

The Science of Compostable Polymers



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September 26, 2016

 **BASF**
We create chemistry

AGENDA

- What is Biodegradation
- Interpreting Bioplastics
- Why Biodegradable
- How Polymers Biodegrade

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What is Biodegradation

A degradation process in which naturally occurring micro-organisms such as microbes, fungi or algae cause the degradation.

What is Biodegradable

The micro-organisms in the target disposal system use the carbon source of the substrate completely and in a short period of time.

What Happens On A Molecular Level

- Microorganisms utilize carbon substrates as “food” to extract chemical energy for their life process.
- Under aerobic conditions, the carbon is biologically oxidized (through cellular respiration) to CO_2 releasing energy that is harnessed by the microorganisms for their life processes.
- By measuring the amount of CO_2 evolved as a function of total carbon input to the process we can directly measure the amount of carbon substrate being utilized by the microorganism.

Rate of Biodegradation

- All natural products biodegrade at different rates
 - Leaves
 - Grass
 - Trees
 - Peanut shells
 - Banana Peels
 - Fruit and Vegetables
- Rate is dependent on how “available” the carbon is to the microorganisms doing the biodegradation

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Interpreting Bioplastics

The Sources of the Carbon

Can be Fossil-based carbon



Come from:

- Coal
- Oil
- natural gas

Bio-based >25% renewable carbon



- Plant Based Materials
 - Starch
 - Bagasse
 - Cellulose
- Compounded with fossil based Polymers

Renewable 100% renewable carbon



Come From:

- Plants
- Animals
- Micro-organisms

Interpreting Bioplastics

Biodegradation

A Carbon Based Process

Biodegradable



- Metabolized by naturally occurring micro-organism
- Produce CO₂, water, energy, and biomass

Compostable



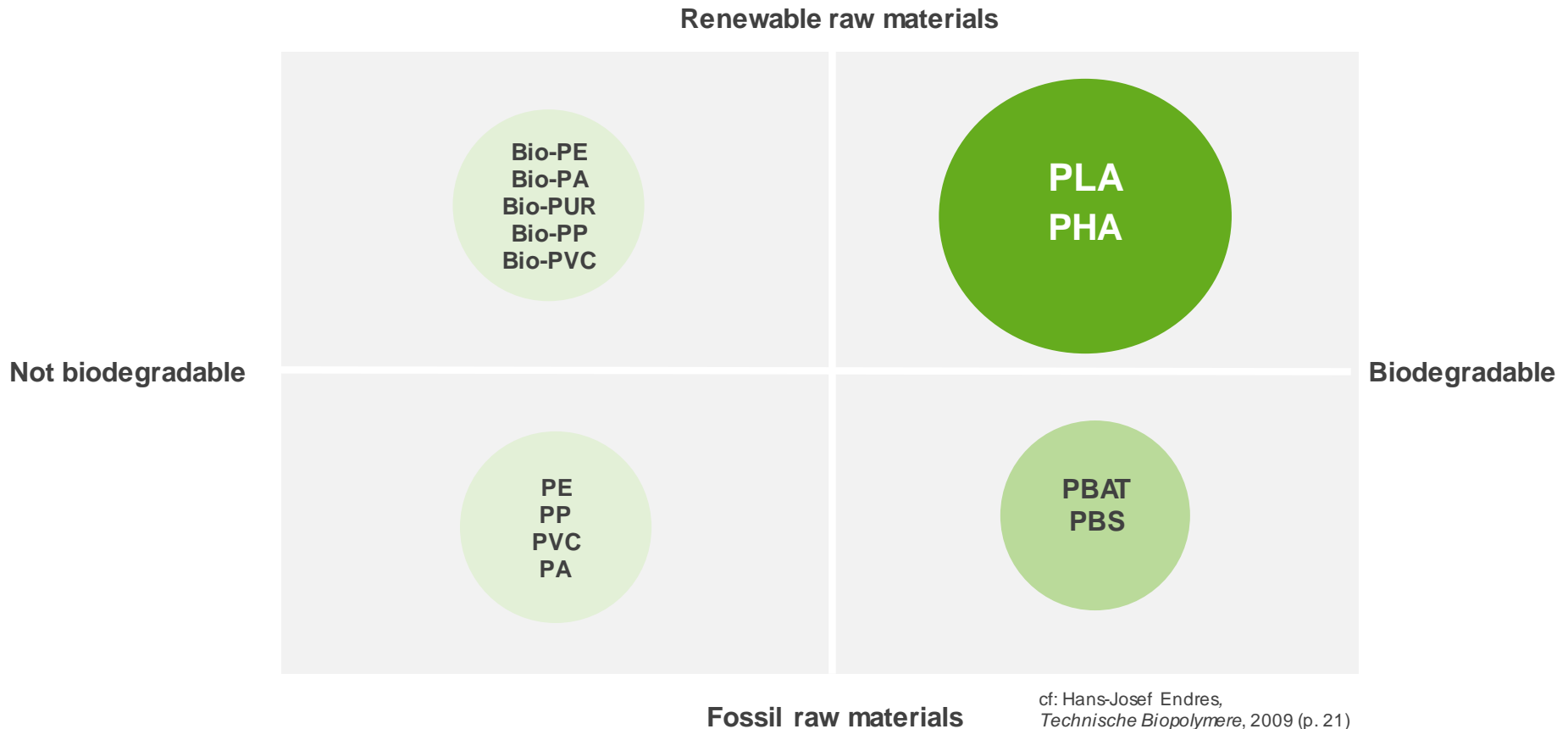
- Biodegradation in a controlled environment
- Water, Oxygen, composition, and temperature are controlled
- Predictable timeframe

Biogas



- Biodegradation in a controlled environment
- No oxygen
- Controlled temperature and composition
- Produces methane (biogas), water and biomass
- Predictable timeframe

Bioterms – What do they mean?



Fossil-based and biobased polymers can both be 100% biodegradable.

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Why Biodegradable

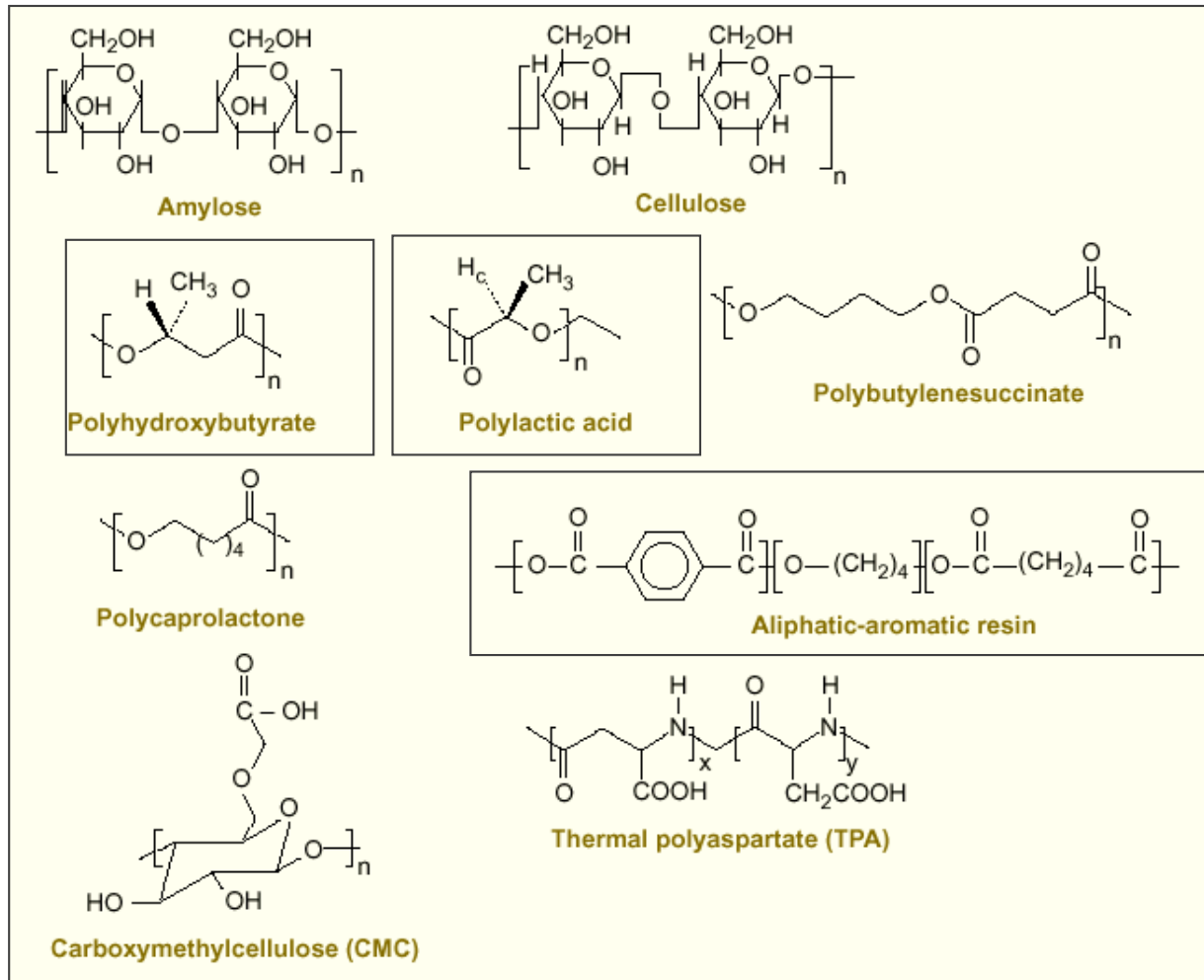
- Can be fossil or bio-based
 - PLA
 - PHA
 - PBAT
- Alternative End Of Life options
 - Food Contaminated products
 - Soil Contaminated Products
 - Complex Structure that are not easily recyclable
- Reduced waste to landfill
- Reduced waste fees
- Produce a usable byproduct

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Biodegradable Polymers

Structures of selected BP

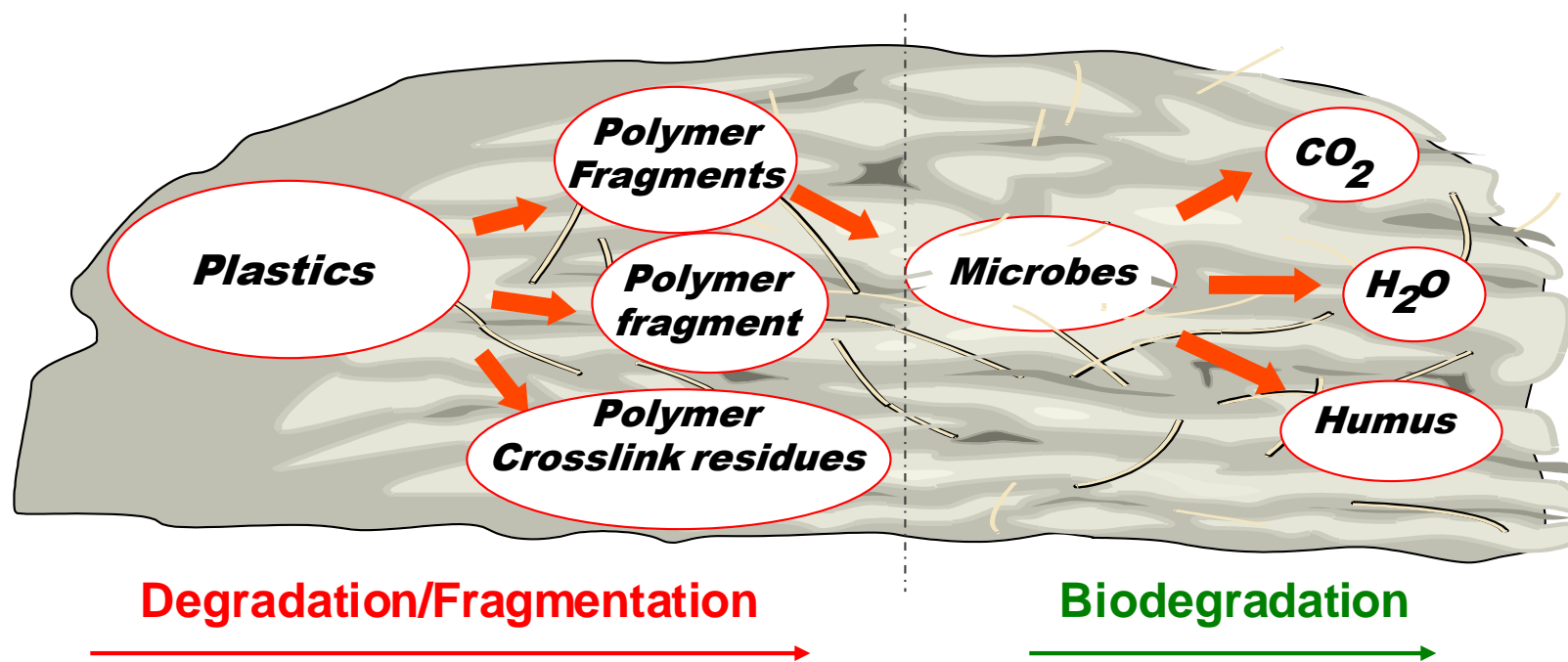


Industrial Composting

ASTM D6400;ISO EN13432;CAN/BNQ 0017-088/2010-12-10

- Biodegradation under controlled conditions
 - C:N Ratio
 - Moisture Content
 - Aeration
- Specified 2 step process with specific criteria and time limit
 - 90% disintegration to less than 2 mm in 12 weeks
 - 90% conversions of bio-based carbon to CO₂ in 180 days
- No Heavy Metals
- Non-detrimental to plant growth

Degradation vs. Biodegradation



- Biodegradability – complete assimilation of the degraded products as a food source by the soil microorganisms

What a Biodegradable Polymer is Not

- Traditional polymer with bio-content added.
 - Adding starch to PE does not make it biodegradable
- Traditional Polymer with a degradation additive
 - An additive would have to change the molecular make-up of the polymer in order to make it biodegradable.

- Any polymer claiming to be biodegradable need to have data to back up the claim.
 - The data needs to show complete conversion of the substrate carbon into biogas and biomass.
 - The data needs to be disposal environment specific.
 - The data must demonstrate biodegradation in a realistic and reasonable time frame

Compostable Bioplastics

Certified Compostability

Specifications with Pass/Fail Criteria

EN 13432



Europe

Greenpla



Japan

ASTM D 6400
D6868



BPI®

COMPOSTABLE
IN INDUSTRIAL FACILITIES

Check locally, as these do not exist in many communities. **Not suitable for backyard composting.** CERT # 890989

North America

BNQ



Canada



Thank you!

