Graphite Recycle Strategies: LCA-based environmental impact evaluation

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The increase in car batteries demand has highlighted the problem of the availability of constituting materials like cobalt, manganese and lithium. In addition, recently, more interest is being placed on the recovery of graphite due to the decreasing availability of natural raw material and the high cost of processes for producing synthetic graphite. It is estimated that up to 80 percent of the graphite used in lithium-ion batteries can be recovered during the recycling process, reducing the environmental footprint associated with battery production.

In this work, an environmental impact assessment of some of the best processes identified in the literature was performed using the open-source software designed for OpenLCA life cycle analysis. Each selected process (four in total) has been studied and described through mass and energy balances in excel based on the information reported in the chosen articles and evaluated of the basis of impact categories known as 18 midpoint impact categories, following the ReCiPe 2016 Midpoint methodology, especially in terms of: Acidification, Climate Change, Water Use, Eutrophication, Ozone depletion and Photochemical Oxidation. To ensure that all evaluated processes had the same input reference, it was decided to consider a common "ideal" batch of 100kg input black mass with a defined mass fraction percentage. After evaluating the consumption of reagents and energy for each process, the data were combined in different LCI and implemented on Open LCA, using as a base the ecoinventV3.10 database, to obtain a reference value for each class of environmental impact following the Impact Assessment Method EF3.1 and perform a sensitivity assessment using Monte Carlo Simulation through Open LCA. Four processes have been identified on a laboratory scale, namely: Fenton assisted froth flotation, sintering process, pyrolysis process, and Curing&Calcination process, being those the units that most characterize each process.

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