DISSOLUTION OF SPENT LEAD ACID BATTERY ELECTRODES TO MAKE ELECTROLYTE FOR SOLUBLE LEAD REDOX FLOW BATTERY

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Abstract: Electrochemical energy storage can be coupled to renewable generation technologies to improve system integration within a grid or to provide a stand-alone network. Two key challenges can be identified for large-scale (kWh – MWh) electrochemical energy storage: cost and end of life recycling. Traditional lead acid batteries are abundant and low cost but have restricted cycle life. This project investigates the recycling of end of life lead acid cells directly into electrolyte suitable for use in the soluble lead flow battery.

Flow batteries have been suggested as an energy storage device, which can offer flexible and scalable storage for large-scale applications. They differ from conventional batteries in that the active materials are solvated and stored in external electrolyte reservoirs.

The soluble lead flow battery (SLFB) is a system based on the two redox couples Pb/Pb^{2+} and Pb^{2+}/PbO_{2}[1]. It has the advantage that no membrane is necessary but it does require the controlled deposition (charge) and dissolution (discharge) of solid lead and lead dioxide on the negative and positive electrodes respectively. Lead(II) is highly soluble in methanesulfonic acid compared to sulfuric acid used in conventional batteries [2]. The reactions are shown below.

Positive
\[ \text{PbO}_2 + 4H^+ + 2e^- \xrightarrow{\text{Discharge}} \text{Pb}^{2+} + 2H_2O \]

Negative
\[ \text{Pb} \xrightarrow{\text{Discharge}} \text{Pb}^{2+} + 2e^- \]

Overall
\[ \text{Pb} + \text{PbO}_2 + 4H^+ \xrightarrow{\text{Discharge}} 2\text{Pb}^{2+} + 2H_2O \]

The project demonstrates a method for dissolving lead from spent lead acid cells to make electrolyte for a soluble lead redox cell. The performance of the cell thus obtained is compared to that of a cell made from pure feedstock chemicals.

References: