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LIFE CYCLE ASSESSMENT FOR ENVIRONMENTAL IMPACT ANALYSIS OF PHARMACEUTICAL COMPOUND MANUFACTURING

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Abstract

The process of Active Pharmaceutical Ingredient (API) manufacturing is a resource-intensive one and has some environmental impacts. These impacts need to be accounted for throughout the product life cycle to assess the environmental sustainability of a manufacturing process for which Life Cycle Assessment (LCA) is a comprehensive tool. Data collection at various stages of the manufacturing process thus assumes importance. This study has employed a data-driven approach using LCA to assess the environmental impact of manufacturing an API named Atorvastatin Calcium. The impact has been studied under different environmental categories, and the case of an Indian pharmaceutical company has been taken. A Cradle-to-synthesis analysis has been performed for the API production and its impact on various environmental parameters has been quantified. The midpoint impact assessment results show that Atorvastatin manufacturing has 96% impact on Ozone layer depletion which further has an endpoint impact on plants, animal life and human beings due to penetration of ultraviolet rays into the Earth's surface. The analysis also showed API manufacturing contributing to 89.81% greenhouse gas emissions which can cause higher temperatures and other severe weather conditions leading to serious environmental endpoint impacts. Unlike other API manufacturing, Atorvastatin manufacturing also has intense energy consumption at different stages, measured through midpoint impacts such as reduced seawater pH and other related consequences. The study tries to make a case for adopting LCA for evaluation of the environmental impacts of a process or product and benchmark the same to make the pharmaceutical industry greener.

Key words: active pharmaceutical ingredient, environmental impact, green-house gas emission, life cycle assessment, pharmaceutical manufacturing, sustainability

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