Introduction to Biodegradation and Composting

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Agenda

- **Terminology**
- **Commercial Composting Method and Types**
- **Compostability Testing and Requirements**
- **Compostability Claims**
Terminology
Terminology

- Degradable - breaks down

- Biodegradable - breaks down by biological action

  - FTC suggests in less than one year unless qualified
Terminology

- Compostable- breaks down under controlled conditions of heat, moisture, oxygen and bacteria
- Types: industrial, backyard, home and vermicomposting
**Terminology**

Degradable
- Photodegradable
- Oxo-degradable
- Landfill Degradable

Biodegradable
- Hydrolyzable
- Soil Degradable
- Anaerobically Digestible
- Water Biodegradable
- Compostable
- Soil Biodegradable
Other End of Life to Consider

- Reduce
- Reuse
- Recycle
  - Mechanical
  - Chemical

Composting

CO₂

Recycle

Material

Reuse

Reduce
Industrial Composting
Industrial Compost Process Types

- Windrow
- In-Vessel
- Aerated Static Pile
Industrial Compost Process Types

Mass Bed

Tunnel
Compostable Feedstocks
Industrial Compost Conditions

- Thermophilic
- 50% moisture
- Aerobic
- 30:1 C:N initial ratio
- Stage 1: 28-90 days
- Curing: up to 90 days
Compostability Testing
Why Test and Specify?
Compostability Requirements

- Disintegration
  - Lab (material/product screening)
  - Field (facility acceptance)
- Biodegradation (Mineralization)
- Hazardous chemicals analysis
- Plant and animal non-toxicity
ASTM Standards

- Six types
  - Classification, Terminology, Practice, Guide
  - Test Method
  - Specification

- Only specifications provide requirements for a term such as ‘compostable’
ASTM Specification Standards

- Compostability specification standards
  - ASTM D6400
  - Single layer plastic product
  - Typically used for non-plastic products
ASTM Specification Standards

- Compostability specification standards
- ASTM D6868
- Multilayer product with a natural fiber layer
- Typically used for any multilayer product
EcoCyle Study

“The study showed conclusively that micro-plastic fragments were shed from all plastic coated samples, whether single or double-coated. This means any plastic-coated paper product, even those that are partially screened out during the composting process, is contaminating the finished compost with plastic particles.”

- LDPE coated paper board
- Evidence that plastic barrier did not greatly impede biodegradation of the fibrous material

Picture: https://ecocycle.org/files/pdfs/microplastics_in_compost_presentation.ppt
ASTM D6400

- **D6400 compostability specification requirements**
  - **Metals content**: ≤50% national regulations for heavy metal content in sludge or compost
  - **Local regulations** should also be met at <50% allowed
  - **Disintegration**: ≥90% through 2mm sieve within 84 days
ASTM D6400

- D6400 compostability specification requirements

- Mineralization: ≥90% converted to carbon dioxide (and/or humus) within 180 days
ASTM D6400

- D6400 compostability specification requirements
- Plant growth: ≥90% biomass and germination rate of control plants
  - Monocots (e.g., wheat and barley)
  - Dicots (e.g., water cress and tomato)
ASTM D6400

- Additional requirements
  - Specific additive added at 1% to 10% must be tested separately
  - Untested additives may not exceed 5% total combined
  - Additives include fillers, resin, colorant, ink and adhesive
  - No preconditioning allowed
- Thickness dependent
- Crystallinity dependent
- Material or product must be tested in final commercial form
ASTM D6868

- D6868 compostability specification requirements
  - Each layer must pass mineralization and plant growth testing per ASTM D6400 independently
    - Layer of ‘natural origin’ not ‘chemically modified’ passes if >95% biobased content
  - Total composite must pass disintegration
Field Disintegration Testing

Samples are placed in nylon bags

80% Feedstock

20% Products
Field Disintegration Testing

12'

6’-8’
Field Disintegration Testing
Certifications and Claims
Certification

- Biodegradable Products Institute (BPI)
  - Certifies only for industrial compostability
  - Certifies materials and products
  - ASTM D6400/D6868 or EN13432 required testing at approved labs
  - DIN Certco reviews test results
  - Additional requirements beyond standards
- www.bpiworld.org
Certification/Approval

Compost Manufacturing Alliance

Accepts only food-related products for industrial compost facilities

Requires BPI certification OR ASTM D6400/D6868 or EN13432 lab results

Reviews certification and/or laboratory test results before performing field tests

Additional requirements beyond standards

www.compostmanufacturingalliance.com
Claims

- Claims regulated by the US Federal Trade Commission (FTC)
- Guides for the Use of Environmental Marketing Claims (aka “Green” Guide)
  - Updated 2012
  - Section 260.4 General Environmental Claims
  - Section 260.6 Certifications and Seals of Approvals
  - Section 260.7 Compostability Claims
  - Section 260.8 Degradable Claims
Claims

- Must be based upon data

- Testing and certification best if by non-affiliated third party
  - Otherwise must qualify relationship to testing and certification organization(s)
  - Or state self-tested and/or self-certified
Claims

- Avoid unacceptable terms, e.g.
  - Environmentally friendly
  - Green
  - Biodegradable

- May need to qualify claims for
  - Time to industrially compost
  - Availability of industrial composting
Claims

- Claims also overseen by
  - Better Business Bureau National Advertising Division (BBB NAD)
  - California law
    - Must have ASTM specification standard
  - Vermont regulation
    - Must label as industrially compostable if not proven for home or backyard composting
- Competitors
- Watchdog organizations
One Last Note

Biobased does not equate to biodegradable

and

Biodegradable does not equate to biobased
Thank You!

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Compostable Materials
Paper Products

- Paper products based upon tree fibers are often accepted by industrial composters without certification or acceptance testing.
- However, many components or products may not pass ASTM D6400 or ASTM D6868 specifications.
- This can lead to sortation issues for industrial composters caused by paper-based products.
- The following slides relate to materials passing ASTM D6400 or D6868 specifications, not to acceptance by industrial composters.
Natural Fibers

- Most natural fibers are compostable
  - Bleached tree fiber
  - Wheat straw
  - Rice hulls
  - Bagasse
Natural Fibers

- Exceptions:
  - Bamboo unless treated
  - Unbleached tree fiber in some instances
  - Additives can affect compostability
Bioplastics

- A bioplastic resin is
  - Partially or fully bio-based
  - and/or
  - Compostable or biodegradable

-Plastics Industry Association
Bioplastics

- Not Biodegradable
  - Oil-based PP
  - Oil-based PET
  - Oil-based PE

- Biodegradable
  - BASF Ecoflex
  - NatureWorks Ingeo PLA

- Biobased
  - Coca-Cola PlantBottle PET
  - Braskem BioGreen PE

- Not Biobased
Bioplastics

- Generally compostable
- PBS
- PBAT
- PLA (Amorphous)
  - Not crystalline
  - Not very high molecular weight
- Blends of compostable resins
Waxes

- Only linear short chain (<40°C) paraffin waxes are compostable
- Not branched or microcrystalline waxes
- Natural waxes need to be individually tested
Other Additives/Substrates

- Most adhesives are not compostable
  - PVOH/PVA may be exception
  - BASF and Danimer Scientific have specific compostable adhesives
- Inks: heavy metal content must be known
  - Set total coverage and loading limits per ink
Other Additives/Substrates

- Many coatings are not compostable including
  - Acrylic coatings
  - Overprint varnishes
  - Paints
  - UV cured coatings
- Mineral additives are generally not taken into consideration