Cellulose Based Packaging Recyclability

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INPACK, Gornja Radgona, 27 August 2014
Packaging is used on a daily basis by a large part of the global population.

**Positive effect:**
- Protection of goods
- Food preservation
- Decrease of food waste increasing shelf life
- Provide information flow to consumer

**Negative effect:**
- It generates waste
Packaging and Packaging Waste Directive
(94/62/CE amended by 2004/12/EC)

Producer responsibility.....
Harmonised standards under Directive 94/62/EC

EN 13428:2004
Packaging - Requirements specific to manufacturing and composition - Prevention by source reduction
CR 13695-1/2
Heavy metals and other dangerous goods

**DESIGN FOR REUSE**

EN 13429:2004
Packaging - Reuse

**DESIGN FOR VALORISATION**

1. EN 13430:2004 - MATERIAL RECYCLING
Packaging - Requirements for packaging recoverable by material recycling

2. EN 13431:2004 - ENERGY RECOVERY
Packaging - Requirements for packaging recoverable in the form of energy recovery, including specification of minimum inferior calorific value

3. EN 13432:2000 - ORGANIC RECYCLING
Packaging - Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging

At least one option

Hierarchy

Product waste

Prevention at source (e.g. weight reduction)

Design for product reuse

- Material recycling
- Organic recycling

Secondary raw material

Energy recovery

Landfilling

Material recycling allows to keep the material in the same value chain loop
Present end-of-life of fibre based packaging

- **Paper & Board**
  - Mono component

- **Paper & Board**
  - Laminates and multilayers

**Type 1**
Components are not all biodegradable (PE, PP..)

**Type 2**
All components are biodegradable (Starch based films, PLA, PHA..)

- **Material recycling**
  - Standard Paper mills
  - Specialized paper mills

- **Energy recovery**

- **Organic recycling**

**Material recycling**
- Standard Paper mills
- Specialized paper mills
Fibre Raw Material Demand in the paper industry (2010)

- Germany: 19.9 Mio t
  - Primary Fibres: 69%
  - Secondary Fibres: 31%

- EU: 99.5 Mio t
  - Primary Fibres: 53%
  - Secondary Fibres: 47%

- World: 373.5 Mio t
  - Primary Fibres: 50%
  - Secondary Fibres: 50%
Recycling rate and Utilization of Paper for Recycling in Europe

Source: CEPI
Increasing the recycling rate decrease the quality of the paper for recycling

High quality of paper for recycling means:

- Less waste
- Lower energy requirements & chemicals consumption

High quality paper for recycling is essential for the sustainability of the paper loop
**Goal**

*Improve the quality of paper for recycling*

**Programme:** Central Europe 2013

**Priority 3.4:** Using our environmental Responsibility - Supporting environmentally friendly technologies and activities

**Lead Partner:** Innovhub-SSI (Milano, Italy)

**Project time frame:** September 2012 - December 2014
### Partnership

<table>
<thead>
<tr>
<th>Partnership</th>
<th>Country</th>
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</thead>
<tbody>
<tr>
<td>Innovhub-SSI</td>
<td>Italy</td>
</tr>
<tr>
<td>Paper Technology Consulting</td>
<td>Germany</td>
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<tr>
<td>University of Darmstadt</td>
<td>Germany</td>
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<tr>
<td>University of Dresden</td>
<td>Germany</td>
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<tr>
<td>ICP, Pulp and Paper Institute</td>
<td>Slovenia</td>
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<tr>
<td>University of Ljubljana</td>
<td>Slovenia</td>
</tr>
<tr>
<td>UWH, Paper Research Institute</td>
<td>Hungary</td>
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<tr>
<td>COBRO, Packaging Research</td>
<td>Poland</td>
</tr>
<tr>
<td>COMIECO consortium</td>
<td>Italy</td>
</tr>
<tr>
<td>Lombardy Region</td>
<td>Italy</td>
</tr>
</tbody>
</table>

### Activity lines

- Public Awareness on recyclability
- Support best practices in collection strategies
- **Enhance life cycle thinking**
  - recyclability design of paper based products
  - Life cycle assessment of different product design
Recyclability: major outputs of the project

- New standard method to assess packaging paper products recyclability
- Regional database on printed and packaging products recyclability
- Developing a score card for packaging recyclability
Definition of recyclability

“Design, manufacturing and converting of paper based products in such a way as to enable a high quality recycling of fibres and other materials in a manufacturing process in compliance – where appropriate – with current standards in the Community.”

How do we evaluate it?

Scientific criteria based on the paper recycling process
Criteria for good Paper based Packaging Recyclability

😊 Low amount of non-paper components

- *less generated waste*

😊 Good repulpability

- *the product disintegrates easily in water into fibre elements*

😊 Low sticky potential (adhesives removability)

- *less deposits and paper machine stops, less energy and chemicals usage*
Macrostickies size and removal

100 µm

Reject = Macrostickies

Accept = Microstickies

Stickies particles present in recycled pulp slurry are normally removed by slotted screen in the recycling paper process.
Size Distribution of Macrostickies in Industrial Recovered Paper Processes

Development of less detrimental adhesives

Sticky Size > x_{min} (Ø 2 000 µm)

high efficiency of
industrial screening

Threshold: 2.000 µm
Packaging design & recyclability

**Monomaterial** it is obviously better, however, paper products suffer of poor barrier properties (moisture, gases)

- Wet strength resistance additives
- Surface treatments (e.g. hydrophobicity, metalization)
- Adhesives
- Varnishes
- Inks
- Composite paper products (plastic lamination, aluminium ..)

→ **Test Method: Simulated Stock Preparation of the paper recycling process**
Paper packaging recyclability available methods:
PTS-RH021/97 (DE) e Aticelca MC 501-13 (IT)

- Low amount of packaging sample (50 g)
- Long pulping time (20 min)
- Coarse screen rejects and flakes are not measured
- Macrostickies evaluation
  - Quantitative evaluation only in the Italian Aticelca method
- Low relevance with industrial plants of repulping and waste rejects results.
New Ecopaperloop method

Prepared Packaging Product 480 g b. d.

~ 11.5 l Fresh Water
40 °C

12 l + 2- 5 l Fresh Water
20 °C

LC Disintegration (c = 4 %, t = 5 min)

Coarse Screening

Ø 10 mm

Coarse Reject

Gravimetric Test

Non-paper components, not disintegrated materials (e. g. packaging parts)

Fibre suspension (Homogenised)

Yield Measurement by Total Volume & Stock Consistency

Flake Content ZM_V/18/62 Brecht-Holl 0.7 mm Ø

Macrostickies INGEDE Method 4 // 100 µm

Fibre Yield

Ash-measurement From Stock Consistency Measurement Filter (525 °C)

Flake Content

Handsheets Min. 2 x Handsheets (60 g/m²)

Macrosticky Content

Ash content
Advantages of Ecopaperloop Method

• Higher amount of tested product (500 g)
• Coarse rejects (non-fiber components)
• Flake content (for disintegration behaviour)
• Fibre yield evaluation
• Macrostickies area and distribution.

Scoring system analogue to existing ERPC Deinkability score for graphic products
Recycling Friendly Printed Products

For graphic paper products a procedure exists since 2009 to evaluate the deinkability. Product specific requirements are fixed in the “Deinkability Scorecard”. Since 2011 a comparable evaluation exists on the removability of adhesive applications on graphic paper products.

Assessment of Printed Product Recyclability
Scorecard for the Removability of Adhesive Applications

Ecolabel of printed products (2012/481/UE-16 august 2012) includes recyclability criteria

www.paperforrecycling.eu
Approximately **160 products** are being tested in 5 countries (Germany, Italy, Poland, Hungary and Slovenia).

**PRODUCT CATEGORIES**

- Corrugated Boxes (all sizes)
- Folding Boxboard (incl. Solid board) – frozen food
- Folding Boxboard (incl. Solid board) – others
- Bags (open bags with handles)
- Sacks (all sizes) – pure paper
- Sacks (all sizes) – with composite material
- Liquid Packaging
- Moulded products
- Other
Corrugated boxes: results from Italian products

Corrugated Boxes

- **Coarse Reject**
  - product 23
  - product 24
  - product 25
  - product 26

- **Yield**
  - product 23
  - product 24
  - product 25
  - product 26

- **Fibre Yield**
  - product 23
  - product 24
  - product 25
  - product 26

- **Flakes**
  - product 23
  - product 24
  - product 25
  - product 26

**Macrostickies, mm²/Kg**

- product 23
- product 24
- product 25
- product 26
Sacks of pure paper: results from Italian products

Sacks pure paper

<table>
<thead>
<tr>
<th></th>
<th>product 11</th>
<th>product 12</th>
<th>product 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Reject</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Yield</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Fibre Yield</td>
<td>70%</td>
<td>90%</td>
<td>50%</td>
</tr>
<tr>
<td>Flakes</td>
<td>30%</td>
<td>30%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Macrostickies, mm²/Kg

<table>
<thead>
<tr>
<th></th>
<th>product 11</th>
<th>product 12</th>
<th>product 13</th>
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<tbody>
<tr>
<td>product 11</td>
<td>16000</td>
<td>16000</td>
<td>16000</td>
</tr>
<tr>
<td>product 12</td>
<td>8000</td>
<td>8000</td>
<td>8000</td>
</tr>
<tr>
<td>product 13</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
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</table>
Sacks with composite material: results from Italian products

Coarse reject
Moulded products: results from Italian products
Macro Stickies in various product categories

Macro Stickies, <2000 micron

<table>
<thead>
<tr>
<th>Category</th>
<th>mm²/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacks with composite material</td>
<td></td>
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<tr>
<td>Sacks with composite material</td>
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<td>Sacks with composite material</td>
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<td>Sacks with composite material</td>
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<tr>
<td>Sacks with composite material</td>
<td></td>
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<tr>
<td>Other</td>
<td></td>
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<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Sacks pure paper</td>
<td></td>
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<tr>
<td>Sacks pure paper</td>
<td></td>
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<tr>
<td>Sacks pure paper</td>
<td></td>
</tr>
<tr>
<td>Folding boxboard - other</td>
<td></td>
</tr>
<tr>
<td>Folding boxboard - other</td>
<td></td>
</tr>
<tr>
<td>Folding boxboard - other</td>
<td></td>
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<tr>
<td>Bags</td>
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<tr>
<td>Bags</td>
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<tr>
<td>Bags</td>
<td></td>
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<tr>
<td>Corrugated boxes</td>
<td></td>
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<tr>
<td>Corrugated boxes</td>
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<tr>
<td>Corrugated boxes</td>
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<td>Corrugated boxes</td>
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<td>Moulded products</td>
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<td>Moulded products</td>
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<td>Moulded products</td>
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<tr>
<td>Liquid packaging</td>
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Packaging score card

Purpose and scope of application

• Applicable to paper and board grades 1 to 4 (according to EN 643)
• Applicable to grade 5 – special requirement has to be fulfilled
• Not applicable for grades which are usually intended for deinking purposes

→ Recyclability Score from -100 to +100
Principle of packaging score card

- Recyclability test: EcoPaperLoop Method 1
- Score card based on product category

<table>
<thead>
<tr>
<th>Objective</th>
<th>Parameter</th>
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<tbody>
<tr>
<td>Low waste/ high yield</td>
<td>Coarse rejects</td>
</tr>
<tr>
<td>repulpability</td>
<td>Flakes</td>
</tr>
<tr>
<td>Adhesives removability</td>
<td>Macrostickies</td>
</tr>
<tr>
<td>Optical homogeneity</td>
<td>Visual aspect (dirt specks)</td>
</tr>
</tbody>
</table>
Score card proposal: weighting the parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coarse Reject</th>
<th>Flake Content</th>
<th>Macro Stickies Area</th>
<th>Optical Homogeneity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Score</td>
<td>35</td>
<td>15</td>
<td>40</td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

- **Score card is based on product category**
- **Threshold values:** *if not reached the product fail*
- **Target values:** *used to define the score*
- **Obtained from a large Central Europe database constructed in the Ecopaperloop project**
Database on market products

Overview: Results of recyclability tests of packaging products  
02.07.2014

X-(y)-z means: Minimum value - (Mean value) - Maximum value

<table>
<thead>
<tr>
<th></th>
<th>Amount of tested products</th>
<th>Coarse Reject in %</th>
<th>Fibre yield** in %</th>
<th>Flake content in %</th>
<th>Sticky Area in mm²/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrugated Boxes</td>
<td>13</td>
<td>0 - (2) - 23</td>
<td>72 - (80) - 85 [8]</td>
<td>1,1 - (7,2) - 21,6</td>
<td>762 - (6.526) - 11.878</td>
</tr>
<tr>
<td>FBB (frozen food)</td>
<td>1</td>
<td>1</td>
<td>91</td>
<td>15</td>
<td>573</td>
</tr>
<tr>
<td>FBB (others)</td>
<td>20</td>
<td>0 - (0,1) - 1,5</td>
<td>73 - (80) - 90 [8]</td>
<td>0 - (2,8) - 9,2</td>
<td>200 - (11.650) - 23.451</td>
</tr>
<tr>
<td>Bags (handles)</td>
<td>12</td>
<td>0 - (10) - 56</td>
<td>41 - (76) - 95 [0]</td>
<td>0,4 - (14,4) - 52,3</td>
<td>220 - (64.505) - 161.386</td>
</tr>
<tr>
<td>Sacks (paper)</td>
<td>7</td>
<td>1 - (10) - 51</td>
<td>48 - (85) - 97 [0]</td>
<td>4,9 - (18,7) - 30,3</td>
<td>8 - (14.141) - 91.146</td>
</tr>
<tr>
<td>Sacks (composite)</td>
<td>14</td>
<td>0 - (24) - 93</td>
<td>7 - (57) - 98</td>
<td>0,6 - (12,1) - 23,2</td>
<td>313 - (17.777) - 42.531</td>
</tr>
<tr>
<td>Liquid Packages</td>
<td>5</td>
<td>36 - (44) - 54</td>
<td>41 [4]</td>
<td>1,9 - (7,7) - 14,8</td>
<td>612 - (34.699) - 164.679</td>
</tr>
<tr>
<td>Molded Products</td>
<td>4</td>
<td>0 - (1) - 24</td>
<td>n.a. [4]</td>
<td>1,0 - (4,7) - 13,3</td>
<td>1663 - (1.940) - 2.208</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>9 - (12) - 14</td>
<td>76 - (81) - 85</td>
<td>3,4 - (4,1) - 4,7</td>
<td>115 - (184.251) - 388.388</td>
</tr>
</tbody>
</table>

Total amount of test 78
Target of tested products 160 (120)
# Score card proposal

<table>
<thead>
<tr>
<th>Packaging Recyclability Score</th>
<th>Evaluation of Recyclability</th>
</tr>
</thead>
<tbody>
<tr>
<td>71 to 100 Points</td>
<td>Good</td>
</tr>
<tr>
<td>51 to 70 Points</td>
<td>Fair</td>
</tr>
<tr>
<td>0 to 50 Points</td>
<td>Tolerable</td>
</tr>
<tr>
<td>negative</td>
<td>Not suitable for use in paper industry</td>
</tr>
<tr>
<td>(failed to meet at least one threshold)</td>
<td></td>
</tr>
</tbody>
</table>

## Stakeholders consultation

- ✓ Public phone conference consultation next 10 September 2014 organised by CEPI
- ✓ Discussion at next ERPC meeting on 2 October 2014
Conclusions

- Recycling friendly products are necessary to support the Eco-Paper Recycling loop

- A large recyclability database is almost available to define thresholds and cut-off criteria for the recyclability of packaging products

- A new score card proposal for paper based packaging will be presented to ERPC
Perspectives

- The score card will allow to benchmark the recyclability of paper based packaging.

- Sustainable packaging products must fulfil both functionality and recyclability standards.

- In the Ecopaperloop project the recyclability parameters will also be connected to pilot LCA studies on recycling oriented eco-design of paper products.
Thank you for your attention!

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ECOPAPERLOOP FINAL CONFERENCE
KRAKOW (PL), 2 December 2014
www.ecopaperloop.eu