

Caitlyn Crowley (B.S. ABE), Sarah DeFlora (B.S ABE), Kaneeka Sood (B.S ABE)

**Objective:**

In recent years, research and development of biodegradable plastics has rapidly grown. Their **advantages** over other traditional plastic materials are their high **tensile strength** to weight ratio, **ability to be molded** into various states, **potential resistance** to environmental conditions, **recyclability**, and their potential to **biodegrade**. Our object is to formulate Poly(lactic acid) (PLA) using a conventional industrial method.

**SWOT Analysis**

**Strengths**

- Reduce flavor scraping
- Stretch ratio is 9:1 to 16:1
- Can be run on PET orientation equipment without any hardware modification
- Non-toxic product
- Sustainability, Environmentally friendly
- Can be done in factories on a large scale
- Recyclable, Biodegradable
- Production only uses about 0.15%

of the total corn for grain production in the USA

**Opportunities**

- More green technology, reducing harmful environmental effects
- If not recycled, can decomposed

**Weakness**

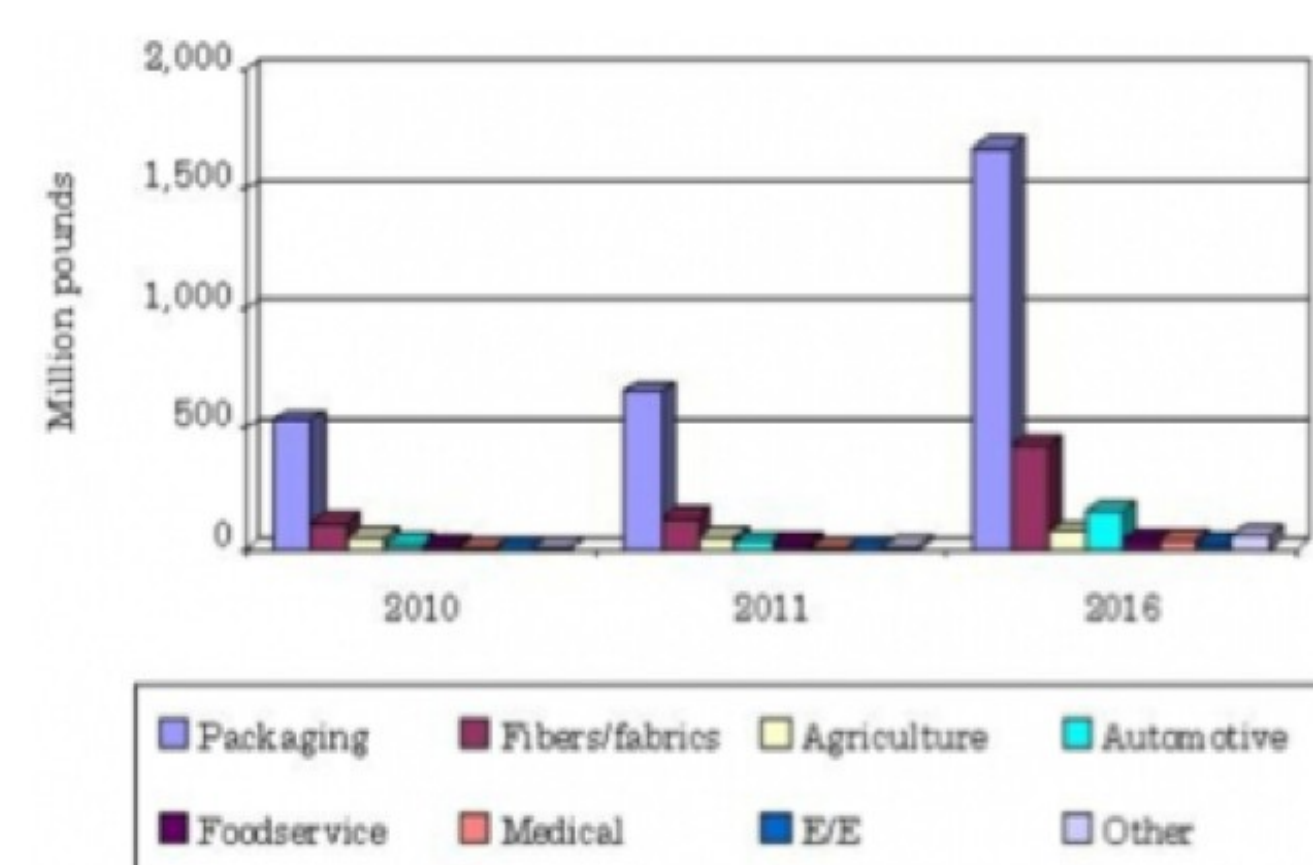
- To decompose requires a temperature of 284 degrees.
- Very few consumers have access to the sort of composting facilities that can recycle PLA
- High density, High polarity, difficult to adhere without tie layers to non polar PE and PP in multilayer structures
- Limited barrier against moisture and gases
- Cycle times for injection molding PLA performs are longer than for PET

**Threats**

- High demand for corn
- Competitor plastics are cheaper PET \$.70/lb vs PLA \$1/lb

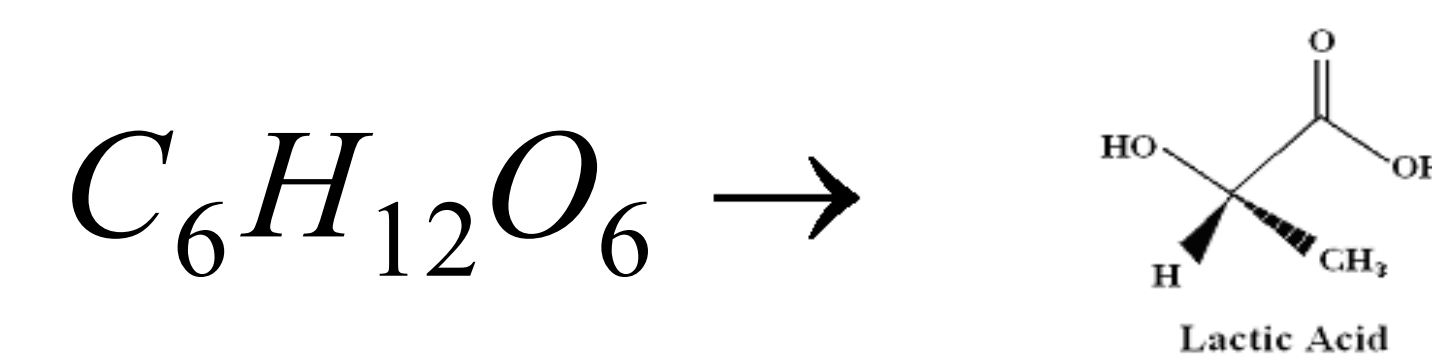
**Market Analysis**

- High growth to over 6 billion USD in 2015 and 12.5 billion by 2025
- Less than 3 percent of all waste plastic worldwide gets recycled, compared with 30 percent of paper, 35 percent for metals and 18 percent of glass.
- Currently cover 10-15 percent of the total plastics market
- By 2020, the market share is projected to increase 25-30 percent.
- Current selling price of PLA: \$1/lb.

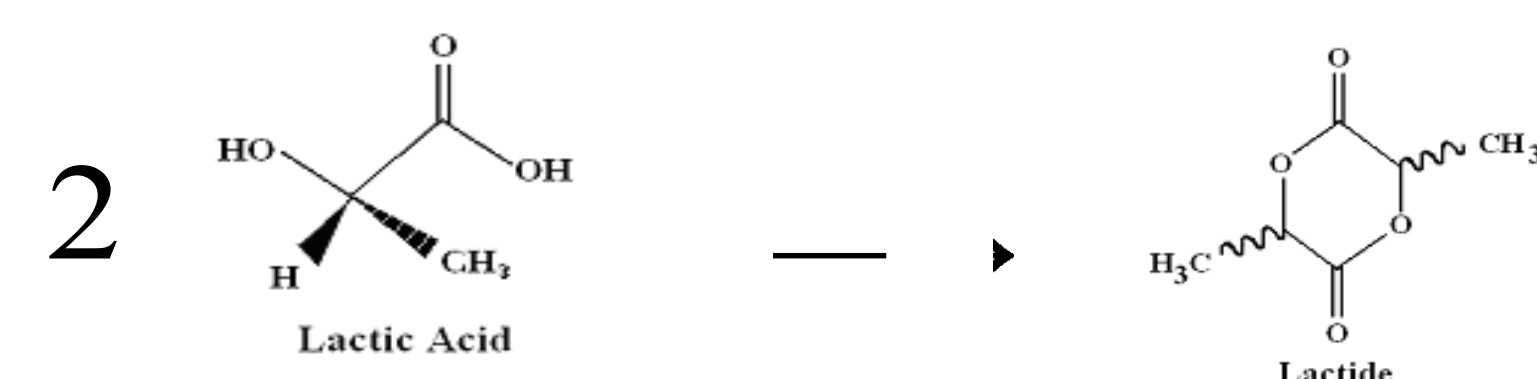


**Process**

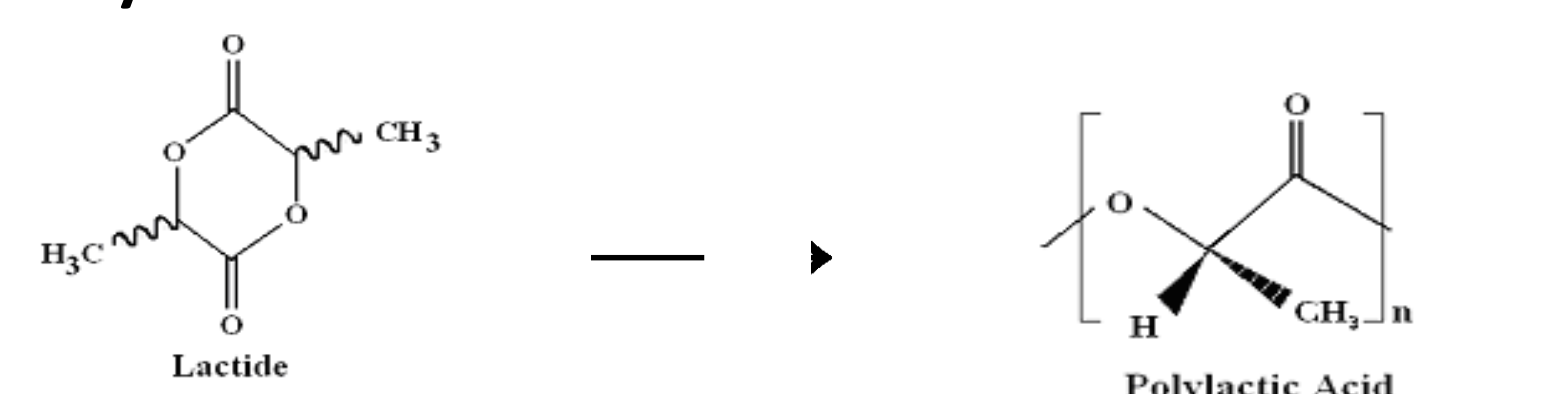
1. Fermentation



2. Lactide Formation

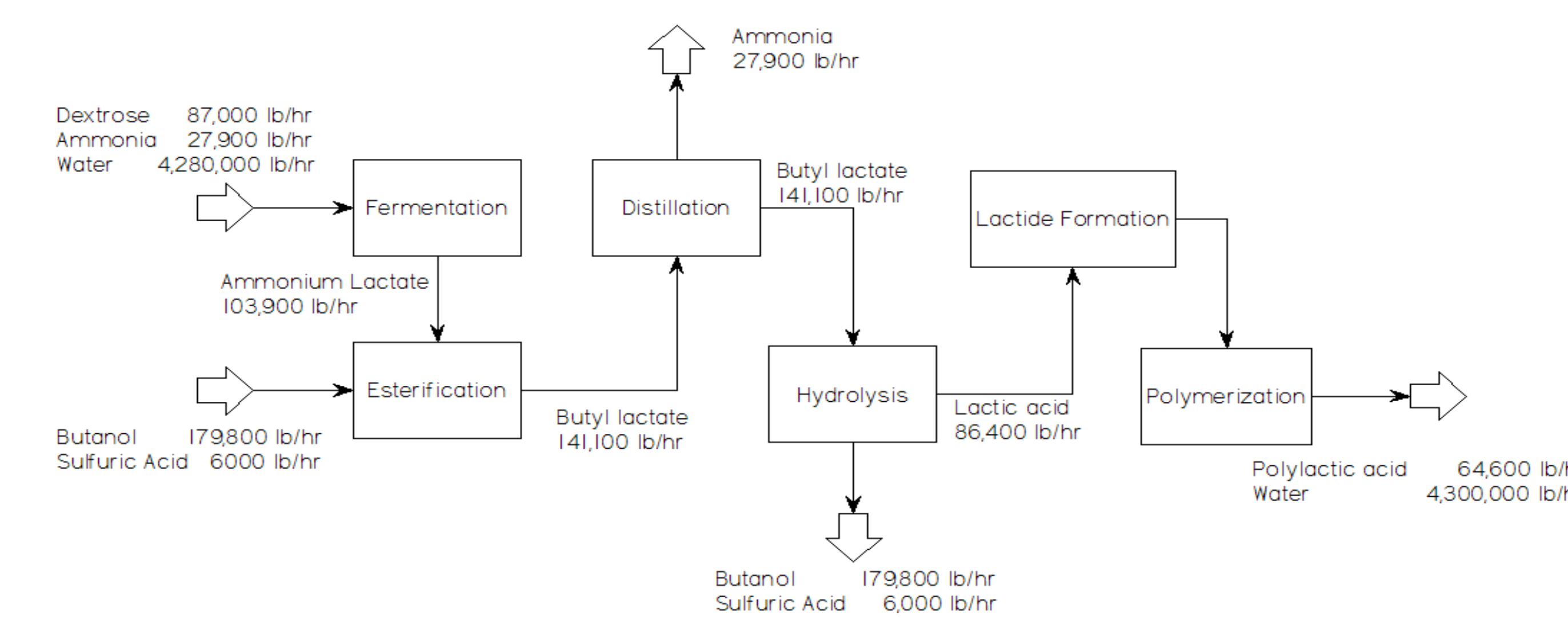


3. Polymerization



**Design Scale Up**

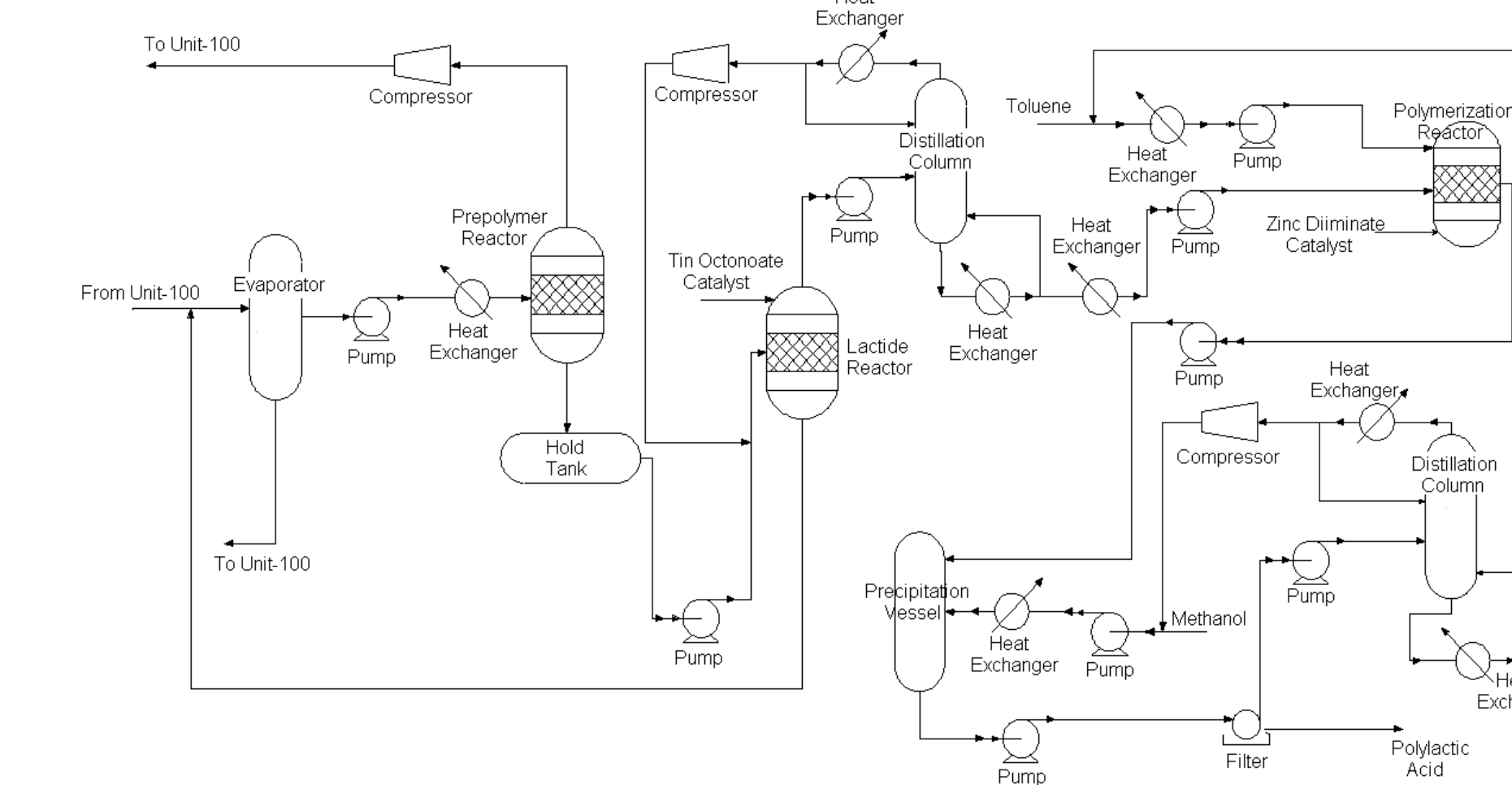
**Process Flow Diagram**



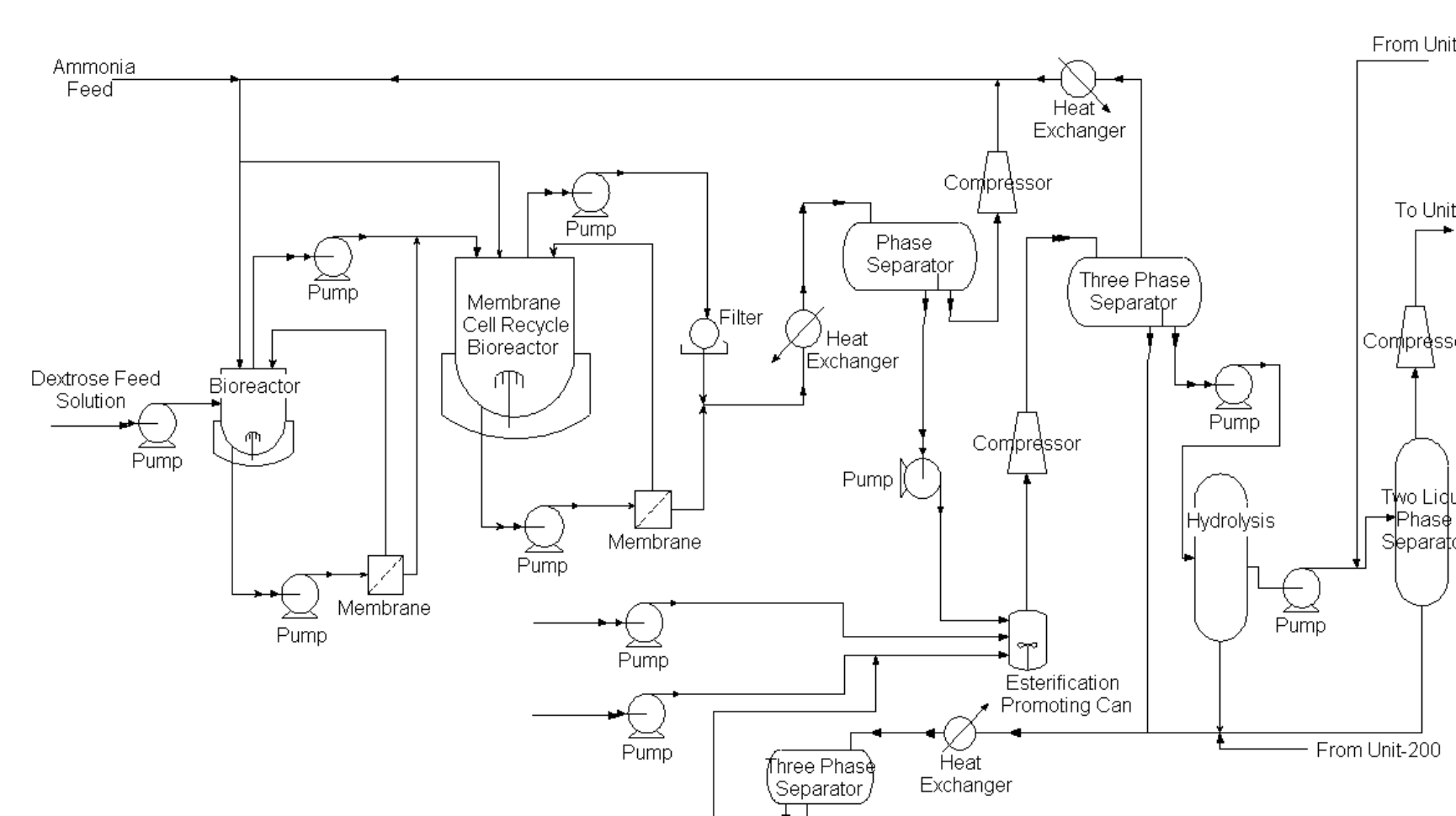
**Catalyst Used: Tin Octanoate**

- When Sn(Oct)<sub>2</sub> is used, highest molecular weight is achieved in comparison to other catalysts.
- Produces a more durable plastic.
- As average molecular weight increases, resin toughness increases. The same holds true for tensile strength and environmental stress cracking resistance.
- Almost 100% regeneration

**Polymerization**



**Fermentation**



**Budget**

**Equipment Costs (in Millions)**

Compressors	3.86
Exchangers	80.83
Pumps	1.34
Reactors	97.3
Tanks	1.51
Towers	2.47
Vessels	77.3
<b>Total</b>	<b>265</b>

**Utility Costs (in Millions)**

Equipment	
Exchangers	68.22
Pumps	0.23
Reactors	38.03
Vessels	19.4
Type	
Cooling Water	13.95
Electricity	0.23
Low Pressure Steam	82.88
High Pressure Steam	1.22
Refrigeration	27.6
<b>Total</b>	<b>126</b>

**Production**

Making 300 Million Pounds Per Year  
**Profit 300**

**Future Opportunities for Price Reduction**

- using wind energy
- using solar energy
- optimization of process
- increasing demand (projected increase up to 30%)



Sponsor : ABE Dept., Purdue University

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