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Life cycle assessment of sample preparation in analytical chemistry: a case study on SBSE and SPE techniques

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PURPOSE OF THE ABSTRACT

In the past twenty years, green analytical chemistry has gained more and more attention. However, quantification of the environmental impacts of analytical methods has never been estimated. The purpose of this work is to apply life cycle assessment (LCA) to the preparation of one sample using SBSE and SPE techniques and to show that LCA is a suitable framework to quantitatively assess the environmental impacts of a sample preparation. The amounts of consumables, chemicals and energy needed to prepare a sample with both techniques were determined with the literature and lab measurements. We converted this data into environmental impacts through the use of a life cycle inventory (LCI) database (ecoinvent 3.7.1) and a life cycle impact assessment method (ReCiPe 2016 Midpoint). The results of the LCA showed that the SBSE process induces less overall environmental impacts than the SPE process and that these impacts could be reduced by reusing the vial and vial caps which are the largest contributors. The spatial location of the laboratory (and its associated electricity mix) also plays a significant role for the SBSE process as it uses more electricity than the SPE process. This study paves the way for the application and standardization of LCA to whole chemical analysis, composed of the sample collection, preparation, analysis and the data analysis.

FIGURES

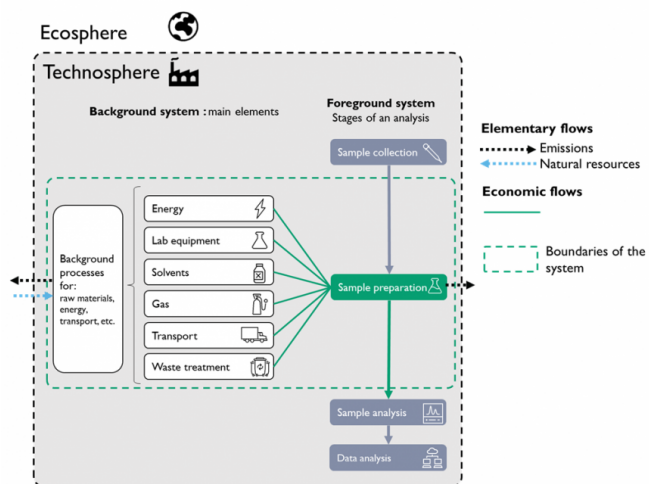


FIGURE 1

Boundaries of system considered for the life cycle assessment of sample preparation

This figure describe the boundaries selected for the life cycle assessment

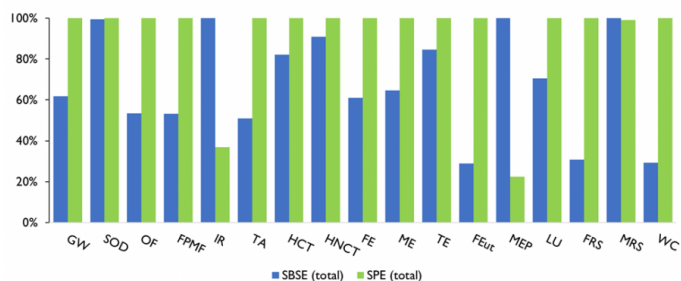


FIGURE 2

Environmental impact comparison between SBSE and SPE extractions of pesticides in freshwater (ReCiPe2016 Midpoint H)

This figure presents the results of the comparison of the environmental impacts for two analytical procedures of extraction of 10 pesticides in a freshwater sample.

KEYWORDS

life cycle assessment | sample preparation | green analytical chemistry | environmental impacts

BIBLIOGRAPHY