

Material flow analysis integrated with Life Cycle Assessment to support a circular economy of plastics in Portugal

Summary

This PhD thesis aims to integrate two methodologies, Material Flow Analysis (MFA) and Life Cycle Assessment (LCA), to analyze and compare Circular Economy strategies. This approach is applied to the case study of plastic packaging in Portugal (a short-use product).

An MFA-based approach was developed to analyze the circularity of plastic packaging in Portugal. This approach encompasses: (i) the development of a comprehensive MFA model that covers the entire lifecycle of a material/product while addressing its uncertainty; (ii) the identification and discussion of trends; (iii) the analysis of several indicators that measure circularity with complementary scopes; and (iv) the evaluation of circular economy scenarios using the MFA model to assess future circularity targets and provide insights into the plastic sector. Following this, the results of the MFA-based approach will be integrated with the LCA methodology to assess and quantify the environmental impacts associated with each stage of the entire plastic packaging system lifecycle. This MFA-LCA integration will enable a holistic assessment of the environmental impacts of the systems' life cycle and the identification of key factors contributing to significant environmental impacts in the plastic packaging system. Moreover, possible trade-offs will be considered in the definition of Circular Economy strategies.

Finally, this thesis proposes strategies for different alternatives for eco-design, substitution (e.g., glass, paper) and reuse, recycling. These strategies are aimed at minimizing environmental impacts throughout the entire life cycle of plastic packaging. The research outcomes facilitate the selection and implementation of Circular Economy strategies that effectively reduce environmental impacts while considering the broader life cycle perspective.

Keywords

Material flow analysis, Life Cycle Assessment (LCA), circular economy, plastics.



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