RecyClass

c/o Plastics Recyclers Europe
Avenue de Broqueville 12
1150 Brussels, Brussels

Phone: +32 2 786 39 08
info@recyclass.eu
www.recyclass.eu

RECYCLASS TECHNICAL REVIEW

Brussels, 18 January 2024

The RecyClass PO Films Technical Committee investigated the impact of laminating adhesives on recycling of PP films. This campaign was coordinated with the support of the laminating adhesive Working Group experts regrouping BASF, Bostik, Coim, Dow, H. B. Fuller, Henkel, Morchem and Sun Chemical, and started in December 2022. After 1 year of tests and meetings, the RecyClass PO Films Technical Committee managed to deliver the first set of recommendations on the compatibility of laminating adhesives with PP flexible packaging recycling.

Two main objectives were targeted with this test campaign:

1) Discriminate the laminating adhesives compatibility with PP films recycling depending on their chemistry,

2) Confirm the findings of the test campaign focusing on laminating adhesives in PE films.

In this test campaign, 9 laminating adhesives were selected, representing most of the polyurethane (PU) chemistries (solvent-based/solvent-free, aliphatic/aromatic and polyester/polyether polyurethanes) used on the European market from various producers, and one acrylic emulsion, as illustrated in Annex I. All laminates were prepared using 2 layers of Bi-Oriented Polypropylene (BOPP) Taghleef Industries TSS (20 µm), and the same BOPP grade was used as control material to be independent of the impact of the PP grade. For all samples, the laminating adhesive represented 4.5 wt% of the total weight of the laminate.

Samples were tested according to the RecyClass Recyclability Evaluation Protocol for PP Films with a focus on extrusion process, pellets yellowing and films gels & specks to discriminate the different laminating adhesives. Other characterisations were skipped because not relevant for the tests.

Results confirmed that the yellowing is more intense for aromatic polyurethane and the tested acrylic adhesive than for aliphatic polyurethane. Besides, solvent-free and solvent-based laminating adhesives showed similar results and the presence/absence of solvent in the initial form of the laminating adhesive could not be considered as a discrimination factor. Note that the results were aligned with the

results of the test campaign on PE films and confirmed that some specific laminating adhesives led to poor-quality films made after reprocessing and converting steps[1].

Overall, the outcome of this test campaign was that laminating adhesives could show different compatibilities with the PP film recycling depending on their chemistries. The main discrimination criterion was the isocyanate chemistry (aliphatic or aromatic) which showed a significant impact on the yellowing of the recycled pellets. As for PE films, the experts of the RecyClass Working Group decided to call for testing with RecyClass testing protocols all laminating adhesives that would be specially developed for high thermal applications above boiling and/or for high chemical resistance.

As a summary and according to the results that were obtained from the Recyclability Evaluation Protocol, the RecyClass PO Films Technical Committee defined the compatibility of the laminating adhesives with the PP flexibles recycling stream as following:

For PP film transparent stream:

- Full compatible: Aliphatic PU < 2.3 wt% of the total weight of the film; Laminating adhesives approved as fully compatible by RecyClass
- Limited compatible: Aliphatic PU < 4.5 wt% of the total weight of the film; Laminating adhesives approved as limited compatible by RecyClass
- Low compatible: Aliphatic PU > 4.5 wt% of the total weight of the film; Aromatic polyurethanes; To be tested: Acrylics; Laminating adhesives specially developed for high thermal applications above boiling and/or for high chemical resistance; Any other laminating adhesives (Epoxy, etc.)

For PP film coloured stream:

- Full compatible: PU (both aromatic and aliphatic) ≤ 3 wt% of the total weight of the film
- Limited compatible: PU between 3 and 4.5 wt% of the total weight of the film
- Low compatible: PU >4.5 wt% of the total weight of the film; To be tested: Acrylics; Laminating adhesives specially developed for high thermal applications above boiling and/or for high chemical resistance; Any other laminating adhesives (Epoxy, etc.)

It is important to highlight that these recommendations are given for PP films not containing any barrier material (except metallization, since it was tested previously[2]). Based on RecyClass expertise, additional

[1] **Technical Review on laminating adhesives in PE film test campaign** available here

[2] Technical Review on Metallisation

c/o Plastics Recyclers Europe
Avenue de Broqueville 12
1150 Brussels, Brussels

Phone : +32 2 786 39 08
info@recyclass.eu
www.recyclass.eu

issues may be observed when laminating adhesives are combined with barrier materials like EVOH, PVOH, or PA. More data will need to be gathered to provide clear recommendations for such combinations with barrier materials.

The RecyClass PO Films Technical Committee would like also to emphasize that these new recommendations on laminating adhesives can be challenged through Recyclability Approval process, to obtain product specific Approval Letters.

Finally, the RecyClass Working Group on laminating adhesives will continue to work on the development of a simplified assessment for laminating adhesives, as well as on acrylics and laminating adhesives specially developed for high thermal applications above boiling and/or for high chemical resistance.

About RecyClass

RecyClass is a non-profit, cross-industry initiative advancing recyclability, bringing transparency to the origin of plastic waste and establishing a harmonized approach toward recycled plastic calculation & traceability in Europe. RecyClass develops Recyclability Evaluation Protocols and scientific testing methods for innovative plastic packaging materials which serve as the base for the Design for Recycling Guidelines and the RecyClass Online Tool. RecyClass established Recyclability Certifications for plastic packaging, Recycling Process Certification and Recycled Plastics Traceability Certification for plastic products.

RecyClass – Plastic Future is Circular

Follow the latest news on RecyClass channels: LinkedIn | Twitter | YouTube

Contact : Jean-Emile.Potaufeux@plasticsrecyclers.eu, www.recyclass.eu

RecyClass

c/o Plastics Recyclers Europe
Avenue de Broqueville 12
1150 Brussels, Brussels

Phone: +32 2 786 39 08
info@recyclass.eu
www.recyclass.eu

Annex I

Table 1: Laminating adhesive chemistries used for the test campaign

#	Solvent	Isocyanate type	Polyol type	NCO/OH termination
0	BOPP TSS			
1	SB	ALIPHATIC	Polyester	OH
2	SF	ALIPHATIC	Polyester	OH
3	SF	AROMATIC	Polyether	NCO
4	SF	AROMATIC	Polyether	NCO
5	SB	AROMATIC	Polyester	OH
6	SB	ALIPHATIC	Polyether	OH
7	SB	AROMATIC	Polyester	NCO
8	SF	ALIPHATIC	Polyester	NCO
9	WB	Acrylic		