A Prospective Life Cycle Assessment (LCA) of Monomer Synthesis: Comparison of Biocatalytic and Oxidative Chemistry

Biotecnological processes are typically perceived to be greener than chemical processes. A life cycle assessment (LCA) was performed to compare the chemical and biochemical synthesis of lactones obtained by Baeyer-Villiger oxidation. The LCA is prospective (based on experiments at a small scale with primary data) because the process is at an early stage. The results show that the synthesis route has no significant effect on the climate change impact [(1.65±0.59) kg CO₂ eq. product⁻¹ vs. (1.64±0.67) kg CO₂ eq. product⁻¹]. Key process performance metrics affecting the environmental impact were evaluated by performing a sensitivity analysis. Recycling of solvents and enzyme were shown to provide an advantage to the enzymatic synthesis. Additionally, the climate change impact was decreased by 71% if renewable electricity was used. The study shows that comparative LCAs can be used to usefully support decisions at an early stage of process development.

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