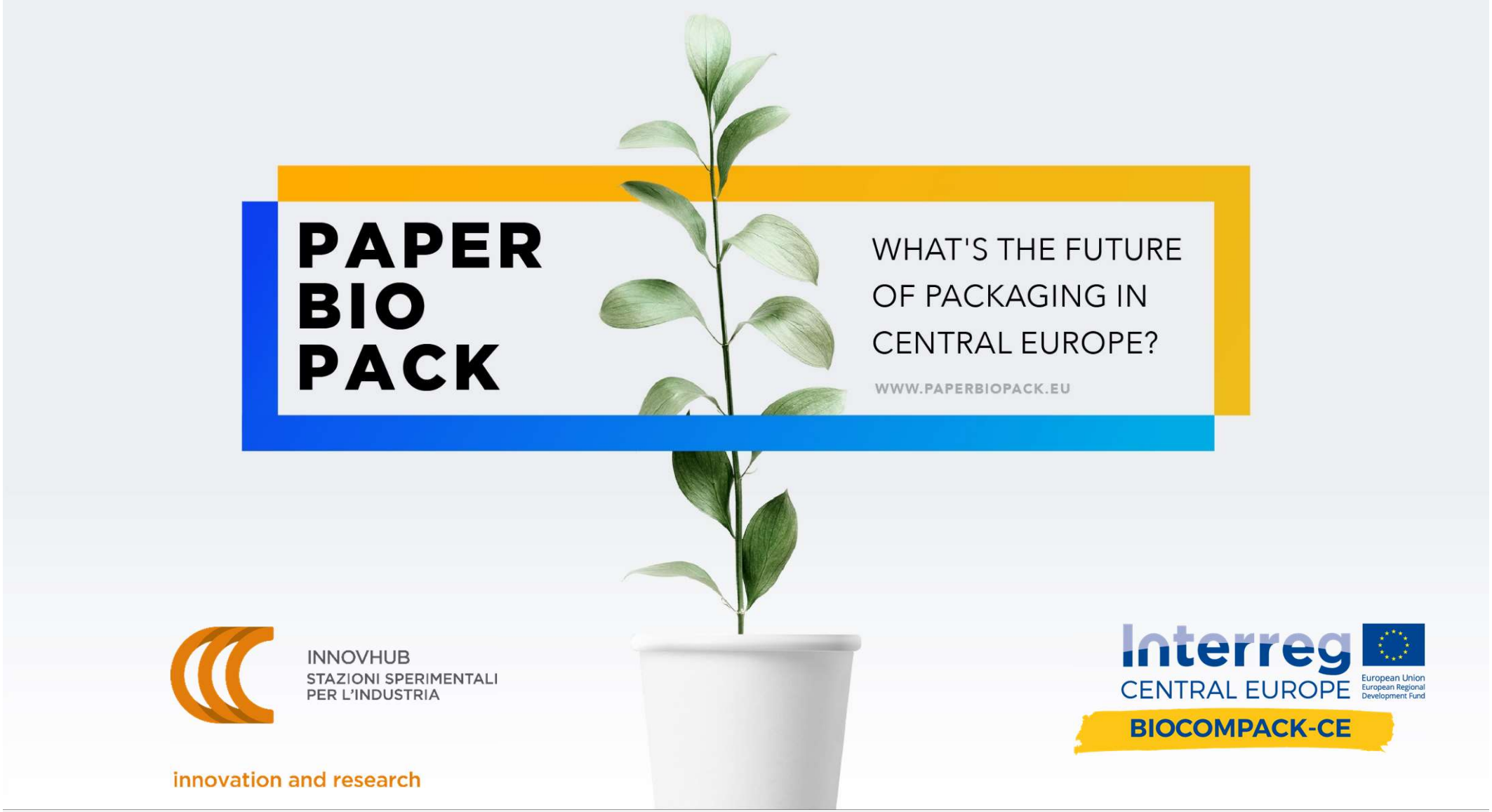


<GRAZIANO ELEGIR, INNOVHUB-SSI. WARSAW 28TH OCTOBER 2020>

End of Life Issues for Recyclability and Compostability within the context of Circular Economy

PACKAGING TRENDS

Replacement of conventional plastics with other materials is becoming a MUST

- Market demand – change in consumers behaviour
- Companies' Sustainability – CSR
- European Directives – Circular economy, SUP
  - Extended Producers Responsability

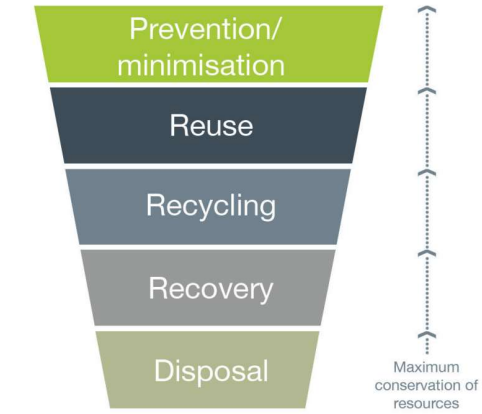
SUSTAINABLE PACKAGING

- Paper is often seen as one of the most eco-friendly alternative.
  - *low barrier properties (gas/moisture/grease)*
- Combination of paper and bioplastics may be a sustainable solution
  - *Replacement of traditional plastics with bioplastics*
  - *New dispersion biobased barrier coatings*
  - Materials with complementary properties
  - Renewable
  - Recyclable or compostable

Mandatory: comply with circular economy concept

RECYCLING OPTIONS

- Material recycling
- Organic recycling (compostability)



Graph: EU waste hierarchy

Nowadays, compostability is a clear market trend
BUT…….
Biodegradable/Compostable is it always the best choice for the ecodesign of paper based packaging products?

What are the main issues regarding waste management and circular economy?

MATERIAL AND PRODUCT ECODESIGN

Ecodesign is a critical factor for circular economy

→ **Functionality and attractive design often conflicts with best possible recyclability**

→ **Knowledge of materials and additives behaviour**

→ **Choice of materials and additives must be function of recycling route:**

- ✓ *Recycling in the paper industry*
- ✓ *Organic recycling in composting plants*

PAPER RECYCLING IN EUROPE

- Paper for recycling is the most important raw material of the industry
- Paper packaging is the most recycled packaging material in Europe

  - All paper products: 74% BY 2020 (industry volontary target)
  - Paper based packaging: 75% by 2025; 85% by 2030

Too much potentially recyclable paper is still lost in residual waste

- ***High fibre quality shall be maintained in the cycle***
- ***Economical and environmental advantage***

MODERN PACKAGING DEVELOPMENTS

Modern packaging is multi-task: protects from contact, dust, moisture, air, damage, microorganisms.

→ Complexity of paper packaging is increasing to meet market demand (barrier properties) thus competing with plastics

→ Food contact packaging is often made of multimaterials

→Plastic/bioplastic lamination

→Dispersion barrier coatings

→ often there are good quality virgin fibers hidden behind a plastic layer

How can packaging be optimally designed for high-quality recycling?

CRITERIA FOR GOOD PAPER PACKAGING RECYCLABILITY

- ☺ **Low amount of non-paper components**
  - ➢ ***less generated waste***
- ☺ **Good repulpability**
  - ➢ ***the product disintegrates easily in water into fibre elements (low energy)***
- ☺ **High adhesives removability**
  - ➢ ***less deposits and paper machine stops, less energy and chemicals usage***

PAPER/BIOPLASTIC MULTI-MATERIALS

→ Multi-material paper based packaging is by large majority MADE OF PAPER

→ COMMON LAMINATES COMPOSITIONS: 95/5.....85/15.....70/30
→ DISPERSION BARRIER COATINGS: approx. 90/10

Some bioplastics behave similarly to conventional plastics

BUT IN GENERAL ARE STILL LESS WELL KNOWN…

! Fragmentation
! Additives (adhesives for lamination)
! Solubilization

EXAMPLES OF COARSE PLASTIC REJECTS

Kraft paper sacks + extruded PE

Solid board: paper laminated with metalized PET film

Solid boxboard for frozen food: *Paper + PE extruded*

Solid board: paper laminated with bioplastic film

NON PAPER COMPONENTS (e.g. Plastic/bioplastic laminates)

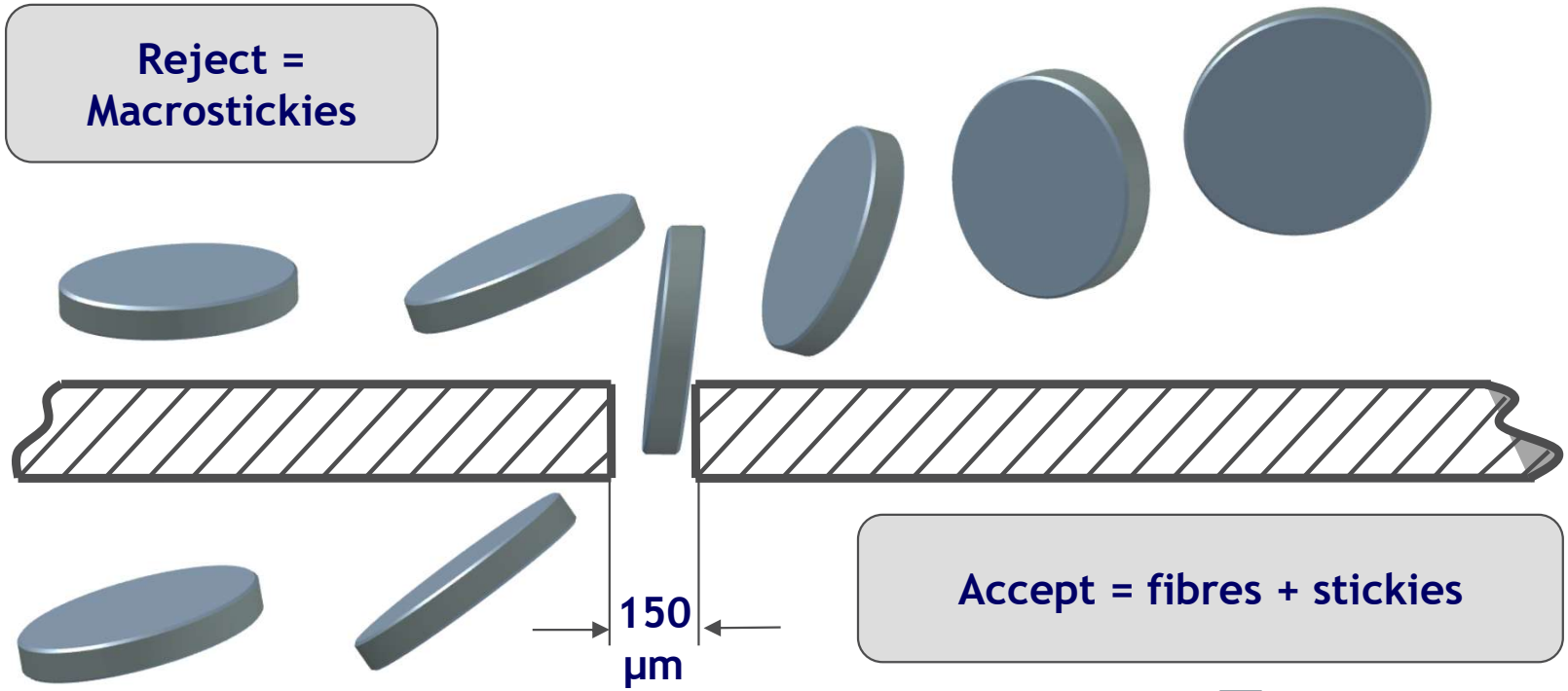
- **Barriers should be easy to separate from the fibres**, either mechanically or manually by the consumer.
- **Plastic layers should not disintegrate or break into small pieces** during paper recycling process
- **Double coating** (front and back) should be avoided

ADHESIVES

- Shall be applied in a way that they can be **easily mechanically removed** in the conditions of a standard recycling process
- **Avoid fragmentation**
- Avoid soft adhesives (certain tapes) Self-adhesives labels (PSA)

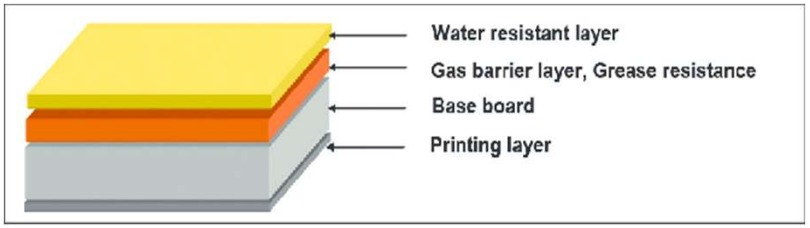
ADHESIVE REMOVABILITY

Stickies (tacky particles) present in recycled pulp slurry are normally removed by slotted screen in the paper recycling process.



Problems in PAPER SHEET formation

RECYCLABILITY OF PAPER BASED MULTI-MATERIALS



Standard paper recycling mills

- can stand only up to a certain amount of multi-materials

Specialized paper recycling mills

- Higher efficiency
- Waste rejects maybe further recycled

PAPER PACKAGING STATISTICS- ITALY

Paper packaging production 5 Mt/year

- Corrugated boxes
- Folding boxboard
- Kraft sacks and shopping bags,

Rigid paper based muntimaterial (liquid beverage, approx. 130.000 t/year)

Flexible paper based muntimaterial ? (growing but statistics not available)

Paper based multimaterials are estimated 2-3% in the paper recycling stream

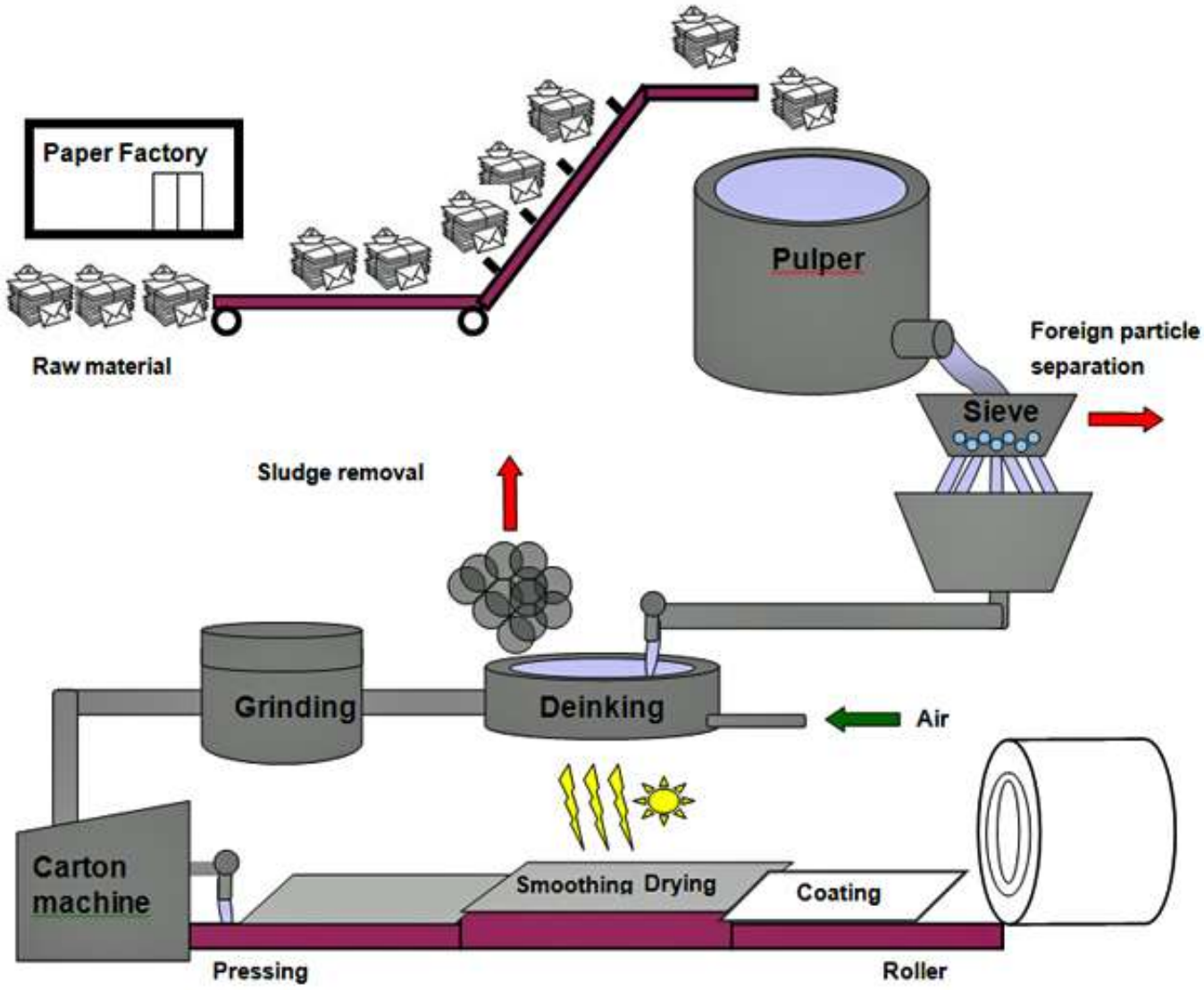
HOW TO MEASURE RECYCLABILITY?

Few standards or test methods are publicly available:

- **Standard UNI 11743 (2019).** Italian official standard method. Assessment scheme available at national level by Aticelca (link).
- **Method PTS RH 021/97 (Version 2012).** German test method developed by PTS research center. Assessment scheme available at national level.
- **EcoPaperLoop Method 1 (2014).** European test method developed along EcoPaperLoop project.
  Draft Assessment scheme (not published).

Efforts towards a harmonization of recyclability test methods are underway in EU
First version expected end of 2020.

PAPER RECYCLING PROCESS SCHEME



COARSE AND FINE REJECTS

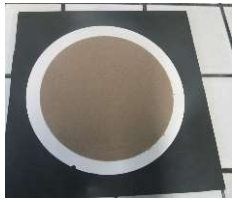
Non paper components

- Plastic
- Metal

Potential Adhesion during sheet formation

SCHEME OF THE ITALIAN STANDARD

Standard UNI 11743-2019. Test Procedure.



RECYCLING PROCESS: MOST IMPORTANT PARAMETERS

- **Re-pulpability.** Good separation of the components. Good separation of the paper in single cellulose fibers.
- **Yield of fibrous material**. Target is to recovery as much cellulose fibers as possible.
- **Coarse reject.** Special waste to be disposed, should be minimum possible.
- **Flake content.** Require extra energy for process recycling,
- **Stickies and pulp cleanliness.** Low amount of detrimental adhesive particles and contaminants means high quality of recycled pulp and final products.

HOW TO USE RECYCLABILITY TEST RESULTS ?

- **supplement the evaluation of recyclability required by EN 13430** with regard to paper and board-based materials and other cellulose fibre-based products that are sent for recycling in the paper industry.
- **guide eco-design**, in terms of recyclability, of paper and board-based materials and other cellulose fibre-based products that are currently in use, as well as new materials currently being developed and of additives used in the converting phase that can affect the recyclability of the final product;
- **support declarations** related to the recyclability of materials or products based on the **grading systems developed by third-party organizations.**

Aticelca

https://aticelca.it/1/riciclabilita-della-carta/il-marchio-riciclabile-con-la-carta/

ITALY: ATICELCA ASSESSMENT

Parameter	Recyclable with paper				Non recyclable with paper
	Level A+	Level A	Level B	Level C	
Coarse rejects (%)	< 1.5	1.5-10	10-20	20-40	> 40
Macrostickies area < 2.000μm (mm2/kg)	<2.500	2.500-10.000	10.000-20.000	20.000-50.000	> 50.000
Flakes (%)	< 5	5-15	15-40	>40	-
Adhesion	absent	absent	absent	absent	Present
Optical in-homogenities	Level 1	Level 2	Level 3	Level 3	-

MATERIAL RECYCLABILITY
CHALLENGES AND PRIORITY ACTIONS

- A common understanding regarding the new packaging developments is a central challenge in the paper packaging value chain of the coming years.
- Promote scientifically based eco-design to avoid/limit recycling constrains
- Promote development of suitable infrastructures (collection and advanced specialized recycling mills)
  - ***new types of packaging*** *that cannot be recycled in the main stream of paper for recycling.*

Organic recycling in composting plants

MAIN REQUIREMENT: BIODEGRADABILITY

Under specific conditions

MULTI-MATERIAL COMPOSTABILITY

STANDARD EN 13432

- ✓ Heavy metals plus fluorine
- ✓ Biodegradability
- ✓ Disintegration
- ✓ Ecotoxicity

Plus restrictions for non biodegradable additives

CHALLENGES

- **organic waste is still highly contaminated** with conventional plastics (dragging effect)
- **compostable packaging is not easily distinguishable** ,
- **integrated anaerobic and aerobic digestion** industrial plants poses additional constrains to the acceptance

ISSSUES ON CERTIFICATION OF PAPER FOR COMPOSTABILITY

- ✓ **Virgin paper is normally accepted (no need of biodegradability test**
  - ✓ *Additives (e.g.wet strength resins often contain fluorine)*
  - ✓ *Not a problem with paper/bioplastics multimaterials*
  - ✓ *As for bioplastics printed products must be controlled*
    - ✓ *(limits for heavy metals)*

- ✓ **Recycled paper is a more complex issue**
  - ✓ Contaminants must be kept under control
  - ✓ Biodegradability test is required for certification
    - ✓ Recycled paper often containas large amount of mechanical pulp with in turn contains native lignin (like in wood)
    - ✓ *Native lignin biodegrades very slowly*
    - ✓ *nonetheless It produces humic substances which is an advantage for compost…*

MULTI-MATERIAL COMPOSTABILITY

Composting plants prefer paper over bioplastics:

- ✓ Disintegrates easily
- ✓ Avoids dragging effect of traditional plastics
- ✓ Less problems with integrated anaerobic/aerobic plants
- ✓ Paper based packaging multimaterials should cause less problems than bioplastic itself
  - ✓ Flexible materials is prefered over rigid products

PRIORITY ACTIONS

- clearer/harmonized labelling and consumers' education
- Development of innovative identification systems

MATERIAL OR ORGANIC RECYCLING

Material recycling shall be the priority at least for:

- Non food packaging
- Food contact packaging in contact with dry foodstuff

Organic recycling shall be limited to specific applications:

- Paper bags for the organic waste collection

- Packaging requires very high barriers against gases, moisture and grease that may be not be convenient to recycle in the paper stream

Particularly in closed community loops school or company catering, large shopping centres, public events/fairs

- **LIKELY the presence of residual food**
- **EASIER to guarantee:**
  - **USE of certified products**
  - **PROPER COLLECTION (agreement with composting plants)**

THANK YOU!!

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