murthy, R., Banerjee, P. K., and Suresh, N. (2017). *"Influence of process parameters of dry high intensity magnetic separators on separation of hematite"*. International Journal of Mineral Processing, 160: 16-31.

[2] Parker, M. R. (1977). *"The physics of magnetic separation"*. Contemporary Physics, 279-306.

[3] Singh, V., Samik, N., and Sunil Kumar, T. (2013). *"Particle flow modeling of dry induced roll magnetic separator"*. Powder Technology, 244: 85-92.