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Treatment and characterization analysis of electrolytic manganese anode slime

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Abstract

This research aims at providing the basic database for reasonable treatment of electrolytic manganese anode slime by comparing its composition, phase and crystal structure before and after the specific treatment. To describe original samples' surface physical and chemical characteristics, X-ray fluorescence (XRF), Flame Atomic Absorption Spectrometry (FAAS), X-ray diffraction (XRD), Scanning Electron Microscope and Energy Dispersive Spectrometer (SEM-EDS) and TG-DTA were used. Then, used XRD and SEM-EDS to describe the system features and characterization of the anode slime performed by Washing-Roasting. Through application of XRF and FAAS, element content in anode slime and the source of each element were analyzed. The results show that the original samples of anode slime mainly contains Mn, Pb, Ca, Se and Sr and averagely the contents of manganese and lead are 47% and 7.46%, respectively. XRD analysis shows that main phases of the anode slime are $KxMn_8O_{16}$,MnO_2,$PbMn_8O_{16}$ and $Pb_2Mn_8O_{16}$, and MnO_2 in the slime has a mixed crystal structure of α-MnO_2,β-MnO_2,γ-MnO_2,δ-MnO_2. SEM-EDS analysis indicates that the anode slime has dense "mineral" phase. TG-DTA/DTG analysis shows that at the temperature of 0 ~ 573 ℃, water in δ-MnO_2 lattice is desorbed; 573 ~ 655 ℃, MnO_2 starts to lose oxygen and turn into Mn_2O_3; 900 ~ 1000 ℃ Mn_2O_3 loses oxygen and turn into Mn_3O_4. Anode slime under different roasting temperature were characterized by XRD and SEM-EDS. The result shows that when roasting temperature reaches higher than 700 ℃, bond energy of Pb-O is broken; when higher than 800 ℃, the crystallinity of anode slime further increases and the dense structure of anode slime is broken, which provides an effective way to remove lead from the slime; when higher than 900 ℃, Mn_2O_3 turns into Mn_3O_4 and the channels in the anode slime become much looser and wider for better leaching of impurity ions.

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1. Introduction

Manganese and its compounds are important modern industrial raw material, and widely used in metallurgy, chemical industry, battery, electronics and environmental protection industries. Recently, with the rapid development of electrolytic manganese industry in China, the scale of electrolytic manganese production capacity reaches at 2,400,000 t/a, and the actual annual output is around 1,200,000 t/a, the equipment utilization is 50%, which obviously suggests it has excess production capacity [1~2]. But due to the limits of technology and lack of environmental protection consciousness, the electrolytic manganese industry cause many environmental problems, although it promotes economic development [3~4].

In the production of electrolytic manganese metal, lead tin alloy material is used as anode plate, due to 1 tons of electrolytic manganese will produce 0.05 ~ 0.08 tons of lead anode slime, over 60,000 tons of electrolytic manganese anode slime is produced in domestic. Y.M.Zhou and H.Yan .et al. [5~6] studied the formation mechanism and the composition analysis of anode slime, and J.G.Tang [7] simply analyzed the technological mineralogy characteristics, the formation and the source of impurities of electrolytic manganese anode slime. Because the systematic studies on electrolytic manganese anode slime are very few at present, and the majority mainly focus on the primary utilization, which is based on destroying the original phase structure and consequently lead to high consumption and secondary pollution. In order to provide basic data for reasonable way of processing and using electrolytic manganese anode slime, this research focuses on electrolytic manganese anode slime and develops systematic investigation on components, phase and changing of crystal structure of electrolytic manganese anode slime before and after treatment.

2. Experimental Methods

2.1. Materials

Manganese anode slime (from Domestic Manganese Plant)

2.2. Analysis of test equipment.

The main experimental apparatus: box-type energy-saving electric resistance furnace and rod mill. Major analytical instruments are shown in Table 1 Main analytical instruments.

Table 1 Main analytical instruments

Test method	Equipment	Manufacturers
Flame Atomic Absorption Spectrometry	TAS-990	Beijing's General Instrument co., LTD
XRF	X-ray Spectrometer	America's dax co., LTD
XRD	X-ray Diffraction	Shimadzu Corporation
SEM-EDS	Scanning Electron Microscope and Energy Dispersive Spectrometer	Dutch's FEI co.
TG-DTA	Diamond TG/DTA	Platinum - Elmer Instrument (Shanghai) co., LTD