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BIOBASED POLYMERS properties, opportunities and challenges



CurCol - Natural Colorants for Bioplastics
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Polymers and plastics

A cooled plastic melt will retain the shape of a mold



Melting plastics allows for additives to be mixed in
→ finetuning of properties possible

Malleable + wide range of properties
= near endless applications



Bioplastics, not a new phenomenon

The first plastics were biobased

Rayon



Celluloid



Cellophane



What are bioplastics?

- Bioplastics "Unregulated term"
- Collective term for very different plastics
- "Bio" can refer to renewable origin and/or biodegradable property

BIO BASED
DEGRADABLE
COMPATIBLE

Why biodegradable?

- Not all plastic products have to be biodegradable, oftentimes recycling is preferred
 - e.g. PET bottles = not contaminated with lots of organic material → recycling is the preferred option
 - Tea bags, fruit stickers, coffee filters... = food-contaminated packaging → good candidate for biodegradability

A Reduce

B Re-use

C Recycling

D Energy

E Incineration

F Landfill



Bioplastics overview

	Biodegradable	Nonbiodegradable
Bio-based	CA, CAB, CAP, CN, P3HB, PHBHV, PLA, starch, chitosan ...	PE, PA 11, PA 12, PET, PTT, PEF ...
Partially bio-based	PBS, PBAT ...	PBT, PET, PTT, PU ...
Fossil fuel-based	PBS, PBSA, PBSL, PBST, PCL, PGA, PVOH ...	PE, PP, PS, PVC, ABS, PBT, PET, PA 6, PA 6.6, PU ... <i>non-exhaustive list</i>

Bioplastics can be biobased, biodegradable or both

→ fossil fuel-based plastics can be biodegradable

Biobased content

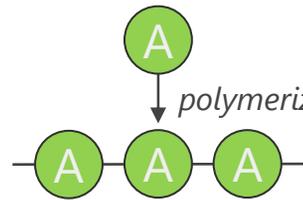
Partially bio-based

Biobased content can vary from 0 to 100 wt%

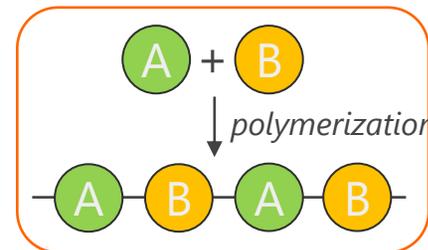
97%
biobased

A = biobased monomer

B = non-biobased monomer



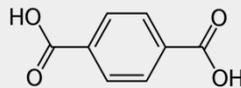
100% biobased



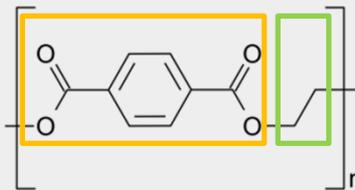
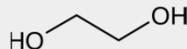
Partially biobased polymer

e.g. bio-PET

Tereftalic acid



Ethylene glycol



30% biobased



"plantbottle"



Biobased content

Most plastics contain a polymer and multiple additives
e.g. flame retardants, colour pigments, fillers, plasticizers...

(Biobased) additives are also important to take into account when considering biobased content



Why biobased?

Plastics are...

- unmatched in available properties → fine-tuning possible = near endless applications
- excellent food packaging (barrier) materials = less food wasted

Plastics have become an integral part of our economy/society



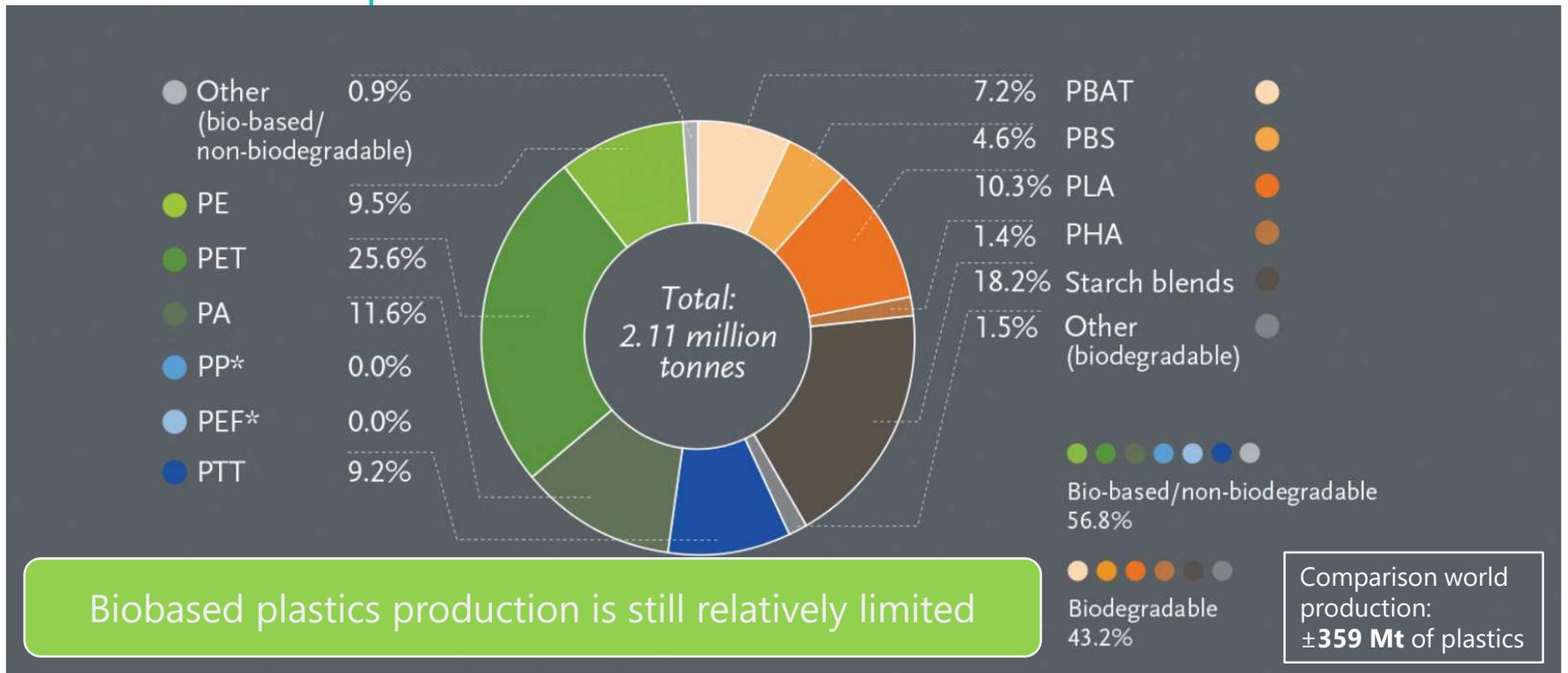
Plastics are...

- usually made from petrochemicals
 - Oil is a limited resource
 - Oil availability is dependent on geography (political)

Plastics production from oil is not sustainable

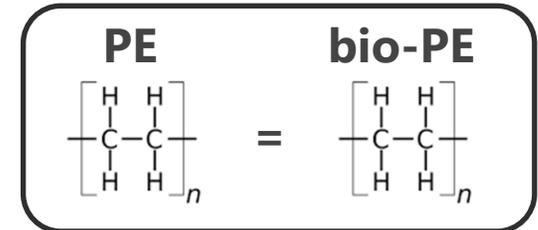


Biobased plastics production - thermoplastics



Biobased plastics production is still relatively limited

Drop-ins



Drop-ins are structurally identical to their petrochemical counterparts

Drop-ins can be processed in the same way as their petrochemical counterparts

e.g. PE can be readily replaced by bio-PE in existing processes. HOWEVER, there is no guarantee that a biobased alternative is available for the specific PE grade used.

New biobased plastics

Some of the latest biobased plastics require a completely new approach to processing

Agar (powder)



1. Dissolving
2. Moulding
3. Freezing
4. Thawing
5. Air-drying

Mycelium



- Growing into desired shape (casting)

Chitosan (powder)



1. Dissolving
2. Moulding
3. Vacuum drying

New biobased plastics



Many of the more widespread biobased plastics are offered as ready to use pellets

e.g. PLA, PHBV, CA, Starch (TPS)

Feeding the machinery is usually not an issue

They can be processed in a similar fashion to petrochemical plastics, but with some caveats



RATHOLE

ARCHING

CLINGING MATERIAL

BRIDGING

Create your biobased solutions!

MATRIX

PLA
Bio-PE
bioPA
acrylics



ADDITIVES

Filler
FR
...

PROCESSING

Molding
Casting
Coating
Extrusion
injection
...



CERTIFICATION

Biobased
Biodegradable
LCA
...

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