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A CRITICAL ASSESSMENT OF RE-PROCESSING THE CATHODE "BLACK MASS" FROM SPENT LITHIUM-ION BATTERIES

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ABSTRACT

Recycling of spent lithium-ion batteries is currently a hot topic in more ways than one. There have been many new entrants into this space, most of them promising "innovative hydrometallurgical processes" to recover battery-grade salts of nickel, cobalt, manganese and lithium, even to the extent of showing such salts on their websites. However, careful evaluation indicates that most of these processes are either still being developed, with very few details being disclosed, or generate a mixed Ni-Co-Mn product. As far as can be determined, none of the new entrants are actually in commercial production.

If the cathode material can be leached successfully, then there is a very complex solution containing Ni, Co, Cu, Mn, Li, Fe and Al in various concentrations. Processing this is new territory, and the traditional cobalt and nickel plant operations actually offer surprisingly little guidance as to how to achieve this. In this paper, the challenges of successfully processing, and especially separating and recovering the contained metals in a state of high purity are critically discussed. It is concluded that the standard, traditional well-known methods of precipitation and solvent extraction with Cyanex 272 or D2EHPA or Versatic 10 are not quite up to the challenge of delivering both high recovery simultaneously with high purity in an economical manner. Therefore, alternative strategies are required. The processes of the new entrants, where they have been published, are critically assessed, and in general, are shown to be inadequate.

Keywords: lithium-ion batteries, "black mass," sulphate, chloride, nickel, cobalt, manganese, lithium, EV revolution.