Environmental Engineering and Management Journal

March 2023, Vol. 22, No. 3, 539-547
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu
http://doi.org/10.30638/eemj.2023.042

"Gheorghe Asachi" TechnicalUniversity of Iasi, Romania

SUSTAINABLE MANUFACTURING: ENVIRONMENTAL STATISTICS AND MAPPING FOR PHARMACEUTICAL INDUSTRY

Umesh Kumar Chaturvedi

Institute of Business Management, GLA University Mathura, 281004, India
E-mail: umesh.chaturvedi@gla.ac.in; Phone: +91-9839773350

Abstract

The pharmaceutical industry has important reasons to adopt sustainability and reduce its environmental footprint. Joining the trend, the Indian pharmaceutical industry is also embracing a cleaner and greener transition and is adopting responsible manufacturing. Adoption of data-driven approaches like Life-Cycle Analysis (LCA) to understand the environmental footprint associated with synthesis of an Active Pharmaceutical Ingredient (API) can help the manufacturers to review and improve their legacy processes. Prioritizing process optimization can result in better environmental performance along with economic, social and competitive advantages. This paper presents a data-driven practical approach for implementing an LCA based method for making the production process greener while comparing environmental impacts under different categories. Accordingly, the approach and methodology adopted and the results highlighted are expected to give an idea to pharmaceutical manufacturing companies to innovate and optimize their approaches to enhance environmental performance within a set of system boundaries. The present study demonstrates 5% improvement in yield for Celecoxib (API) synthesis and the resulting improvement in environmental performance. The framework presents an alternative method to reduce waste, energy consumption and emissions to minimize the environmental burden. Accordingly, the system boundaries cover cradle-to-synthesis stages of the API manufacturing. The effectiveness and potential of using LCA in analyzing and optimizing the pharmaceutical manufacturing process alongside improving the environmental performance with higher yield has been shown. The need to integrate LCA methodology with product and process development has thus been shown. Process optimization through greener methods of API manufacturing can be guided by such framework studies.

Keywords: active pharmaceutical ingredient, environmental performance, life cycle assessment, pharmaceutical manufacturing, sustainability

Received: August, 2022; Revised final: February, 2023; Accepted: February, 2023; Published in final edited form: March, 2023