Clean Technologies and Recycling

Clean Technologies and Recycling, 3(1): 1–3.
DOI: 10.3934/ctr.2023001
Received: 16 December 2022
Accepted: 02 January 2023
Published: 03 January 2023

http://www.aimspress.com/journal/ctr

Editorial

Life cycle assessment of clean technologies and recycling

Nighat Afroz Chowdhury[1], Apurba Kumar Saha[1], Gwendolyn Bailey[2], Andrea Di Maria[3], Dieuwertje Schrijvers[4] and Hongyue Jin[1,*]

[1] Department of Systems and Industrial Engineering, University of Arizona, 1127 East James E. Rogers Way, Tucson 85721, AZ, USA
[2] Umicore, Rue du Marais 31 Broekstraat, B-1000 Brussels, Belgium
[3] TERRA Teaching and Research Unit, Agro Bio-Tech Gembloux, University of Liege, Liege, Belgium
[4] WeLOOP, 254 rue du Bourg, 59130 Lambersart, France

* **Correspondence:** Email: hjin@arizona.edu.

1. Introduction

Clean technologies and recycling are crucial to lower anthropogenic emissions and achieve sustainable development goals. As clean technologies and recycling gain traction, the trade-off between their environmental costs and benefits is still unknown. One way to assess this trade-off is to conduct a life cycle assessment (LCA). LCA is a methodology which quantifies potential environmental impacts in all stages of a product life cycle. For instance, this approach allows one to understand the environmental balance between the burden avoided through recycling, and the burdens incurred by the use of materials and energy in the recycling/reuse processes themselves.

This special issue aims to publish original research and review articles to promote the application of LCAs for clean technologies and sustainable recycling and discuss the challenges and complexities behind the evaluation of environmental performances. Four peer-reviewed articles have been published on a variety of research issues, including ex-ante LCA of emerging recycling processes, development of life-cycle inventory, and review of sustainable waste management practices.

2. Contributions

In the first paper of this special issue, Schrijvers et al. [1] conducted a consequential LCA to evaluate the effect of different market factors (such as constrained supply and demand, primary and co-products for mining operations, and identification of marginal suppliers) on the environmental benefits of rare earth element (REE) recycling. A recycling innovation by Solvay that recovers REEs such as europium (Eu) and yttrium (Y) from end-of-life fluorescent lamps was utilized as a case study. The findings demonstrated a strong correlation between the market conditions and the life-cycle benefits of REEs recycling. For example, within the timeframe of 2013−2016, increased recycling of Eu and Y was environmentally beneficial, as fluorescent lamps could displace halogen lamps and the market demand for these REEs was adequate. This study helps comprehend the potential benefits of recycling under varying market conditions.

Another recycling technology featured in this special issue was the development of a novel packaging system for dry-cured ham slices consisting of reusable and disposable polymers (i.e., polypropylene and polyethylene with natural antioxidants). Beigbeder et al. [2] evaluated the environmental life cycle impacts of the proposed packaging system using the ILCD PEF method. When compared with a conventional packaging system used in the dry-cured ham industry (i.e., a multilayer polymer film and polyethylene terephthalate/polyethylene tray), the study revealed a significant reduction in the environmental impacts for reusable packaging. Since plastics cause substantial environmental damage, the study demonstrated a promising solution via reusable and recyclable food packaging.

The third article featured Shadia et al. [3] which highlighted the inaccuracy in polyester textile environmental product declarations (EPD). More specifically, the authors presented EPD case studies on recycled polyethylene terephthalate (rPET) fiber. They found a large variation in the energy consumption data for rPET melt-spin process, which undermines the veracity of any rPET fiber EPD. Therefore, the authors recommended collecting new, accurate, consistent, and reliable melt-spin energy data for LCA of such EPDs. In case accurate data is inaccessible, the authors suggested presenting LCA results from life cycle inventory of best-case and worst-case scenarios.

In the final article of this issue, Wilson et al. [4] reviewed various personal protective equipment (PPE) used during the COVID-19 pandemic. The study revealed that these PPEs are mainly produced from plastics and rubber. Open burning and traditional landfilling are the most common approaches for managing the discarded plastic wastes in developing countries, which have serious toxic effect on human health and environment. To this end, the authors applied SWOT (i.e., Strengths, Weaknesses, Opportunities, and Threats) analysis to demonstrate how adoption of modern technological solutions (e.g., pyrolysis, incineration, and engineered landfills) can convert these wastes to wealth.

Acknowledgements

We would like to express our gratitude to the whole AIMS Press team for their invaluable collaboration and active participation in the publication. In addition, we would like to conclude by thanking all the contributing writers and reviewers for their exceptional work, which enabled us to compile this special issue. We hope it will stimulate further research on LCA for clean technologies and recycling.

Conflict of interest

There is not any conflict of interests between authors.

References

1. Schrijvers DL, Loubet P, Sonnemann GW (2022) The influence of market factors on the potential environmental benefits of the recycling of rare earth elements. *Clean Technol Recycl* 2: 64–79. https://doi.org/10.3934/ctr.2022004
2. Beigbeder J, Allal A, Robert N (2022) Ex-ante life cycle assessment of a partially reusable packaging system for dry-cured ham slices. *Clean Technol Recycl* 2: 119–135. https://doi.org/10.3934/ctr.2022007
3. Moazzem S, Jones D, Vlieg M, et al. (2022) Inaccurate polyester textile environmental product declarations. *Clean Technol Recycl* 2: 47–63. https://doi.org/10.3934/ctr.2022003
4. Eze WU, Oyegoke T, Gaiya JD, et al. (2022) Review of personal protective equipment and their associated wastes, life-cycle and effective management during the COVID-19 pandemic in developing nations. *Clean Technol Recycl* 2: 1–31. https://doi.org/10.3934/ctr.2022001