The Battery Materials Challenge: Sodium Sulphate – An Economic Analysis of Valorization Technologies

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ABSTRACT

Sodium sulphate is a byproduct from the production of battery materials such as metal sulphates ($NiSO_4$, $CoSO_4$, $MnSO_4$), lithium hydroxide, and pCAM (precursor cathode active material). The recycling of end-of-life batteries also produce significant amounts of sodium sulphate. Given the low cost of sodium sulphate and the rapidly rising demand for battery materials, the supply of sodium sulphate is expected to surpass the demand in the near future, making it difficult for facilities to secure off-take agreements for the by-product. Disposal of the material poses a financial cost and an environmental concern, thus there is a need to develop a process to convert sodium sulphate to a higher value product. Furthermore, given the lack of regulation around the discharge of sodium sulphate, the necessity of valorisation may be driven by more stringent environmental regulations.

The economics of three processes to valorise sodium sulphate are presented. The Glaserite flowsheet and Hatch's proprietary ion exchange flowsheet converts sodium sulphate to potassium sulphate (SOP) and sodium chloride using potassium chloride (MOP) as a reagent. While both MOP and SOP are fertilizers, SOP is used for chloride sensitive crops and holds a price premium to MOP. Additionally, the use of bipolar electrodialysis (BPED) to valorise sodium sulphate to sodium hydroxide and sulphuric acid is considered. However, the quality of the acid and base, and the limitations posed by impurities have a major impact on the feasibility of the process. A capital cost estimate for each process is developed and compared. Additionally, the operating cost for each flowsheet is developed and compared using reagent and utility rates from different regions.