



HF wastewater remediation by electrocoagulation process

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ABSTRACT

Wastewater from surface treatment of silicon wafers is rich in fluoride ions. This is attributed to the use of hydrofluoric acid in huge quantities during stripping operation. Lime precipitation is insufficient to comply with environmental standards. In this work, the electrocoagulation (EC) was used for polishing treatment after neutralizing step. Synthetic solutions were used for the investigation into main operational factors affecting fluoride removal performance such as electrode material, initial pH, current density, salt nature, etc. The experimental results showed that EC is efficient for the removal of fluoride ions. This performance is ascribed to the effect of anodically generated coagulants. A removal efficiency of more than 99% of fluoride may be obtained. The quality of the effluent water met the specifications for the national discharge standard.

Keywords: Photovoltaic cell; HF wastewater; Fluoride removal; Electrocoagulation

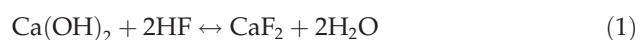
1. Introduction

The photovoltaic cell industry is growing very fast in the past few years. The manufacturing of cells requires large volumes of ultra-pure water and considerable amounts of chemicals and therefore generates large volumes of wastewaters. During manufacturing, huge quantities of hydrofluoric acid (HF) are used in etching and cleaning of silicon wafers. Hence, effluents from this process contain high levels of fluoride. Typical fluoride concentrations are from 1,000 to 3,500 mg/L [1,2]. The discharge of such wastewater into the surface water would lead to the contamination of groundwater. Long-term drinking of water that containing high fluoride content can result in mottling of teeth, softening of bones, ossification of

tendons and ligaments and several neurological damages in severe cases [1,3].

Due to its high toxicity, industrial wastewater containing fluoride is strictly regulated. Environmental authorities limit fluoride discharge levels to 15 mg/L or less.

The most commonly used way to remove fluoride ions from wastewater is to form calcium fluoride (CaF₂) by adding excess of lime according to the following reaction:



In spite of its advantages, lime precipitation is insufficient to comply with environmental standards. In practice, the precipitation can only reduce the fluoride concentration to 20–100 mg/L. Consequently,

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