

The RecyClass PO Films Technical Committee (TC) investigated the impact of Polyvinyl alcohol (PVOH) on recycling of PE films. This testing campaign was supported by Kuraray, C.O.I.M, and SAES Coated Films who supplied the samples. With the result of this test campaign, the RecyClass PO Films Technical Committee confirmed the design for recycling criteria on the limited compatibility of PVOH with PE flexible packaging recycling and extended it to soluble EVOH.

To reduce the amount of barrier material, PVOH is sometimes considered as an alternative and can be either coated or coextruded to PE films. In this test campaign, a focus was done on PVOH coatings, usually representing only few percents of the total weight of the multilayer packaging. Among its specific features, PVOH is known to be water-soluble (conditions depends on the grade), but also to possess a relatively low thermal stability, which can be a challenge for recycling. Note that some soluble EVOH, with an ethylene monomer content inferior to 10 mol% can also be sometimes referred as PVOH on the market. For these reasons, the RecyClass PO Films TC focused on evaluating three multilayer structures containing PVOH, with the following compositions (see Annex I):

- 1) MDO-PE / Fully hydrolysed PVOH coating / Laminating adhesive / LDPE
- 2) MDO-PE / Soluble EVOH coating / Laminating adhesive / LDPE
- 3) MDO-PE / Fully hydrolysed PVOH coating / AlOx coating/ Laminating adhesive / LDPE

Each film was produced with 50 µm MDO-PE and 50 µm LDPE, and 2 gsm of a laminating adhesive already tested and approved by RecyClass<sup>1</sup>. The differences lied on the coating weights, which were 1 gsm for the fully hydrolysed PVOH coating, and 2 gsm for the soluble EVOH, which represented respectively about 1 wt% and 2 wt% of the total weight of the film. Tests were conducted at Proplast according to RecyClass Recyclability Evaluation Protocol for PE Films, with a film made from LDPE 310E as control material, and an additional reference made of 50 % MDO-PE and 50 % LDPE to identify the impact of the presence of the MDO-PE.

During the washing step of the recyclability evaluation, a significant amount of foam was generated by each sample, which could be related to a partial solubility of the coating despite the lamination. After extrusion, results showed a high coloration of the pellets due to presence of the PVOH. Note that the soluble EVOH also led to a yellowing of the pellets, but with a lower intensity (see Annex II). The

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<sup>1</sup> Approval Letter of Novacote® SF 724 A + CA 332 [available here](#)

extrusion process was stable, and no sign of build-ups could be observed on melt filters. These pellets could still be used to produce blown film, but the films containing soluble EVOH were suffering from many defects such as rough surfaces, and a high increase of gels, and black specks, which could be attributed to thermal degradation of the soluble EVOH, its higher concentration (2 wt%) or its interaction with the laminating adhesive. Fully hydrolysed PVOH coating showed a better quality of films, with only a limited increase of gels, remaining within benchmark recommendations. This limited increase of gels could be attributed to the PVOH, and more precisely to the high melt temperature of PVOH, which could avoid a perfect blend during the extrusion process. Finally, the sample containing an ALOx layer exhibited similar levels of performance than the sample containing PVOH, validating that ALOx was not impacting the recyclability of the film.

As a summary and according to the results that were obtained from the Recyclability Evaluation Protocol, the RecyClass PO Films TC defined the following level of compatibility:

**For the coloured PE films:**

- **Limited compatible:** PVOH and soluble EVOH coatings  $\leq 1$  wt%, for PVOH with a melt temperature inferior to 225°C.
- **Low compatible:** Soluble EVOH coatings > 1 wt%; PVOH > 1 wt% (to be tested)

**For the transparent PE films, PVOH and soluble EVOH are considered as low compatible with natural PE films recycling, due to the significant coloration of the recycle.**<sup>2</sup>

The PO Films Technical Committee emphasized that these recommendations on PVOH coating can be challenged through Recyclability Approval process, for future innovations, to obtain product specific Approval Letters by RecyClass. Besides, it is crucial to ensure that PVOH grades will have a thermal stability superior to 230°C to avoid degradation during the PE films recycling process.

#### **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.

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<sup>2</sup> [Design for Recycling Guidelines for PE films](#)

## Annex I

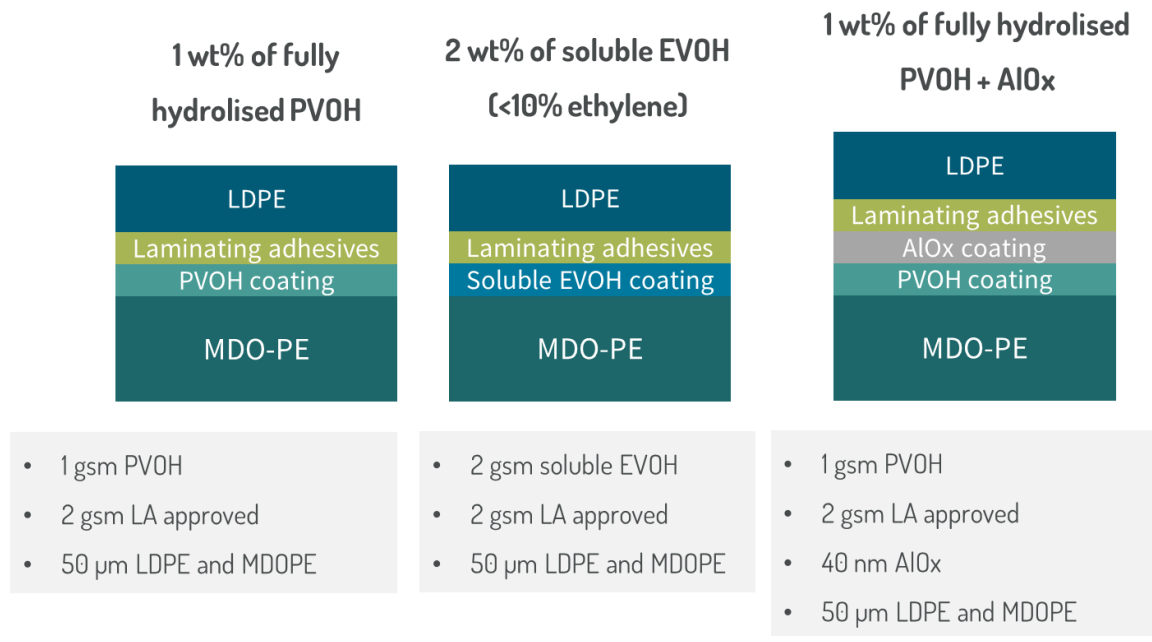


Figure 1: Composition of samples used for the test campaign.

Annex II

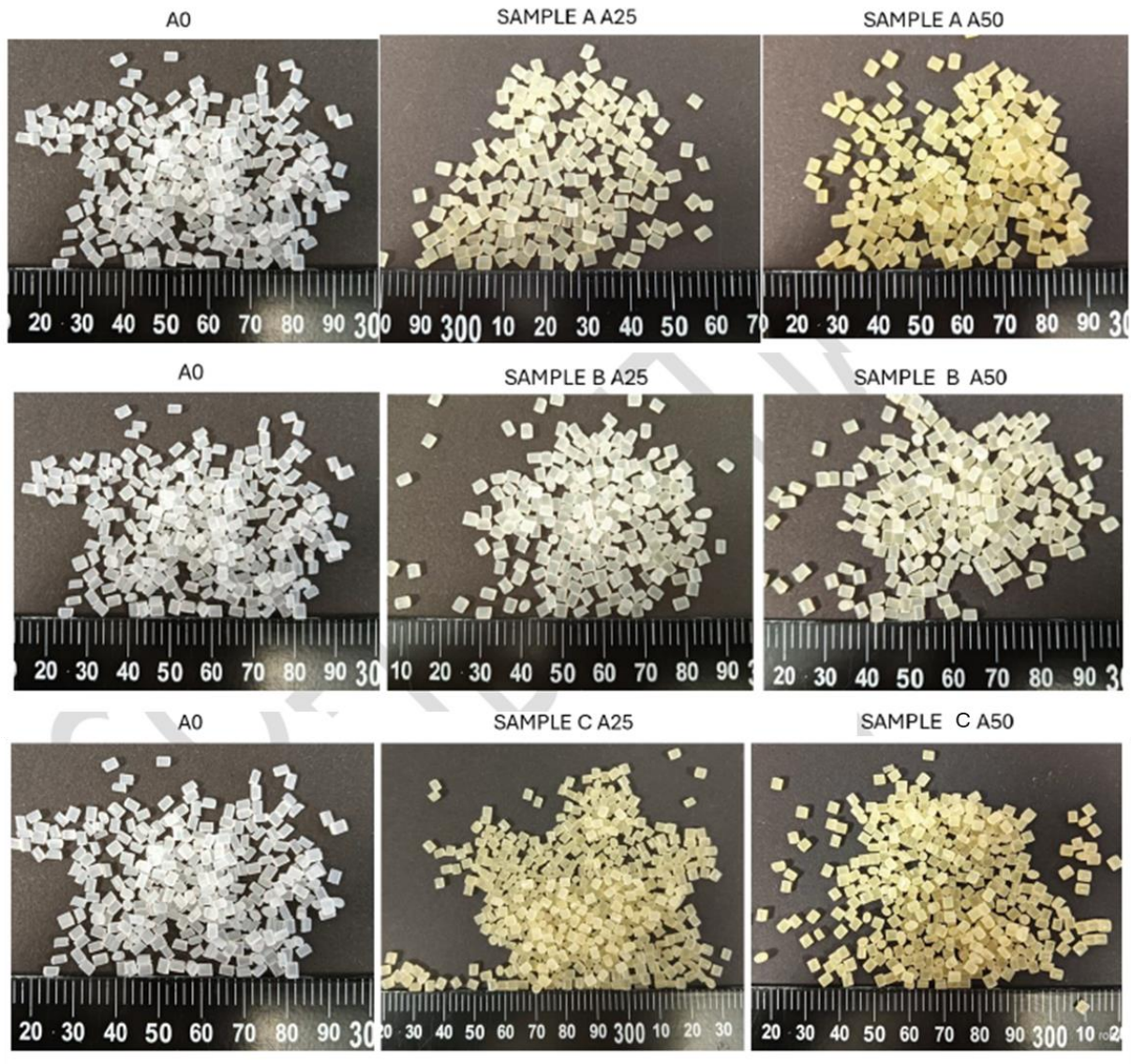


Figure 2: Coloration of A.0, A.25 and A.50 blends after extrusion, due to the presence of PVOH or soluble EVOH (from top to bottom: sample 1, 2 and 3)