Life Cycle Assessment of Potato-Derived Polylactic Acid (PLA)

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Abstract

It has been shown not only can polylactic acid (PLA) be synthesized from the biological starch of potatoes grown in Maine, but also that the environmental and economic incentives could be significant enough to warrant a large scale bio-PLA production plant. . Not only is it desirable to have a "green" process that synthesizes a plastic created from biological components, but also to create a plastic that has better recycling properties as well. "Green" process developments have shown that plastics originating from biological substances are a viable alternative to those created from petroleum-based chemicals.

This project aimed to develop a proposed biological process model including the equipment necessary to synthesize potato-derived PLA. Secondly, this project identified the critical resource consumptions and environmental emissions to water, land and air for the production of bio-based PLA or bio-plastics from potatoes. Thirdly, this work assessed the environmental impacts from gate-to-gate of potato-based bio-PLA which can be used as basis for environmental process and product improvement. Lastly, this work evaluated how data uncertainty and changes in systems parameter values using statistical analysis affect the major environmental impacts of producing bio-PLA from potatoes.

A theoretical production pathway has been developed in attaining high molecular weight polylactic acid from Maine potatoes. Optimally through comparison of viable alternative production pathways, the suggested method of deriving PLA from potato is by way of raffination, hydrolysis, fermentation, polymeric condensation, catalytical dimerization, and ring opening polymerization. It is found that 39.1 tonnes of potato could ultimately yield the desired one tonne of PLA. (You can insert here the process efficiency). The estimated grassroots cost for producing a one tonne of PLA in pilot scale would be $684,600.