Removal of Ultrafine Iron Impurities from Clay in Designed Experiments by Taghuchi Method

1st Amin Ostovar*
Department of Mining engineering, University of Tehran, Iran
Amin.ostovar@gmail.com

2nd Mohammad Noaparast
Department of Mining engineering, University of Tehran, Iran
m.noaparast@ut.ac.ir

ABSTRACT

In this paper separation of iron minerals which most of them was Limonite and Hematite from clay of Mehran mine was performed to produce a concentrate with acceptable Fe_2O_3 grade for applying in ceramics industries and sufficient recovery. Regarding mineralogy investigations, the iron minerals in the sample were in the form of coating and crack filler and were liberated in very fine sizes (less than 20 microns). The applied iron removal process included high shear agitation in presence of Sodium Oleat that leads to flocculation flowed by high gradient magnetic separation. This process was chosen because of very fine particle size and low magnetic susceptibility of the iron minerals presented in the sample. Effects of variations include time of agitation, collector concentration, pH, pulp density in flocculation and magnetic field intensity on Fe_2O_3 grade and recovery of concentrate was investigated.

In this work experiments were designed by Taghuchi method and results were analyzed with statistic methods by DX7 software. Besides preparing models, optimum conditions for reaching sufficient grade and recovery were determined by the software. The raw ore contained more than 10% Fe_2O_3. By this process concentrate with 4% Fe2O3 content and recovery of 87% was produced in one step.

Keywords: Iron removal from clay, Shear flocculation, High gradient magnetic separation, Design of experiments, Mineral Processing.

INTRODUCTION

Shear Flocculating

Fire clay of Mehran mine contains impurities much more than the standard amounts. Impurities such as iron and titanium compounds reduce refractoriness of the ore. This causes that the mine product couldn't be used in refractory industries without removal the impurities. With respect to the ore mineralogy investigations, clay minerals in the sample specially pyrophilite are the main component of the ore and Limonite, Goethite and Hematite are main impurity minerals. These investigations also declared that Limonite particles (main impurity mineral in the ore) are in the form of coating and crack filler and liberated in very fine sizes less than 10 microns. Flowing relation shows the relation between magnetic force affects a particle and size of the particle.

$$F \alpha V(S_P - S_O)H\frac{dH}{dl}$$

In the above relation F represents magnetic force affecting the particle, V represents volume of the particle, S_P and S_O are magnetic susceptibility of the particle and environment respectively, H is magnetic field intensity and dH/dl is magnetic field gradient. This relation shows that magnetic force affecting on a particle will decrease when the particle size decreases. This causes the low efficiency of magnetic separators when work with fine particles. In Mehran ore, Limonite particles liberated in very fine sizes and this causes the separation process become difficult.

Flocculation before magnetic separation can increase the efficiency of the process by bringing fine particles together and producing larger flocs. Flocculation process almost conducted by polymers and electrolytes, but flocs that produced with these methods doesn't have sufficient