"Bioplastics": Types, Pros and Cons

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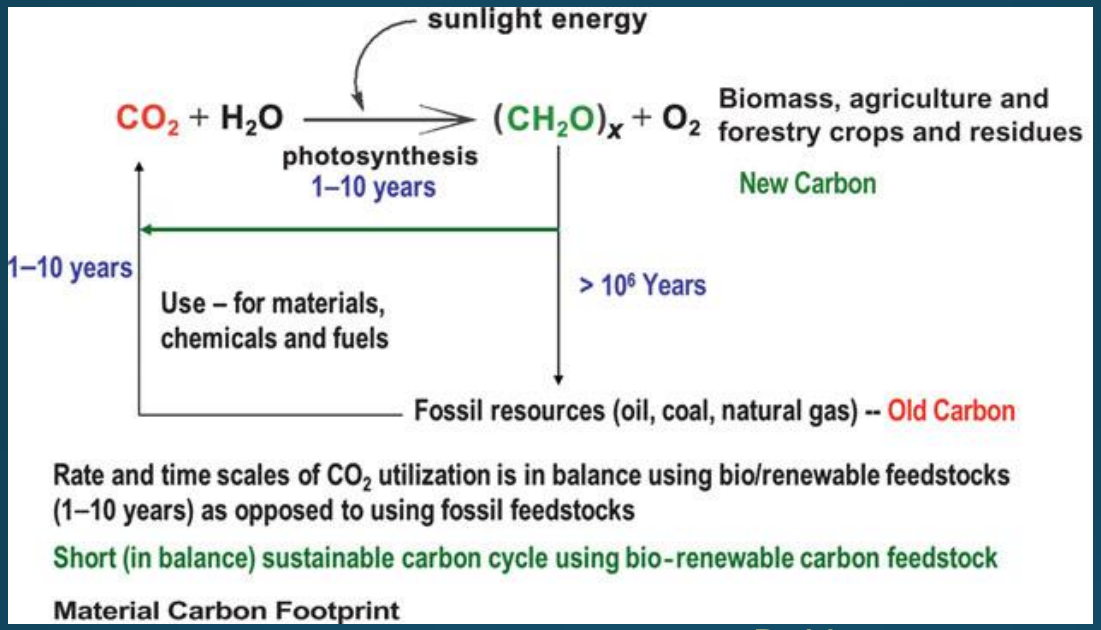
Microplastic Research at SEA

Three main groups of “bioplastics”:

- Bio-based plastics
- Degradable plastics
- Biodegradable plastics

Bio-based Plastics



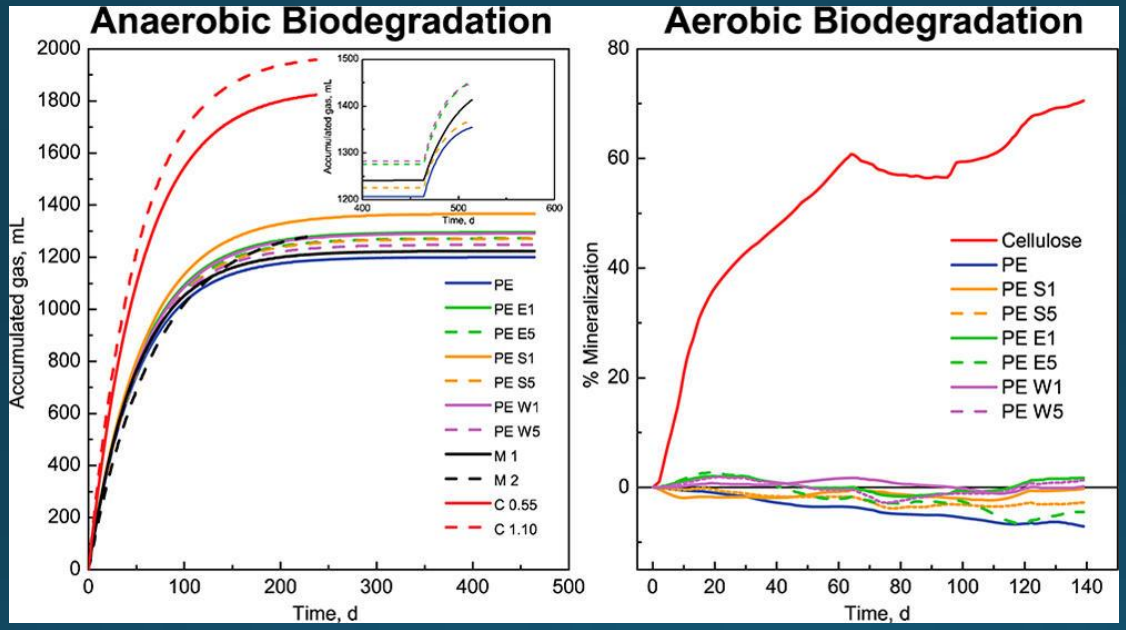
R. Narayan, 2011

Bio-based ≠ Biodegradable

- Pros:
  - Reduces carbon footprint of production of plastics
- Cons:
  - Has nothing to do with end-of-life solutions

Degradable plastics

- These are oxo-biodegradable or degradable plastics



Selke et al., 1015

- Pros:
  - Helps with some entanglement issues
- Cons:
  - No scientific evidence to support true biodegradation
  - Faster creation of microplastics
  - Contaminate recycling stream

"Green Washing"

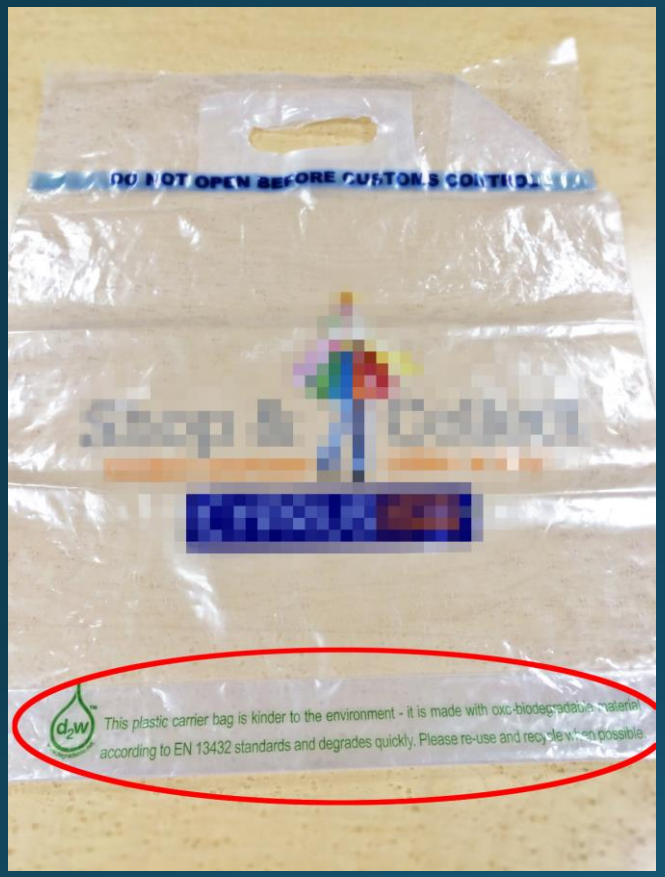


Image: European Bioplastics

Biodegradable PVC product claim

"Biodegradation process begins only when the bio PVC film is introduced into an environment (compost, both commercial and home, trash dump, the ground, lakes, rivers and the ocean) that allows microorganisms, which break down matter, to come into constant contact with the bio PVC film. Once that happens the 'special ingredients' attract the microorganisms that begin to break the hydrogen carbon chain that exists in the PVC. Once the chain is broken, this allows oxygen to enter which will attach itself to the hydrogen and carbon creating H_2O and CO_2. The lone chlorine atom bonds to a hydrogen atom creating a very weak salt that does not have any adverse effect on the ecosystem. The biodegradation process works in both aerobic and anaerobic conditions. So the absence of oxygen or water will not keep the bio PVC film from biodegrading. All that is needed are the microorganisms"

Oxo-biodegradable polyethylene (PE) film claims

"The technology is based on a very small amount of prodegradant additive being introduced into the manufacturing process, thereby changing the behavior of the plastic and the rate at which it degrades. The plastic does not just fragment, but is then consumed by bacteria and fungi and therefore continues to degrade to nothing more than carbon dioxide, water and biomass with no toxic or harmful residues to soil, plants or macro-organisms".

"Designed to interact with the microorganisms present in landfills, composters, and almost everywhere in nature including oceans, lakes, and forests. These microorganism metabolize the molecular structure of the plastic breaking it down into soil".

Source: R. Narayan, "Biodegradability" 2009

Image: Lindsay Miles http://treadingmyownpath.com/

Faster way to create:

Image: Sea Education Association

Biodegradable Plastics:

- Adhere to strict standards by ASTM, ISO or EN to actually be **metabolized by microorganisms** in a **short period of time** in a **specific disposal environment**

- Pros:
  - If disposed of properly can actually biodegrade, help with end-of-life solutions
- Cons:
  - Have to have access to proper disposal (industrial composting), otherwise just adding to waste stream
  - Difficultly recycling

Is this an answer to plastic waste issues?

- Need to look at complete life cycle of plastics
- Does not solve over use of plastics/single use plastics
- Even if some are biodegrade – not necessarily in marine environment
  - PLA does not biodegrade in marine environments
  - Some versions of PHA do, but the marine environment is not an "end-of-life" option
- Marine biodegradability – not a solution, but reduces risks
  - Preventing plastic from entering the ocean in the first place is necessary
- Does not solve waste management issues

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