

Degradable Plastics

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Degradable Plastics

- Degradable Plastics
 - A rather “loose” term
- What I would like you to take away from this session are four questions
 - Degradable *where*?
 - Degradable *when*? How long does it take to degrade?
 - Degradable *how*? Are any of the residues harmful to the environment
- Does this product bring environmental benefits greater than the alternatives
- Any consideration of degradable materials should include these questions

Degradable Plastics

- **Degradable**

- Usage of the term

- A characteristic of a product or packaging that, with respect to specific conditions, allows it to break down to a specific extent within a given time.

NOTE: Degradability is a function of susceptibility to changes in chemical structure.

Consequent changes in physical and mechanical properties lead to disintegration of the product or material.

National Standard of Canada CAN/CSA-ISO 14021-00

“Environmental labels and declarations– Self-declared environmental claims”

- **What is a degradable plastic?**

- a plastic designed to undergo a significant change in its chemical structure under specific environmental conditions resulting in a loss of some properties that may vary as measured by standard test methods appropriate to the plastic and the application in a period of time that determines its classification.

ASTM D883

(ASTM is the American Society for Testing Materials, a standards writing body)

Degradable Plastics

Terminology

- **Bio-degradable:** biological aerobic or anaerobic decomposition by bacteria, fungi or algae
 - **Compostable:** biological decomposition during composting to yield CO₂, water, inorganic compounds and biomass at a rate consistent with other compostable materials in commercial/industrial composting conditions and leave no visible, distinguishable or toxic residue.
- **Oxo-degradable/Bio-degradable:** degradation via a multi-stage process using a chemical and heat, sunlight etc. to initiate the degradation with remnants then potentially bio-degrading over time.
- **Photo-degradable:** degradation under the action of UV light such that the material fragments into minute particles.
- **Water-soluble:** soluble in water within a specified temperature range.

Degradable Plastics

Environments for Degradation

1. Landfill
2. Aerobic/ anaerobic digesters (enclosed vessels)
3. Compost: commercial and domestic
4. Marine: salt and freshwater
5. Waste water/sewerage
6. Open environments (exposure to wind, sun) eg. Mulch films
7. Waste to energy facilities (thermal degradation)



Degradable Plastics

Types of Degradable Plastics

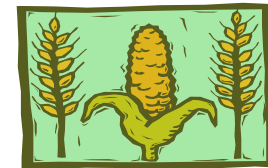
1. Petrochemical feedstock

- Polyolefin (polyethylene) with pro-degradant additives
- Biodegradable polyesters
- Polyvinyl alcohol derivatives



2. Renewable resource feedstock (bio-plastic) (not all bio-plastics are degradable)

- Cellulose
- Starch/sugars
- Vegetable oil
- Products derived from “natural sources” can have chemical structures identical to those derived from petrochemicals and behave the same. The first nylon was based on a chemical from corn cobs. “Green Polyethylene” is based on sugar cane.



3. Combinations

- Various bio-plastics
- Starch/polyester

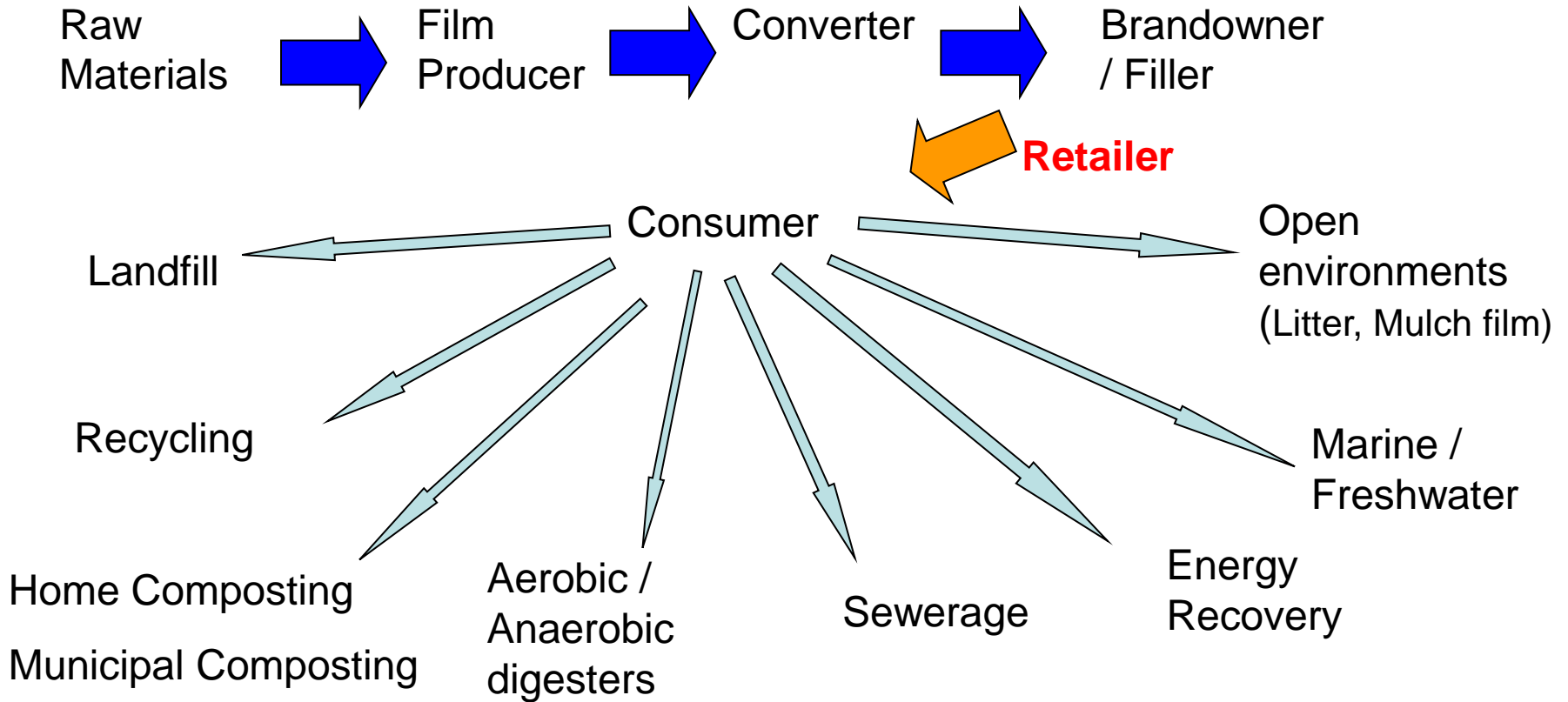
Degradable Plastics

- A complex “stew”: 3 sources of materials, 4+ degradable mechanisms, 7 end environments
- Good design criteria are needed
 - Degradability needs to add value
 - Degradation must occur at the right time, in the right place
 - The function of the product must not be compromised
 - There must not be any adverse contamination of the environment such as the release of toxic chemicals
 - Consumers must be informed and educated regarding proper application/disposal of the product



Design of the Product Chain

Education of the Consumer



Certification

- How can a supplier of a degradable product provide proof that his products meet what is claimed for them
- By Certification
 - Certification is a process whereby technical information regarding the characteristics of a product are submitted to a recognized third party which will rule on whether or not the product meets the requirements for a particular application.
 - Most often the ruling is based on whether or not the product meets recognized standards. Certified products usually bear a symbol
 - For compostable plastics the certification agencies include
 - BNQ, BPI, OK Compost. Canada has launched its prog. for compostables
 - All agencies certify to similar standards

Effect of Degradable Plastic Bags on the Recycling of Conventional Plastic Bags

- Plastic bags are collected in many parts of Canada for recycling through in store, curbside and depot collection.
- Questions have been raised regarding the effect of degradable bags on those currently being recycled.
- Recyc-Quebec, City of Montreal, PFMAC sponsored work at Centre de recherche industrielle Québec (CRIQ) to investigate the effect.
- A test protocol was developed by EPIC and other technical persons
- Unused conventional bags, certified compostable bags and two types of “oxobiodegradable bags” were taken from the marketplace.
 - Mixtures of the degradable bags and conventional bags were made at levels of 5% to 50% degradable. Conventional bags were used as the control.
 - The mixtures and the control were re-extruded into film and thick plaques molded.
 - The re-extruded materials were exposed to heat, humidity and UV light for periods of 1 to 7 weeks.

Effect of Degradable Plastic Bags on the Recycling of Conventional Plastic Bags

- The physical properties of the control and mixtures were measured
- Results:
 - The compostable bags were incompatible with conventional bags
 - **One** type of oxobiodegradable bag was compatible with conventional bags, **the other was not.**
- Outcome:
 - Recyc-Quebec has initiated a certification program to assure compatibility of degradables with conventional bags.
 - BNQ, a national certification agency will develop the protocol for certification and the testing procedure.
 - Test results carried out by recognized third party laboratories will be assed by BNQ. Those bags meeting the protocol for certification will be given a logo by BNQ.

Questions to Ask When Considering Degradables

Compostable Materials

1. Will the product biodegrade in municipal composting operations and will it compost at the same rate as food waste?
2. Will the product in any way affect the quality of the compost? (Canada has an official standard describing the quality of compost developed by the CCME)
3. Does the material meet the requirement of ASTM D6400 Compostable plastics.
4. Is there third party documentation (certification) verifying the claims made for the product?
5. Will the product possibly get into the recycling stream? If so what is the impact? *Testing carried out at CRIQ shows that some “degradable” plastic bags have a major detrimental effect on the recycling of conventional bags*

Questions to Ask When Considering Degradables

Degradables other than Compostable Materials

1. Is there a chance that the material will enter the recycling stream?
2. Is the material compatible with current recycling programs for plastics?
3. What is the time frame for degradation (weeks, months, years)?
4. What are the by-products of degradation (eg. greenhouse gases, toxic residues etc.)?
5. Is there documentation of third party verification that supports claims that the material will degrade?

Environmental Claims

- Anyone making a claim of degradability would be wise to read carefully the relevant sections of ISO 14021
 - In Australia the Federal Court has had a successful prosecution based on 14021
- We have recently met with the Canadian Competition Bureau
 - They are aware of the confusion that exists in the market regarding degradable products.
- The Competition Bureau have just revised ISO 14021 and use it
- CPIA has initiated the development of a “Product Stewardship Guide and Commitment for Degradable Plastics”