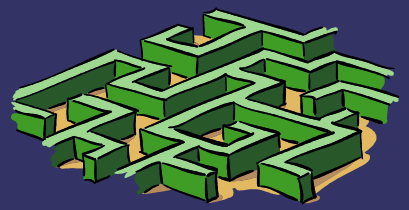
Green chemistry

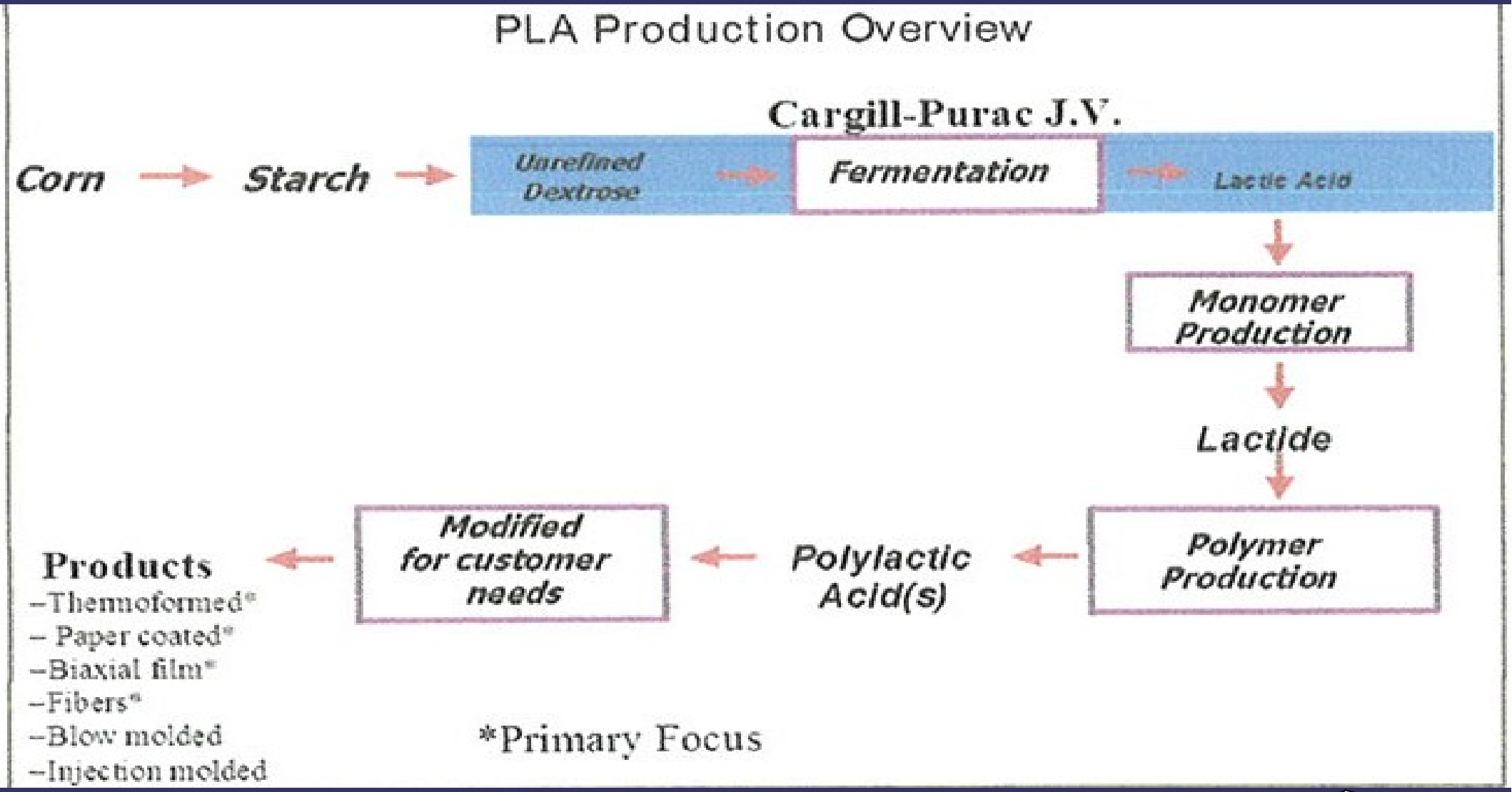
Polylactic acid

Background
PLA-polylactic acid

Reduce the consumption of Petroleum products
reasonable price
suitable for different applications
biodegradable



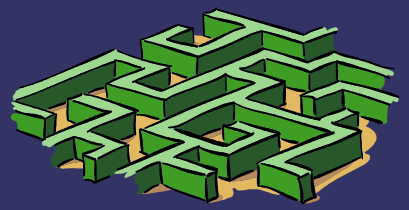
Process


PLA Production Overview
Cargill-Purac J.V.
Corn
Starch
Unrefined Dextrose
Fermentation
Lactic Acid
Monomer Production
Lactide
Polymer Production
Polylactic Acid(s)
Modified for customer needs
Products
–Thermoformed*
– Paper coated*
–Biaxial film*
–Fibers*
–Blow molded
–Injection molded
*Primary Focus

Prevention

All products and by-products are useful

Can be transformed into CO_2 and H_2O if necessary



Atom economy

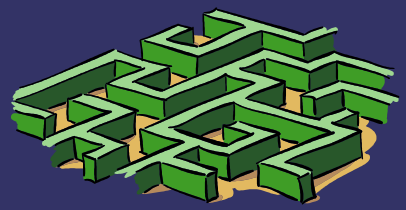
Homo-fermentative method is used instead of heterofermentative method

use of *Lactobacilli* which give high yields of lactic acid.

The conversion yield from glucose to lactic acid is more than 90 per cent.

By-products are reduced

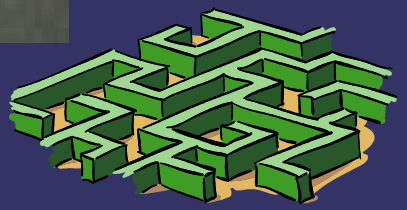
- acetic acid
- ethanol,
- glycerol,
- mannitol
- carbon dioxide



Less hazardous synthesis

- Products are non-toxic!!!

- examples of application



Designing safer chemicals

- Non-toxic
- can be processed
- Polymerization of a racemic mixture of L- and D-lactides usually leads to the synthesis of poly-DL-lactide (PDLLA)
- Different properties are resulted from the ratio of D to L enantiomers used

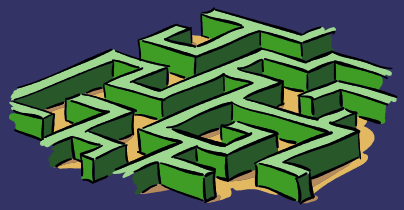
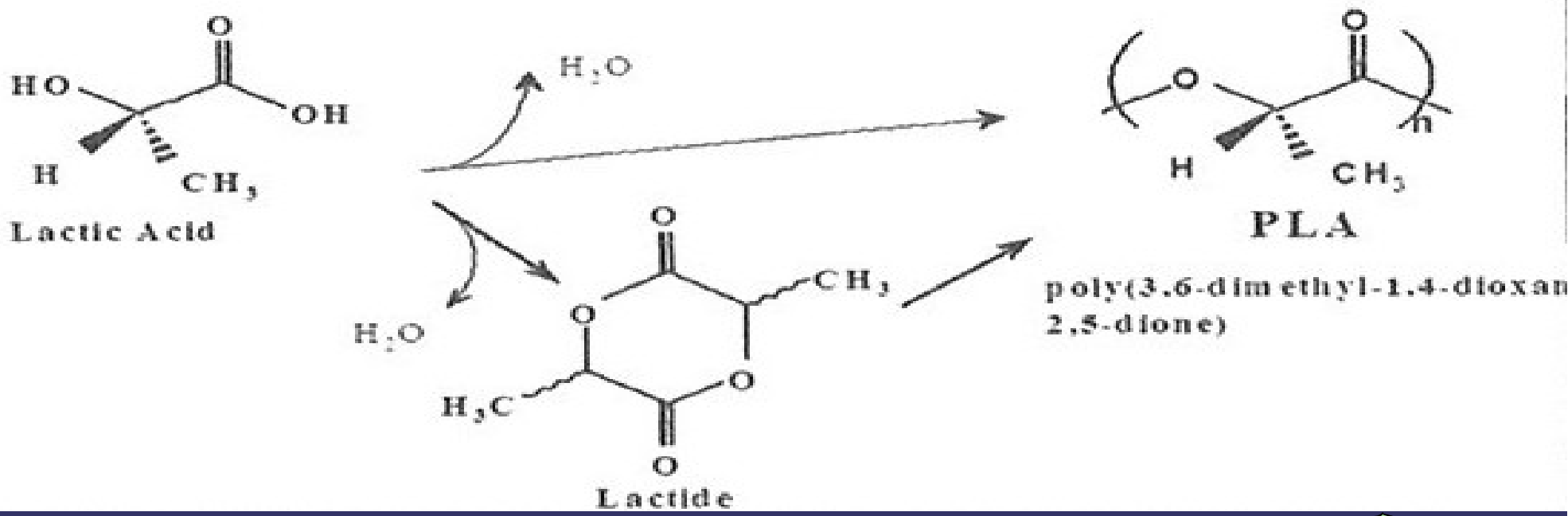


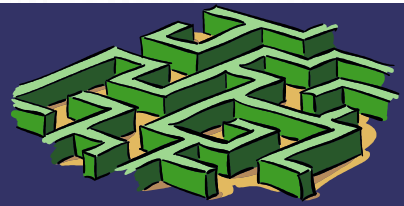
Figure 2

Manufacture of Polylactic Acid

Two Routes:

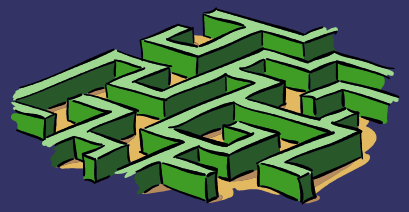
1. Direct Condensation- Involves the use of solvents under high vacuum
2. Formation of a cyclic dimer intermediate (lactide) - No solvent



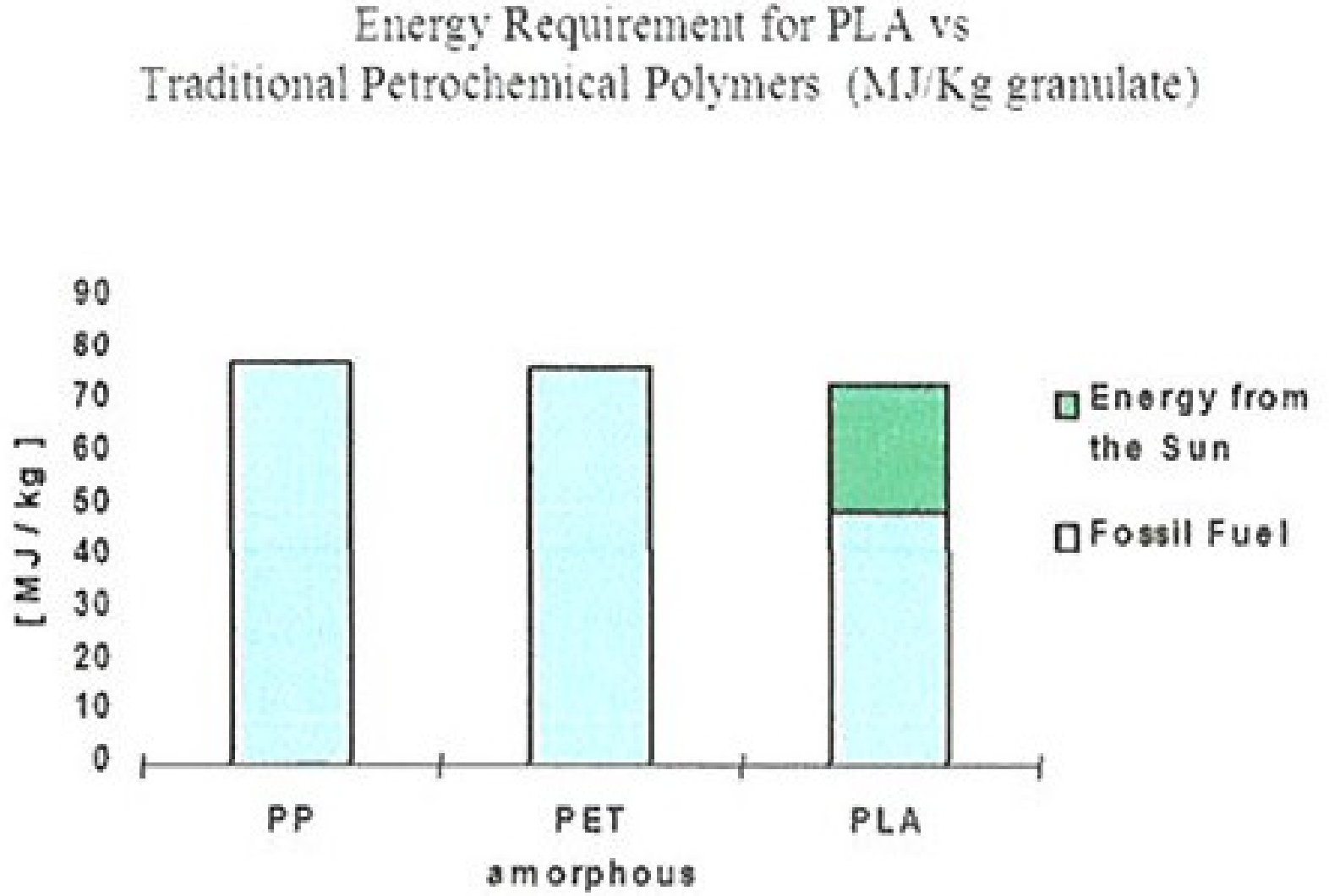


Energy efficiency

- Only requires energy from sun for the production of CORN
- Independent to petroleum resources
- conducted at ambient temperature and pressure

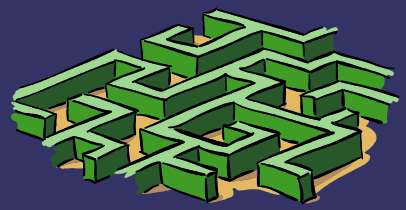


Use of renewable resources



Reducing derivatives

- The degree of crystallinity depends on the type of catalyst used.
- Water producing in the process stop itself from condensation
- Azeotropic dehydration condensation(1-Step)



Catalysis

STARCH

Hydrolysis

GLUCOSE

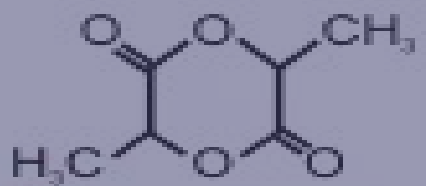
Fermentation ← *Lactobacilli*

SODIUM-LACTATE

Purification and Electrodialysis

LACTIC ACID

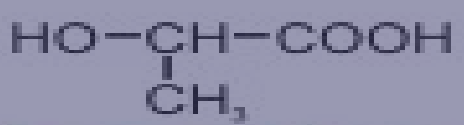
stannous octoate catalyst



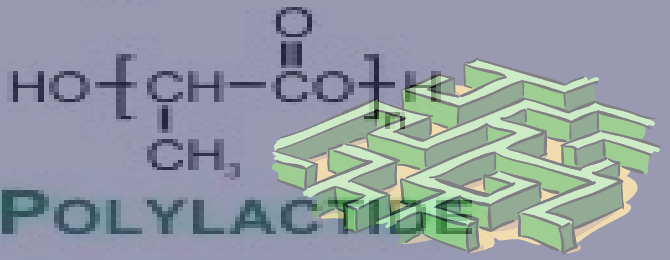
DILACTIDE

Oligocondensation and Depolymerisation

Ringopening Polymerisation



LACTIC ACID



POLYLACTIDE

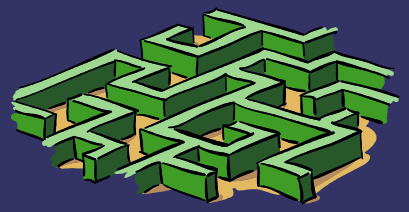
Design for degradation

Biodegradable polymers

can be degraded by abiotic degradation

Only CO_2 and H_2O are produced after degradation

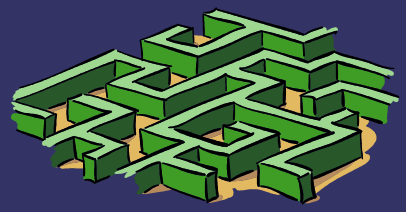
can be recycled back to a monomer



Analysis for pollution prevention

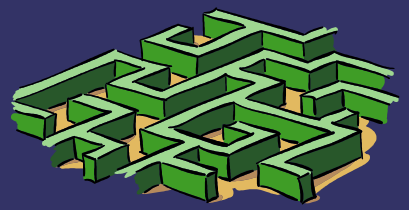
- In 2002, Cargill Dow improved polylactic acid polymerization process

- developing a second generation of polylactic acid product



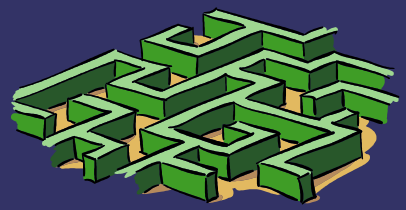
Accident prevention

- Low temperature and pressure
- Reduce the chance of accidents e.g.explosion,fire lighting...
- Non-toxic products



Advantages of using PLA instead of other plastics

- Renewable resources
- Degradable products
- Cheap
- Environmentally friendly
- Diverse application
- Safer



Information resources

- http://en.wikipedia.org/wiki/Green_chemistry
- http://en.wikipedia.org/wiki/Polylactic_acid
- www.techome.com.tw/technology/PLA.doc
- http://www.biodeg.net/fichiers/Polylactic%20Acid%20Synthesis%20Prop

THE END

THANK YOU