Team 19: The PLAstics
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Introduction

Polylactic acid is a biobased polymer derived from renewable sources, such as corn and sugarcane. PLA has comparable mechanical properties to fossil-based resins, which makes it ideal for applications such as 3D filament, food packaging, or medical devices. Products made from PLA resin, if composted correctly, can be broken down in a timely manner and thus reduce plastic waste. PLA therefore represents a more environmentally friendly option for single-use plastics and other applications. Industrially compostable products like PLA follow an innovative concept called “Cradle to Cradle”. This means that the materials get fed back into the Earth at the end of their life cycle, creating a closed-loop cycle that minimizes extra waste. PLA is a promising product, as the market is expected to grow 11.6% annually.

Acknowledgements

Gloriana Teh
Professor Andrew Wilson
Professor Jeremy VanAntwerp
Professor Jennifer VanAntwerp
Professor Wayne Wentzheimer
Senior Design Project faculty

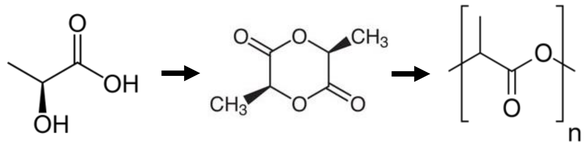
Design Decision

1st Step - Lactic Acid to Lactide

- A one-step process with SnO_2-SiO_2 as the catalyst was used. This reduced the amount of equipment required while still giving a good yield.
- The reaction was run at a high temperature and low residence time to reduce undesired side products.

2nd Step - Lactide to Polylactic Acid

- A zinc complex of (imidazo[1,5-a] pyrid-3-yl) phenol was used as the catalyst. This gave a conversion of 96% for a 2-minute residence time and represents a more environmentally friendly option compared to Sn(Oct)2 catalyst.



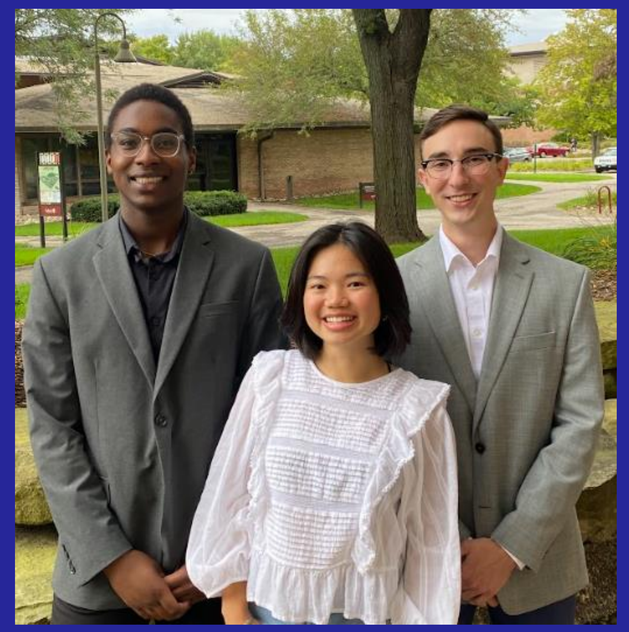
Objectives

- Design a process to produce 11,300 tons of PLA per year
- Justify the feasibility of this process through economic analysis
- Produce PLA at a 95% purity standard while using L-lactide of high enantiomeric purity
- Use the process simulation software UNISIM to demonstrate feasibility of the design and to justify calculations

Results

Capital Investment	$24,671,320
Yearly Cost	$27,219,912
Revenue	$41,120,000
Yearly Income	$5,189,470
Internal Rate of Return	19.6%

Based on an anticipated plant life of 15 years, the economic analysis found the process to be profitable with an estimated internal rate of return of 19.6%.



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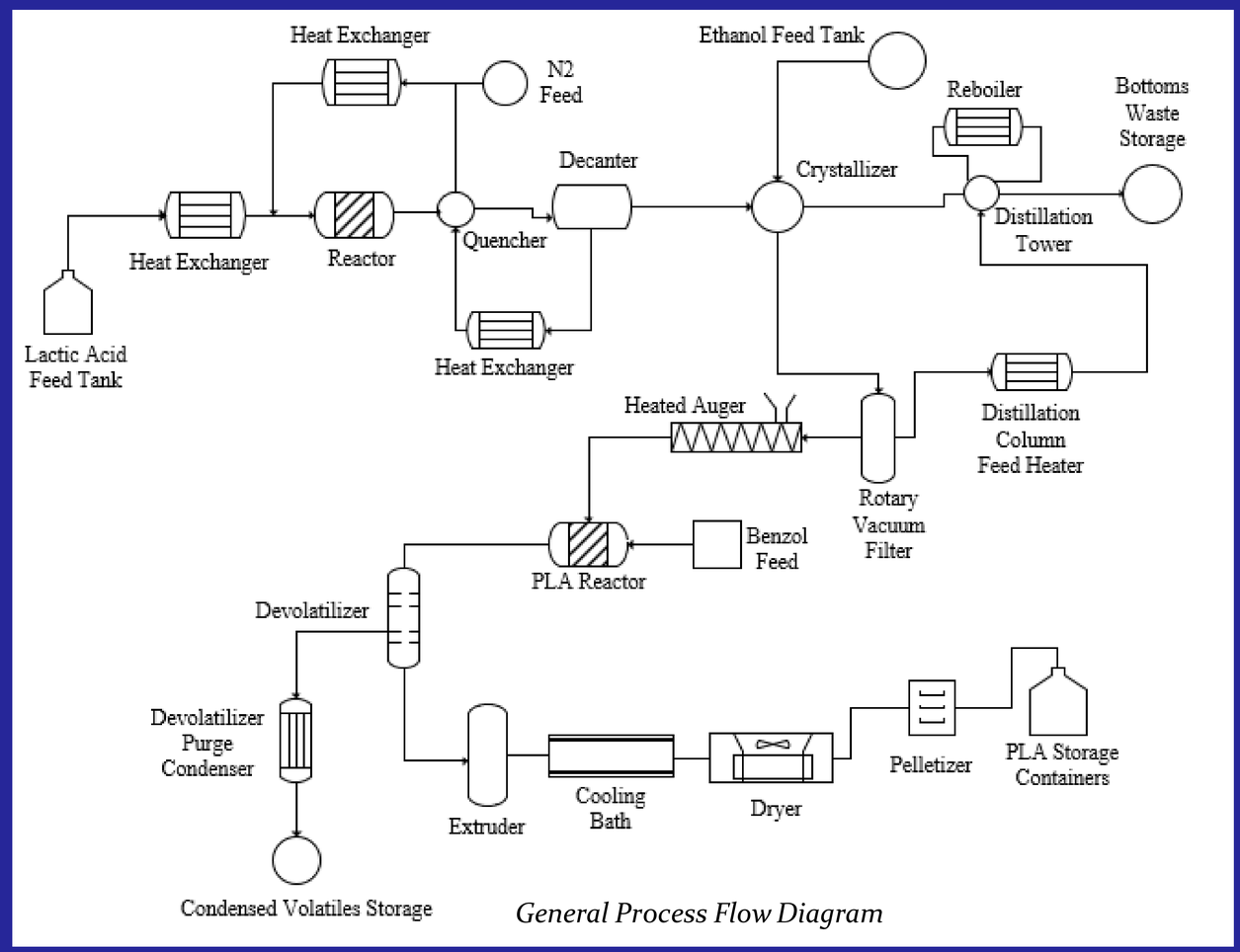

General Process Flow Diagram