Technology Summary: Porous Lead Electrode for Zinc Production

Opportunity Statement

Sulfuric acid is a widely used electrolyte in electrochemical processes, but only a few electrode materials can withstand its high corrosivity. Lead or lead-based alloy electrodes can generate a protective covering of lead dioxide in the process of anodic polarization in the sulfuric acid solution; thus, it has become a common material for use in sulfuric acid electrolyte systems.

In particular, lead anodes are used in extractive electrolysis (electrowinning) of zinc. Lead is preferred as an anode material due to its high resistance to corrosion in sulfuric acid solutions, conductive nature, alloying ability with silver, tin, titanium and antimony, and inexpensive cost as compared to other anode materials.

Plate-type lead-based electrodes are primarily used as anodes in zinc electrowinning. The plate-type electrodes are advantageous as they provide better mechanical strength and robust handling characteristics.

Problem

Plate-type lead electrodes have the following disadvantages:

- The oxygen over-potential voltage at commercial operating current densities is close to 1.0v, representing 30% of the cell voltage. The over-potential is inefficiency in the cell operation.
- Anodic corrosion is high, leading to lead content in the extracted metal. If lead levels in the deposited zinc exceed a minimum level, chemicals must be added to the electrolyte to precipitate the excess lead and to keep the particles from reaching the cathode.
- The lead alloy is soft and bendable, leading to short circuits in the cell with a corresponding increase in power consumption.
- Some of the metals involved in the process of electrowinning get reduced, but fail to deposit on the cathode due to the unavailability of active surface area on the cathode. These reduced

metal particles sink at the bottom of the electrolyte as slime. Slime represents inefficiency in the process and requires periodic cleaning of the electrolytic cells.

Therefore, there is a need for a solution which addresses the limitations of current lead anode technology to lower power consumption while simultaneously increasing the purity if the zinc metal product.

360ip Partner's Solution

The invention developed by 360ip's Partner focuses on resolving these problems by designing a novel porous composite electrode to decrease cell voltage, decrease power consumption or increase production at existing power consumption levels and improve the purity of the final zinc product.

The Partner's electrode consists of three parts:

1. A structural base conductive layer
2. A lead-based transition layer
3. A lead-based porous layer

The porous lead-based anodes have a higher active surface area, effectively reducing the localized current density, which reduces oxygen over-potential. Reduction in over-potential results in less energy consumption per ton of zinc produced. Over-potential can be decreased by up to 0.13v, which represents a 3.1% decrease in power consumption.

At the lower localized current densities, the lead dioxide passivating film formation is denser, effectively reducing the anode corrosion rate. Decreased anodic corrosion rate increases zinc purity and eliminates the need for chemical additives to the electrolyte. The corrosion rate of the Partner's electrodes is 80% less than conventional flat plate anodes. The lead content in the zinc is decreased by 60%.

Slime formation is decreased by 90%, which lowers the frequency of cell cleaning.

Compared to flat-plate anodes, the porous anode developed by the Partner is approximately 50% lighter in weight. This translates to an advantage in both assembly time and labor requirements.

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The Partner's composite-reinforced porous electrode has the following advantages as compared to the plate-type electrodes:

- Higher active surface area
- Lower cell voltage
- Lower current density
- Better corrosion resistance
- Lighter weight
- Cleaner zinc product
- Less slime formation

Patents

360ip's Partner has one filed patent application on this novel electrode technology and plans to file patent applications in major countries throughout the world.

360ip is seeking interested parties for licensing, further development and commercialization of this technology-based product.

For additional information, contact: licensing@360ip.com