FEICA WEBINAR

Laminating Adhesives Supporting Flexible Packaging Recycling

23 April 2024
10:00 - 11:00 Brussels CET
Proceedings

- Please be advised that this webinar will be recorded. By joining, you are consenting to the recording.
- Note that you will be muted and your camera will be turned off automatically upon entry.
- During the Q&A session following the presentations, you will be able to use the chat box to ask questions.
- In case we don’t have sufficient time during the Q&A session to address your question, please feel free to send your question to info@feica.eu.
- The presentation slides and recording will be sent to all webinar registrants.
Agenda

10:00 Introduction - Ms Jana Cohrs, Executive Director Regulatory Affairs, FEICA

10:05 Why Laminating Adhesives? - Dr Christos Lecou, Marketing Manager, Sector Industrial Adhesives, Covestro, and Member of the FEICA Expert Group

10:20 Overview of recyclability guidelines and testing protocols - Mr Arne Jost, Senior Manager Circularity Assessment & Validation, Packaging & Consumer Goods, Henkel Adhesive Technologies, and Member of the FEICA Expert Group

10:35 Laminating Adhesives in Recycling of flexible packaging: State of Play and Outlook by Mr Sergio Doldi, Technical Manager, COIM, and Member of the FEICA Expert Group & Mr Marc Defoin, Flexible Lamination R&D Director, Bostik, and Member of the FEICA Expert Group

10:50 Q&A session moderated by Ms Jana Cohrs

11:00 Close of the webinar
Ms Jana Cohrs
Executive Director Regulatory Affairs, FEICA

Introduction
16 National Associations representing 17 Countries 450+ members

24 Direct Company Members

24 Affiliate Company Members
Contribution of the adhesives and sealants industry in Europe

19.9 billion euros contribution to the EU economy

800 adhesives and sealants manufacturers, of which 90% are SMEs

4.8 million tonnes of adhesives and sealants used in everyday products

Investing 470 million euros in Research and Innovation

Employing over 45,000 people
2022 European adhesives demand by market segment (€ million)

- 30.0% Paper, board & related products
- 22.8% Transportation
- 17.2% Footwear & leather
- 10.2% Consumer/DIY
- 9.3% Building, construction, civil engineering, craftsmen
- 8.6% Woodworking & joinery
- 2.0% Assembly/other

Source: Smithers
FEICA Expert Group
Sustainability and Recycling of Adhesives Applications in Paper and Packaging

National Associations

Company Members
Cooperation and communication along the supply chain

- Adhesives in packaging are very complex. FEICA is supporting stakeholders with expertise.

- Cooperation amongst different actors in the supply chain is key to further improving recycling.

- More information on paper and packaging is on our website: https://www.feica.eu/our-projects/paper-and-packaging

- For questions and comments after the webinar, please contact us at info@feica.eu
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Why Laminating Adhesives?

Dr Christos Lecou
Marketing Manager, Sector Industrial Adhesives, Covestro
Packaging eases logistics and preserves goods

- Key functions of packaging
  - Product protection
  - Product promotion and information
  - Transport and storage effectiveness

- Adhesives are used in almost all packaging types
  - Labelling
  - Sealing
  - Lamination
Combining properties with laminating adhesives

- Used to combine different films into one packaging material
- Improvement of properties such as mechanical resistance and barrier
- Food and non-food applications
  - (Stand-up) pouches
  - Certain wrappers
  - Medical/pharmaceutical packs
Packaging design is subject to performance needs

**High Performance**
For laminates that are used in a sterilisation process (>121°C). Aggressive, wet filling. Food and medical application, typically with AL foil as high barrier layer

**Medium Performance**
For laminates that are used in pasteurisation (<121°C), wet, oily, fatty filling, flavor protection, often with AL foil

**General Purpose**
For laminates that are used with dry filling and lower processing requirements

Current examples of laminated flexible packaging (FlexPack)
Why laminating adhesives?

Low packaging to product ratio

- Typically 2-3%
- Highly dependent on packed goods, load, preservation & handling requirements

Outstanding logistics efficiency

- 26 trucks Unfilled jars
- 1 truck Unfilled FlexPacks

High production efficiency & flexibility

- Easily adjustable sizes, formats & shapes
- Fast roll-to-roll processing
- Low energy processing

High appeal packaging

- Glossy, matt, high resolution finishes
- Customising haptics

Sources: Based on Flexible Packaging Association & Flexible Packaging Europe
Flexible packaging in a circular economy (CE)

EU food packaging utilisation in retail (in terms of primary packaging units)

- ~50% FlexPack
- ~50% Other formats

EU packaging waste creation (in terms of waste material weight)

- 10% FlexPack (thereof 1% laminated)
- ~90% Other packaging formats

Low packaging material use

CE optimised laminates

Less attractive for recycling
- Low volumes
- Various compositions
- Collection
- Sorting
- Investments

Assessments of adhesive impact on recyclability

Sources: Based on Flexible Packaging Europe, eurostat, CEFLEX
Flexible packaging in the framework of the PPWR*

- Counteracting the increase of packaging waste
- Reducing packaging waste in the EU by at least 15% by 2040 (vs. 2018)
- Focussing on 3 areas
  1) Recyclability of packaging
  2) Mandatory quotas for reusable packaging
  3) Minimum content of recycled material in packaging
- Binding and applicable to every EU state
- Expected to come into force in 2024/2025

*PPWR: Packaging and Packaging Waste Regulation (replacing the current EU Packaging Directive)
POLL

You can **use the chat box or the pop-up screen** to participate in the poll.

Note that you can **select multiple answers**.
POLL 1

Select the most important recycling challenges for laminating adhesives:

- Laminated mono-material recyclability
- Laminated multi-material recyclability
- Maintaining bonding performance whilst being formulated for recyclability
- Adequate sorting
- Availability of state-of-the-art recycling facilities
- End markets for the recycled material
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Overview of recyclability guidelines and testing protocols

Mr Arne Jost
Senior Manager Circularity Assessment & Validation, Packaging & Consumer Goods, Henkel Adhesive Technologies
Major trends in flexible packaging design

- From multi-material to ‘mono’-material
- From plastics to paper
- Phasing out of barrier materials, e.g., aluminum, PVC, PVDC
- Still, the consequences of the PPWR remain unclear to the industry, especially on recyclability and recycled content,
- Future PPWR-related trends:
  - Portfolio streamlining
  - Design simplification
- Unsolved: Flexible structures will come under pressure (recyclability, recycled content) but they are best performers when it comes to carbon footprint or LCA!

PPWR = Packaging and Packaging Waste Regulation
The Recyclability Testing Triad

- **Design Guideline**
  - Advises on how to design
  - Available

- **Testing Protocol**
  - Explains how to test
  - Available

- **Evaluation Scorecard**
  - Interprets the test results
  - Available

Can be combined into one document!
The Design Guidelines (advise on how to design)

- APR (USA)
- CEFLEX (EU)
- CEN – EN 13430
- COTREP (F)
- cyclos-HTP (EU)
- RECOUP (UK)
- RecyClass (EU)
- ZSVR – German minimum standard (D)
- Others: see FEICA Report on Laminating Adhesives in Flexible Plastic Packaging Recycling

Bold ➔ Relevance for lamination adhesives
# The RecyClass Guidelines: lamination adhesives

<table>
<thead>
<tr>
<th>Lamination Adhesives</th>
<th>Compatibility</th>
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<tbody>
<tr>
<td></td>
<td>Full</td>
</tr>
<tr>
<td>LDPE Natural</td>
<td>-</td>
</tr>
<tr>
<td>Colored PU/WBA ≤ 3%</td>
<td></td>
</tr>
<tr>
<td>PP Natural</td>
<td>Aliphatic PU ≤ 2.3%</td>
</tr>
<tr>
<td>Colored PU ≤ 3%</td>
<td></td>
</tr>
</tbody>
</table>

**PU = polyurethanes, WBA = water-based acrylics**

Laminating adhesives approved as fully compatible by RecyClass; To be tested if in combination with a barrier material.

Laminating adhesives approved as limitedly compatible by RecyClass; To be tested if in combination with a barrier material.

Laminating adhesives specially developed for high thermal applications above boiling and/or for high chemical resistance.
# The RecyClass Guidelines: lamination adhesives

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The flexpack Testing Protocols explain how to test

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<thead>
<tr>
<th></th>
<th>APR (US)</th>
<th>COTREP (F)</th>
<th>cyclos-HTP (EU)</th>
<th>RecyClass (EU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorting</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>LDPE Recycling</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>PP Recycling</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
The flexpack Testing Protocols – Procedure (simpl.)

- Grinding
- Extrusion/Compounding
- Recycling* /Compounding
- Recyclability Evaluation

*Film blowing, film sealing, injection molding
The Testing Protocols – Comparison

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<th>Extrusion/Compounding</th>
<th>Recycling*/Compounding</th>
<th>Recyclability Evaluation</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>cyclos-HTP</th>
<th>RecyClass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar extrusion process; different compounds.</td>
<td>Film blowing</td>
</tr>
<tr>
<td>Film blowing, film sealing, injection molding</td>
<td>Against recycled material; significant neg. deviation → k.o.</td>
</tr>
<tr>
<td>Against recycled material; significant neg. deviation → k.o.</td>
<td>Against virgin material; 25% deviation accepted.</td>
</tr>
</tbody>
</table>

*Film blowing, film sealing, injection molding
Recyclability Testing – Key Take-aways

- With the **PPWR**, the packaging landscape in Europe and in exporting countries will change.
- There are today a lot of packaging **design guidelines**. The PPWR will harmonize the landscape.
- A lot of flexpack guidelines do not look at **lamination adhesives** specifically.
- **RecyClass** has the most explicit flexpack design guidelines with reference to lamination adhesives.
- **cyclos-HTP**’s and RecyClass’s flexpack testing protocols are similar from a procedural point of view but differ largely in their recyclability evaluation.
POLL

You can use the chat box or the pop-up screen to participate in the poll.

Note that you can select multiple answers.
POLL 2

Which characteristics are most important for recyclability testing protocols?

- Country-specific frameworks
- European harmonisation
- Scientific validity
- Economic viability
- Practicability in current recycling infrastructure set-up
- High quality recycled output
<table>
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<tr>
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</table>
Laminating Adhesives in Recycling of flexible packaging: State of Play and Outlook

Mr Sergio Doldi
Technical Manager, COIM

Mr Marc Defoin
Flexible Lamination R&D Director, Bostik
Recycling of flexible packaging: the starting point

Recycling of flexible packaging is still being developed; this is mainly due to a number reasons, like:

- Complex structures made of several layers (needed to ensure the functionality of the packaging)
- Light weight of FP: recycling has low economic attraction
- Small size, often escaping from sorting (going into waste)
- Multi materials, non-homogeneous polymers as target materials
Laminating adhesives at the core of the flexible packaging recycling

Transition from multi- to mono-material laminates is strongly recommended to facilitate the recycling of the flexible packaging.

Laminating adhesives can efficiently support the production of laminated mono-material structures, too.
Laminating adhesives at the core of flexible packaging recycling

In this context:

‘Laminating adhesives, just as other non-target materials, are required to be compatible with recycling processes for flexible plastic packaging, so as to not disturb the process itself or the quality of its output’.

(FEICA, Laminating adhesives in the context of flexible plastic packaging recycling)

A challenge for the adhesive industry, that came together to understand more, to explore possible effects of laminating adhesives in recycling
The steps which have been investigated (or are under investigation) for flexible materials containing laminating adhesives are:

- NIR-based sorting
- Washing/density separation
- Compatibility with the PO extrusion process
NIR-based sorting

In no case have laminating adhesives been found to affect the sensor-based sorting of plastic waste.

Ceflex NIR sorting study: no impact from laminating adhesives on sorting of many different laminated structures

<table>
<thead>
<tr>
<th>Material reference</th>
<th>Material description</th>
<th>Classification</th>
<th>Comment</th>
<th>Next steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesives-1,</td>
<td>PP structures containing PU and acrylic laminating adhesive</td>
<td>PP</td>
<td>Adhesives did not influence the classification result as they did not influence the NIR spectrum substantially or at all</td>
<td></td>
</tr>
<tr>
<td>Adhesives-4,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adhesives-3</td>
<td>PE structures containing PU laminating adhesive</td>
<td>PE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PET-2, PET-7</td>
<td>PET, PE MMML structures containing unspecified laminating adhesive</td>
<td>PET or PE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PET-4</td>
<td>MMML structures containing PET and PP layers</td>
<td>PET or PP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PET-20</td>
<td>MMML structures containing PET and PET layers</td>
<td>PET</td>
<td></td>
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</table>
Washing/density separation

No case of laminating adhesives affecting density-based sorting of plastic waste has been reported. Laminating adhesives are present in flexible packaging structures in a low weight percentage (often < 5 %) with a negligible impact on the overall density of the packaging item.
Washing/density separation

- Washing processes for flexible packaging waste today are generally mild.
- Laminating adhesives are required to be highly resistant against liquids (such as the filling goods).
- Laminating adhesives are located in between water-impermeable plastic layers.

Therefore, a removal of laminating adhesives with wash water is generally not expected to be an applicable requirement (in the present conditions).

Recommendation:

Distinguish laminating adhesives from labelling adhesives!
Compatibility with PO extrusion process

- RecyClass: Participation of major adhesives manufacturers in Laminating Adhesives working group.
  - Wide testing campaigns on both PE and PP films based on Recyclability Evaluation Protocols
  - Assessment of impact on the extrusion process stability and quality of the recyclate (discoloration, gel particles, etc.)

- Ceflex mechanical recyclability testing study (ongoing)

- Company-specific recyclability evaluations
Compatibility with PO extrusion process

A challenge for the adhesive industry, but solutions are already being provided.

It is possible to design adhesives showing good compatibility in mechanical recycling as demonstrated by several tests run at both industry and institute levels.

Several laminating adhesives have been tested and approved by initiatives of single adhesives manufacturers.
DfR Guidelines as study outcome

The outcome of the previously mentioned studies are becoming the baseline of the current DfR guidelines (i.e. RecyClass: Last update January 2024, Ceflex Phase 2 ongoing).

DfR guidelines should be living documents, intended to be updated when new studies become available, reflecting the status of evolving knowledge.

It is essential to always be able to challenge the guidelines by means of testing.
Laminating adhesive current status

A deep knowledge of the different kinds of adhesives and their behaviour inside the recycling processes is crucial to ensure compatibility with the existing (and upcoming) recycling technologies.

An extensive investigation into raw materials and their combinations is a big step to cover the need.

Formulation design and testing are key to keep our adhesives in line with a challenging landscape.
Next steps

The Adhesives Industry is working to support existing and emerging technologies for new recycling paths, targeting a high quality output material.

Knowledge is evolving; we are strongly committed to study, monitor and understand more to support a circular economy for flexible packaging.

Each segment of the value chain has its own expertise: stay in touch with us for any discussion related to laminating adhesives. We’ll be glad to support you.
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