Abstract

A local manufacturer of lead chemicals has expressed a definite interest in buying recovered lead sulphate from S.A Precious Metals, a minerals processing company. The recycling of lead provides a means of reducing the strain on resources that is caused by the use of virgin materials such as lead. In addition, recycling prevents any damage caused by improper treatment processes and disposal practices that would otherwise lead to groundwater contamination.

Research into lead precipitation has so far focused mainly on acid waste, perhaps because of the size and influence of the lead acid battery industry. The work described in this dissertation was motivated by the efforts of S.A Precious Metals to process the company's lead-alkaline waste. Initially, the scientists carrying out laboratory-scale tests encountered solids-handling problems. The writer undertook the investigation reported in this document to find a viable means of recovering both lead sulphate and sodium sulphate from solution.

During the batch trials, the researcher recovered lead sulphate via precipitation from the lead-containing solution, while precipitating the sodium plumbate solution (normally considered hazardous waste) with sulphuric acid. This process offers a low-cost answer to the problem that also offers a quick turn-around, saleable by-products and a benign waste stream.

Precipitation to a pH between 6 - 7 using a 20% solution of sulphuric acid added at the point of mixing resulted in a final lead concentration of 2.7 ppm with no ageing period necessary. During solid-liquid filtration, the temperature was maintained above the sodium sulphate temperature of crystallisation of 32 °C, which reduced the amount of sodium sulphate precipitated out into the lead sulphate cake. The final step, which involved crystallising the sodium sulphate out of the lead filtrate solution, yielded high recoveries of sodium sulphate in excess of 61%.

In order to collect the necessary data for large-scale implementation of the process, the writer tested the roles that different parameters such as starting lead and sulphuric acid concentrations, final pH, and filtration and precipitation temperatures played on lead removal from solution. It was found that dropping the pH by several units through acid addition played the governing role in effecting lead sulphate precipitation. Thereafter she compared the final lead concentrations obtained experimentally against the local (Ekurhuleni Metropolitan Municipality) lead discharge environmental requirements limit of 5 ppm and the allowable pH range of 6 – 10 for wastewater effluent.

The optimal technique and process conditions that the researcher developed for precipitation, solids-handling and sodium sulphate crystallisation processes for production on a large scale are not only compliant with environmental regulations but offer maximum recovery and consequently profit.

For maximum value gain and environmental compliance, optimal technique and process conditions were chosen for precipitation, solids handling and sodium sulphate crystallisation processes for production on large scale.