SUPERECO
Degradable/Biodegradable film

Packing freshness, an overall protection of environment

SUPERECO
Degradable/Biodegradable film

- *Today what Customers are expecting from packaging :*
  - **Food products**
    - Good protection of product 92%
    - Easy to handle , easy to transport 88%
    - Biodegradable 56%
    - Can be re-use 42%
    - Ecological 41%
  - **Health and beauty**
    - Easy to handle , easy to transport 92%
    - Good protection of product 92%
    - Biodegradable 48%
    - Ecological 40%
    - Can be re-use 26%

From MV2 consultant made in march 2005 , among 1200 people

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- How long time it takes to degrade for :

✓ Paper	2-5	months
✓ Rope	3-14	months
✓ Orange peels	6	months
✓ Cigarette butts	1 to 12	years
✓ Plastic coated paper milk cartons	5	years
✓ Plastic bags	10 to 20	years
✓ Nylon fabric	30 to 40	years
✓ Tin cans	50 to 100	years
✓ Aluminum cans	80 to 100	years
✓ Plastic 6-pack holder rings	450	years
✓ Glass bottles	1million	years
✓ Plastic bottles	Forever	

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5 categories of biodegradable packaging

- ✓ Biopolymers coming from plants (starch , cellulose , lignin ,…)
- ✓ Biopolymers produced by chemical polymerisation , joining renewable raw materials with industrial polymerisation process (PLA)
- ✓ Biopolymers produced by micro-organism genetically modified (PHA ,PHV , PHB)
- ✓ Synthetic polymers
- ✓ Fossil source of polymers such as PE ,PP , PET with additives that promote their biodegradability .

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Degradable Plastics (ASTM D883)

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

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Biodegradable Plastics

A degradable plastic in which

- degradation results from the **action of naturally occurring micro-organisms** such as bacteria, fungi and algae.
- 2 main types of biodegradable plastics: application
- **Hydro-Biodegradable Plastics (HBP)**
- **Oxo-Biodegradable Plastics (OBP)**

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Compostable Plastics

- A plastic that undergoes degradation by
- **biological process** during composting to carbon dioxide, water, inorganic compounds, and biomass
- **at a rate consistent with other known compostable materials** and leaves no visually distinguishable or toxic residue

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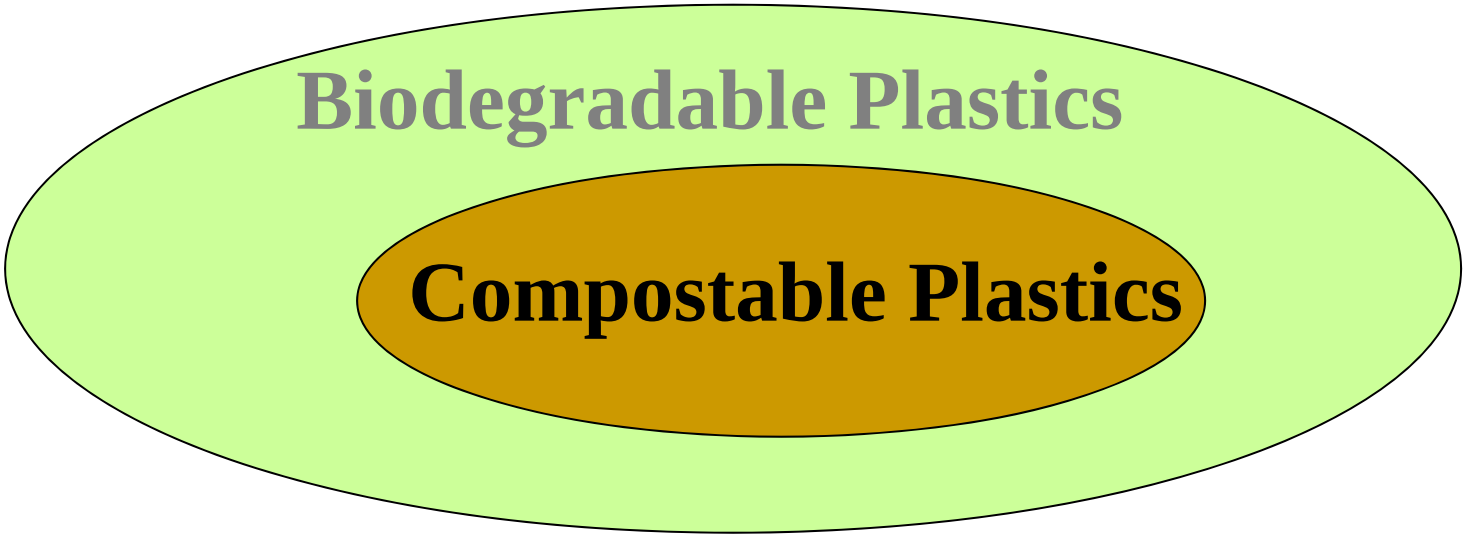
Compostable and Biodegradable Plastics



A product that is "compostable" must be biodegradable.

However, the reverse logic is not necessarily true.

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What is SUPERECO made for :

- Supereco has been designed to end up in landfill and not in compost (just because composting units are still representing less than 5% waste and because composting units require selective collection of material)
- Supereco is stable during all storage life of product between film production, storage at converting plant, converting, packing of products, storage at shops or distributors wharehouse , storage at end user before usage
- Supereco does not change properties and processability versus regular BOPP
- Supereco is the cheapest solution versus other biodegradable materials
- Supereco does degrade and biodegrade in much shorter time than regular packaging

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Process of degradability /biodegradability of SUPERECO :

- Supereco has been designed to first degrade in **abiotic** conditions ie
  - In Soil (effect of temperature and stress)
  - In outside (joined effect of oxygen , temperature, light)
  - More generally in landfill conditions

- Supereco under those conditions has a very fast degradation cycle in ultimate particles , those particles are hydrophilic (18 to 24 months to reach this step after discarding)

- This ultimate degradation with final particles that become hydrophilic make residual material (which is no more polypropylene) favorable for biodegradation process to occur .

- The biodegradation process will occur at a rate which mainly depends of both microorganism types and density.

- Final material will then be biomass , CO_2 and water

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Degradable/Biodegradable film

Disadvantages of PLA

PLA made from corn starch has bad eco assesment:

- Required 30.7 hectars of land to produce 100 tons of PLA
- Yield is 2.5 kg corn for 1 kg PLA
- Needs 4.45 m³ of water per ton of PLA (do we have enough water ??)
- Assuming that corn is non transgenic (no guarantee given by producers)
    - Require 89 kg of herbicides /100 tons of PLA
    - Require 2.3 kg of persticides/100 tons of PLA
    - 76.76 kg of fertilizers /100 tons of PLA are necessary (pollution of underground water)
- Fossil ressources are consumed during polymerization and film production
- Polypropylene film based releases thermal energy through incineration, but PLA not
- PLA contribute 11 times more than polyolefin to water surface eutrophisation
- PLA participate to 60% more acid gas emission than polyolefin

SUPERECO Degradable/Biodegradable film

Bio Polymers - Observations*

Market slow to develop because of supply problems

- Limited number of suppliers
- Small capacity availability
- Rising cost of feedstocks and competition with biofuels

- **Demand slow to develop because:**
  - Single source polymers
  - Pricing unclear
  - May be based on genetically modified feedstocks
  - Availability constraints puts off major users

* The AMI Plastics Industry Strategy Seminar – April 2007

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Advantages and Disadvantages of Biopolymers

- **Advantages**
  - Some types (eg. PLA) meet composting standard
  - Renewable resource
- **Disadvantages**
  - High price
  - Poor processability
  - Limited applications: primarily for thermoforming and sheet applications
  - Cannot recycle
  - Generally lower strength and melting point

* **The AMI Plastics Industry Strategy Seminar – April 2007**

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Advantages and Disadvantages of OBP

- **Advantages**
  - Cheaper
  - Maintains all plastic properties
  - Good barrier properties
  - Controlled degradation
  - Look and perform like conventional polymers, except they breakdown when discarded
  - Recyclable
- **Disadvantages**
  - Does not comply with composting standard

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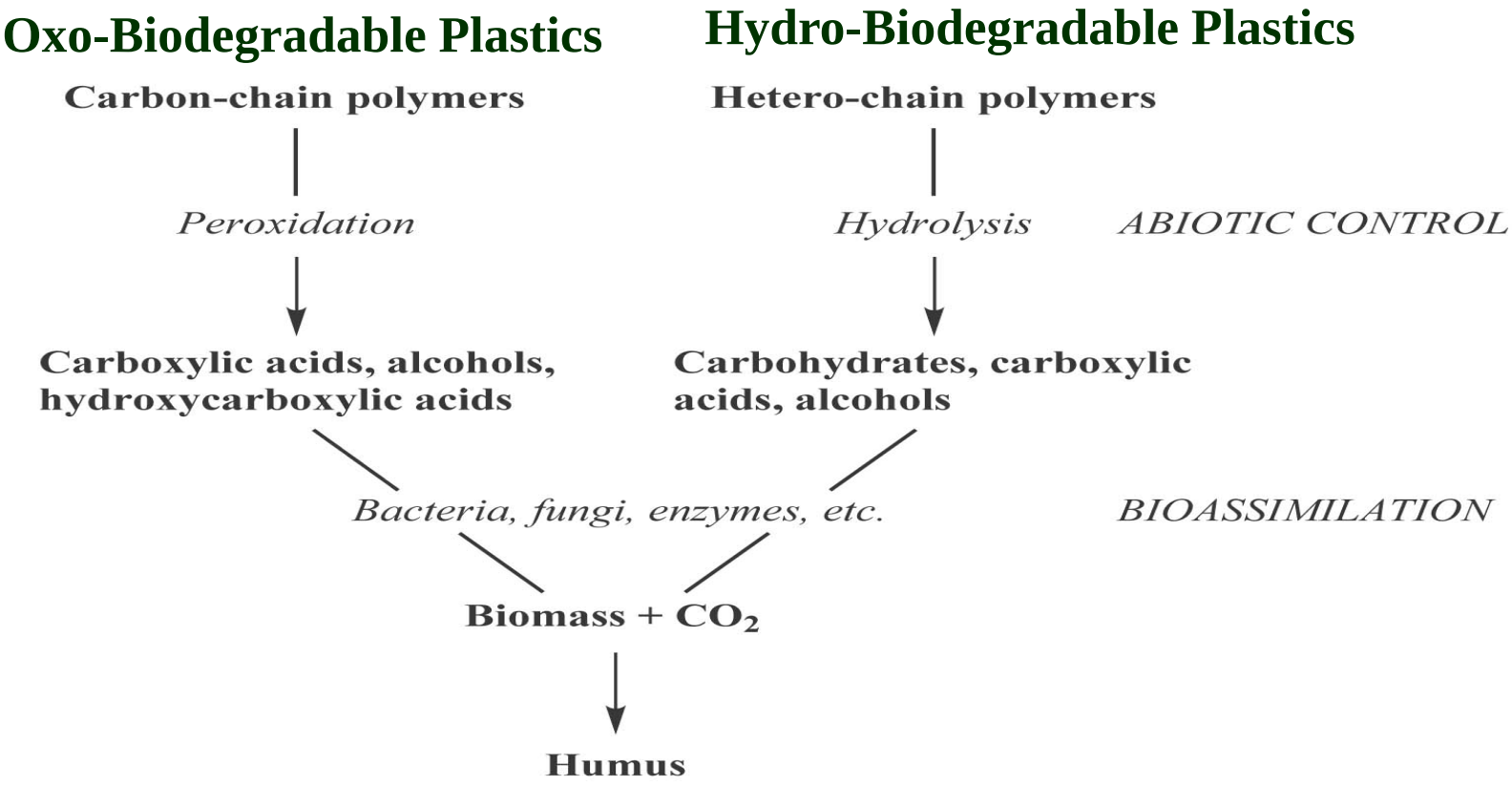
Bio-degradation Mechanism



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Oxo-Biodegradable Plastics

Degradation Triggers By:

Thermal (Heat)

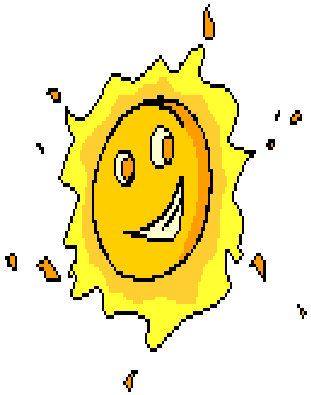

Photo (UV Light)

Mechanical Stress

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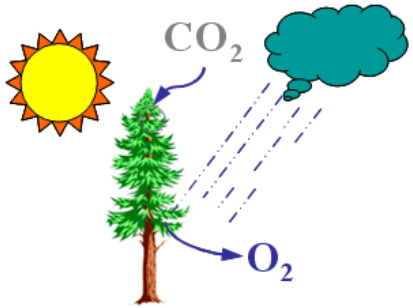
Oxo-Biodegradation: 2 Step Process

1st Stage: Degradation

carbon dioxide + water + biomass



Photosynthesis…

2nd Stage: Biodegradation

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Biodegradability and compostability

There is no norm today concerning biodegradability of plastics

Existing norms and standard guide test are :

EN 13432 on **compostability** (4 criteria to satisfy)
-Composition ie max heavy material in initial material
-Desintegration in composting : refuse limit is 10% with 2 mm sieve
-Quality of final compost : performance superior to 90% of virgin compost
-Convertion of CO_2 : 90% at max 180 days

-**ASTM D 6400** says : 60% CO_2 in 180 days

-**ASTM 6954-04** standard guide that recognizes oxo-biodegradability as a two step process

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Biodegradability and compostability :

Conformity with EN 13432

Criteria	PLA	SUPERECO
Composition	OK	OK
Desintegration	OK	OK
Quality of final compost	OK	OK
CO_2 convertion	Pass	Do not pass

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Biodegradability and compostability

Additional facts :

- It has been proven that oxo-biodegradable plastic products can also be composted in well managed facilities
- If everything entered in compost facility biodegradade as fast as required by compostable standard in CO_2, there will be no compost at all
- Oxo-biodegradable plastics use small amounts of salts of transition metal (manganese, iron, cobalt), but regulated by fertilizer act in Canada* (soil amendment contain less than 150 ppm of cobalt) only country to regulate this metal
- Oxo-biodegradable compost containing cobalt had just 2 to 3 ppm more than regular non –oxobiodegradable composts (Study done by government of Quebec)
- It has been stated that moisture accelerates degradation of oxo and not the opposite (Journal of Polymer Degradation and Stability, 91 ,1556, 2006)

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Biodegradability and compostability

Additional facts :

- Practical tests in landfills and compost environment demonstrate that oxo-biodegradable plastics degrade and desintegrate in a relatively short time and the degraded plastics are then amenable to biodegradation by naturally occuring micro-organisms. (chapters 13 and 16 of Biodegradable Polymers for Industrial Applications)

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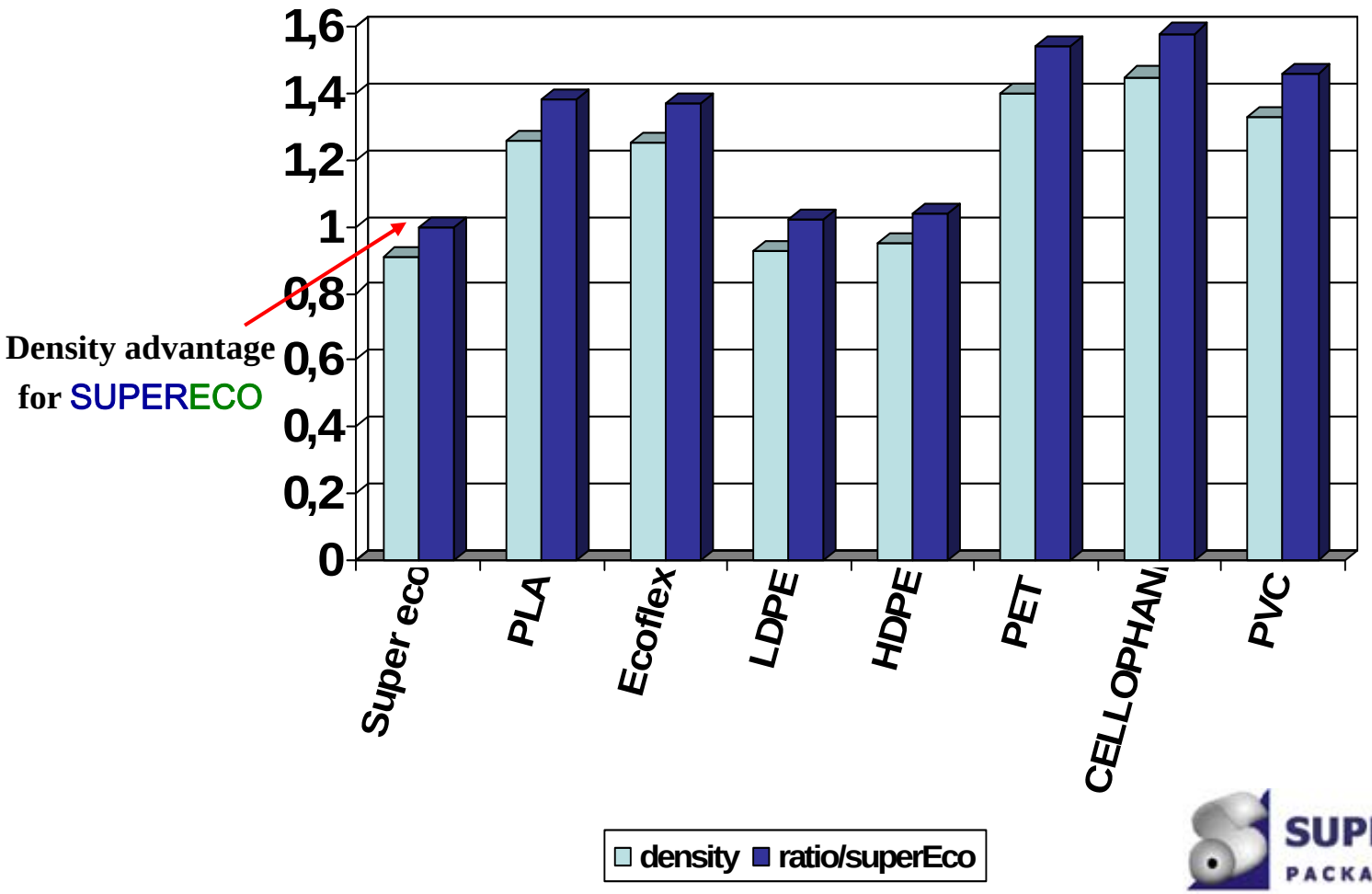
So many advantages for SUPERECO

- Density advantage



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And much more versus other biodegradable films

- Low density : 0,91
- Excellent tensile strength in both directions
- Low haze and high gloss
- Not crunchy material when handled (no noise)
- Film is scratch free (*under normal conditions*)
- Very large thickness range possibility
- Can be converted in same conditions as BOPP
- Has controlled shelf life required for application
- Excellent perforation resistance

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Standards for Degradable Plastics

Composting Standards:

- ASTM D6400 & EN13432
- Relate to performance in a commercially managed compost environment but are not biodegradation standard
- 3 basic criteria (ASTM D6400):
  1. Disintegration
  2. Biodegradation (60% mineralization in 180 days)
  3. Eco-toxicity
     (Heavy metals, plant growth test and germination test)

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Standards for Degradable Plastics

Oxo-Biodegradation Standard Guide:

ASTM D6954: 3 tiers testing to assess

- Degradation, biodegradation and eco-toxicity **impact to the environment of disposal**

- Does not include any pass/ fail criteria
- Other standards in development for specific disposal environment (eg. landfill, litter, soil)

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Degradation (Tier 1 of ASTM D6954)

Accelerated test procedures are used to assess degradation of every TDPA-product to simulate exposures in common disposal environments

- Accelerated Weathering- QUV (ASTM D5208) Photo-degradation test to simulate uncontrolled littering or outdoor exposure
- Heat Aging (ASTM D5510)
- Degradation rate when disposed of in landfill or composting
- Also to determine shelf & service life (product life)

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Degradation Testing

The following test methods are used to assess the extent of degradation of PP films and products

1. Monitor physical transformation (ASTM D 1238)

- Change in Melt Index (MI) is monitored
- The higher the MI, the lower the molecular weight
- MI is inversely proportional to molecular weight

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Degradation Testing

2. Assess mechanical transformation
   (ASTM D 882 and ASTM D 2836)

- The change in tensile elongation is monitored during the degradation process.
- When 75% of the specimens tested have an Elongation @ Break of ≤ 5%, the polymer is considered to have reached its degradation end point (brittle point).

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Degradation Testing

3. Assess chemical changes (ASTM 5576)

- Using FTIR (Fourier Transform Infrared Absorption Spectrometer) to determine chemical changes occurring in the degraded polymers
- Detect presence of ketone groups in the carbonyl region 1715 ± 5 cm-1.

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Biodegradation (Tier 2 of ASTM D6954)

TDPA modified plastics biodegrade when exposed in an environment of oxygen, soil, moisture and microbes.

Biodegradation of PP

- Prof Jacques Lemaire (CNEP) have demonstrated the ultimate biodegradation of PP containing TDPA.

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Eco-Toxicity(Tier 3 of ASTM D6954)

1. **OWS study in Raninger report (Vienna Neustadt in Austria Composting Plant)**

- Test results showed that the TDPA material had no negative effects in the cress test, summer barley plant growth test, daphnia test and the earthworm test.
- Tests conducted are in accordance to DIN V 54900-3 (German Standard), ON S 2200 and ON S 2023 (Austrian Standards) showed absolutely no toxic or harmful by-products.

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Eco-Toxicity(Tier 3 of ASTM D6954)

2. CalRecovery (Compost plant in Leeds, UK)

- Composting study was subjected to ecotoxicity testing and tested according to EN13432.
- Test results showed no phytotoxic effects and the compost met all of the requirements of EN13432 in respect to disintegration, compost quality and ecotoxicity.

3. CRIQ (Quebec Industrial Research Centre Quebec)

- Resulting compost show no phyto-toxic effects in composts made using TDPA bags.

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- Controllable shelf life and degradability
- Retain physical properties of conventional polypropylene
- Reusable and recyclable
- Affordable
- Processed in existing facilities with the existing equipment at the same throughput rate
- No toxic effects, comply with regulatory requirements

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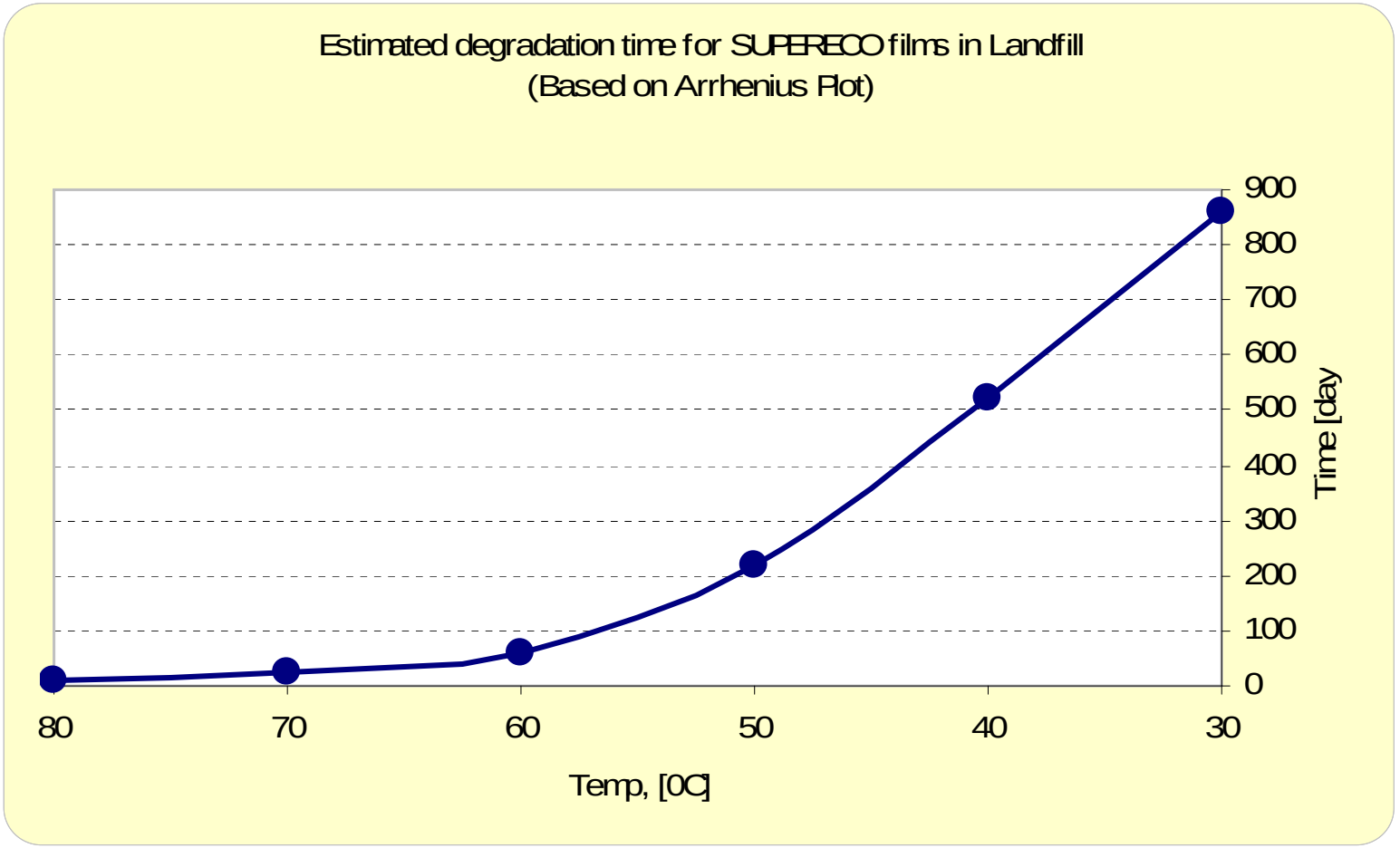
Degradable/Biodegradable film



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Conformance with current regulation on Food Contact :

- ✓ Commission Directive 2002/72/EC and 2004/19/EC
- ✓ EU directive 67/548/EC

  (amended by Directive 93/72/EEC ,Directive 93/101/EEC , Directive 94/96/EEC ,Directive 96/54/EEC ,Directive 97/69/EEC and Directive 98/73/EEC)
- ✓ EC Directive 94/62/EC (20-12-1994)

  amount of Pb,Cd,Cr-VI, and Hg< 0.01%

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Degradable/Biodegradable film

SUPERECO is a large family of products that can be recognized by an eco friendly logo

Super Film, as an innovative supplier, introduce you these special Degradable/Biodegradable SUPERECO films. SUPERECO films are rendered as degradable/ biodegradable by combination of heat and UV as a first step and absorption by micro-organism naturally present in soil as second step. Film shall disappear in nature by a non-hazardous degradation and biodegradation process.

(PATENT PENDING)

SANKO

SUPER FILM
PACKAGING FILMS

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Degradable/Biodegradable film

SUPERECO 1011 MMB

Description

SUPERECO 1011 M MB is a transparent, one side treated, non heat-sealable degradable/biodegradable, biaxially oriented polypropylene (BOPP) film specially designed for flower wrapping and general lamination purposes.

Properties

Degradable/biodegradable in landfill after disposal
Low Noise and crackle free
All other properties are the same as standard BOPP films, like;
High clarity and gloss
Good puncture resistance
Excellent machinability
Good moisture barrier
Resistance to chemicals, greases and oils
Excellent ink and coating adhesion

Applications

SUPERECO 1011 MMB is specially designed for flower wrapping and general lamination purposes. It can be also used as lamination substrate to itself and/or to other Degradable/Biodegradable SUPERECO films by using approved ink or adhesives.

(PATENT PENDING)

SUPERECO
Degradable/Biodegradable film

SUPERECO 2011 MMB

Description

SUPERECO 2011 M MB is a transparent, one side treated, both sides heat-sealable degradable/biodegradable, biaxially oriented polypropylene (BOPP) film specially designed for fresh vegetables and pasta packaging .

Properties

Degradable/biodegradable in landfill after disposal
Low Noise and crackle free
All other properties are the same as standard BOPP films, like;
High clarity and gloss
Broad seal range
Excellent hot tack and heat seal strength
Excellent machinability
Good moisture barrier
Resistance to chemicals, greases and oils
Excellent ink and coating adhesion

Applications

SUPERECO 2011 MM B is specially designed for HFFS/VFFS packaging machines where strong seals and excellent hot tack is needed. It can be also used as lamination substrate to itself and/or to other Degradable/BiodegradableSUPERECO films by using approved ink or adhesives. .

(PATENT PENDING)

SUPERECO
Degradable/Biodegradable film

SUPERECO 1012 SMB

Description

SUPERECO 1012 SM B is a transparent, two sides treated, non heat-sealable degradable/biodegradable, biaxially oriented polypropylene (BOPP) film specially designed for single web no-label look roll fed or C&S labels.

Properties

Degradable/biodegradable in landfill after disposal
Low Noise and crackle free
All other properties are the same as standard BOPP films, like;
High clarity and gloss
Good puncture resistance
Excellent machinability
Good moisture barrier
Resistance to chemicals, greases and oils
Excellent ink and coating adhesion
Low static properties

Applications

SUPERECO 1012 SM B is specially designed for single web bottle labeling applications with improved antistatic property. It can be also used as lamination substrate to itself and/or to other Degradable/Biodegradable SUPERECO films by using approved ink or adhesives

(PATENT PENDING)

SUPERECO
Degradable/Biodegradable film

SUPERECO NP2011MMB

Description

SUPERECO NP2011 MMB is a transparent, one side treated, non heat-sealable degradable/biodegradable, Cast Polypropylene (CPP) film specially designed for all kind of pasta packaging.

Properties

Degradable/biodegradable in landfill after disposal
Low Noise and crackle free
All other properties are the same as standard CPP films, like;
High clarity and gloss
Excellent machinability
Excellent hot tack and heat seal strength
Good moisture barrier
Resistance to chemicals, greases and oils
Excellent ink and coating adhesion

Applications

SUPERECO NP 2011 MMB is CPP film specially designed for packaging applications where softness, very strong seals and excellent hot tack and micro perforation property are required like fresh vegetables, bread, textile packaging and bag making applications. It can be also used as lamination substrate to itself and/or to other Degradable/Biodegradable SUPERECO films by using approved ink or adhesives.

(PATENT PENDING)

SUPERECO
Degradable/Biodegradable film

WE ALSO HAVE NEW SUPERECO GRADES

- **White Opaque Cavitated Films**
- **Solid White Films**
- **Antifog Property Films**
- **Metallized versions of all grades**

SUPERECO
Degradable/Biodegradable film

- We have a third party report to refer the biodegradability of SUPERECO
- The report is prepared by Prof.Lemaire of CNEP (France) after extensive tests.
- Now we are proud and ready to share this report with our customers.

SUPERECO
Degradable/Biodegradable film

STATEMENT FOR SUPERECO

As you read in the attached statement letter dated November 7,2007 which is based on a study on Supereco grade films conducted by Prof.Jacques LEMAIRE, head of CNEP 'Centre National d'Evaluation de Photoprotection of Universite Blaise Pascal, France', we are now able to confirm that SUPERECO grade BOPP and CPP films produced by SUPERFILM are biodegradable.

This statement by Prof.Lemaire is based on an extensive study over the past months. This R&D work is supported by extensive scientific, documentation, details, tables, and graphs and has been briefly summarized in the attached letter. It explains the chemical process that our Supereco films undergo when subjected to normal enviromental conditons such as being placed in a land fill site for disposal after usage.

SUPERECO
Degradable/Biodegradable film

Université Blaise Pascal (Clermont II)

CNEP

Centre National d'Evaluation de Photoprotection
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Aubière, November 7. 2007

Mr Turgut SELBASTI
SUPERFILM amb San Ve Tic A.S
2 Organize Sanayi Bölgesi
Haci Sani Konukoglu Bulvari #1
27 120 Baspinar / Gaziantep – Turkey

SUPERECO films produced by Superfilm, when scattered accidentally into the environment, are degraded through photothermal-oxidation (effects of UV, heat and O2) and through thermooxidation (heat and O2, without any UV). These oxidations are accelerated by prodegradant additives included in the matrix.

Through oxidation, additivated SUPERECO films undergo fragmentation i.e. conversion into low fragments. Even in the absence of light, fragmentation occurs after 330 days at 25°C and 840 days at 15°C in the soil for SUPERECO films produced by Superfilm examined in the CNEP study.

In the presence of solar light, photo-fragmentation could occur in several months (depending of the additivation) for the SUPERECO films examined in our study.

In that phase, BOPP is converted partly into low molecular weight compounds which escape from the matrix and are biodegradable, and partly into PP oligomers (macro-chains moderately long which are not biodegradable).

Oxidation of PP oligomers proceedes further, even in the absence of light, and ultimately these oligomers are converted into low molecular weight compounds which are biodegradable. The time required to convert completely the PP oligomers into biodegradable molecules can not be predicted precisely, it could be of the order of 3 years at 25°C and 6 years at 15°C in the absence of light. This order will be less when higher temperature is present in the environment.

It could be concluded that SUPERECO films degrades in the environment ultimately and completely into biodegradable molecules.

Prof. Jacques LEMAIRE
Head of CNEP

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THANK YOU