RecyClass

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RECYCLASS TECHNICAL REVIEW

Foamed elements (liners, seals and valves) on HDPE containers

Brussels, 24 January 2023
Revised: 15 July 2024

The RecyClass HDPE Technical Committee investigated in 2022 the impact of foaming on HDPE containers recycling. The test campaign was made on two samples representative of the market provided by Berry Global, as illustrated in Annex 1. Tests were carried out following the procedures described by the RecyClass Recyclability Evaluation Protocols for HDPE containers[1].

The samples consist of natural HDPE jar and lid with an Expanded Polyethylene (EPE) liner of 3mm, representing approximately 12 wt% of the total weight of the packaging. The two different liners' technology differed by the presence of Chemical Foaming Agents (CFAs) or not in their composition. Such CFAs are typically citric acid-based chemicals used as nucleating agents for the foaming process. Such packaging and liners are often used for cosmetics and food.

The recyclability evaluation was performed at the Centre Technique Industriel de la Plasturgie et des Composites (IPC) by following the RecyClass Recyclability Evaluation Protocol for HDPE Containers. The control material used for the test corresponded to the same HDPE jar and lid without the EPE liner, meaning that the only difference with innovation packaging was the presence of the foamed PE.

During the pre-treatment steps, it was observed that about 25 wt% of both liners were separated during the air elutriation process. In order to evaluate a worst-case scenario, it was requested to reintroduce this light fraction to the flakes that would further be extruded. Extrusion of the flakes as well as pellet and mechanical characterizations showed no negative impact related to the presence of the PE foamed liners. However, the converting step exhibited strong issues for the samples containing EPE, in particular due to irregularities of the parisons that led to disruptions during the blow moulding process, as illustrated in the Annex 2. Bottles produced with these samples showed significant decrease in mechanical properties compared to the control bottles.

The outcome of this test campaign was that foaming is detrimental for HDPE recycling. As foamed packaging elements (such as liners and gaskets) often represent a share of the total packaging inferior to 1 wt%, the HDPE Technical Committee decided to define a threshold of 1 wt% for PO foamed parts to be accepted as compatible with HDPE recycling, based on previous recyclability assessments performed by RecyClass.

[1] Recyclability Evaluation Protocol for HDPE Containers

As a summary and according to the results that were obtained from the Recyclability Evaluation Protocol, the RecyClass HDPE Technical Committee defined the compatibility of the PO foamed liners, seals and valves with the HDPE rigid packaging as following:

- **Limited compatible** with HDPE if **≤** 1 wt% of the total weight of the packaging
- **Low compatible** with HDPE if > 1 wt% of the total weight of the packaging

The HDPE Technical Committee welcomes the possibility in the future to study the impact on recycling of foamed HDPE containers, which are produced following a different foaming technology.

Revision - July 2024

The RecyClass HDPE Technical Committee reviewed the results of this test campaign to determine if similar outcomes were achieved when using a blow moulding HDPE grade to produce the containers where the liners would be used. In that context, through a Technology Approval, the same type of liner as used in the "Innovation 2" in the previous test campaign, which includes Chemical Foaming Agents (CFAs), was employed. The liner constituted approximately 9.5 wt% of the total packaging weight. Details of the innovation can be found in Annex 3.

The recyclability evaluation was performed at the Institut für Kunststofftechnologie und -recycling (IKTR), carried out as per the RecyClass Recyclability Evaluation Protocol for HDPE Containers. The control material used for the test corresponded to the same HDPE container without the EPE liner and blends A.50 and A.100 were performed.

During the pre-treatment steps, almost all the liner parts were removed via air elutriation, i.e. ending up in the light fraction. In order to simulate a worst-case scenario, it was decided to re-add the light fraction again to the heavy one.

The extrusion of the flakes, along with pellet and mechanical characterizations, indicated no negative impact from the presence of the PE foamed liner. During the conversion step, the resulting bottles exhibited no visible grainy aspect, nor any defects as observed during the initial test campaign. All evaluated properties on bottles (geometry, absence of defects, mechanical properties, etc.) were within benchmark recommendations.

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These new results suggest that the use of injection moulding grades might have contributed to the grainy appearance observed in the previously obtained bottles. However, the reason why these defects were not present in the control sample remains unclear. Another hypothesis could be a too high moisture content before processing.

In light of this new results the HDPE TC has reassessed the compatibility of PO foamed liners with the HDPE recycling stream, considering them as:

- **Fully compatible** with HDPE recycling.

This means that, a company using a foamed liner on an HDPE container, can proceed directly with a certification of their packaging without the need to perform a RecyClass Recyclability Evaluation Protocol.

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Annex I

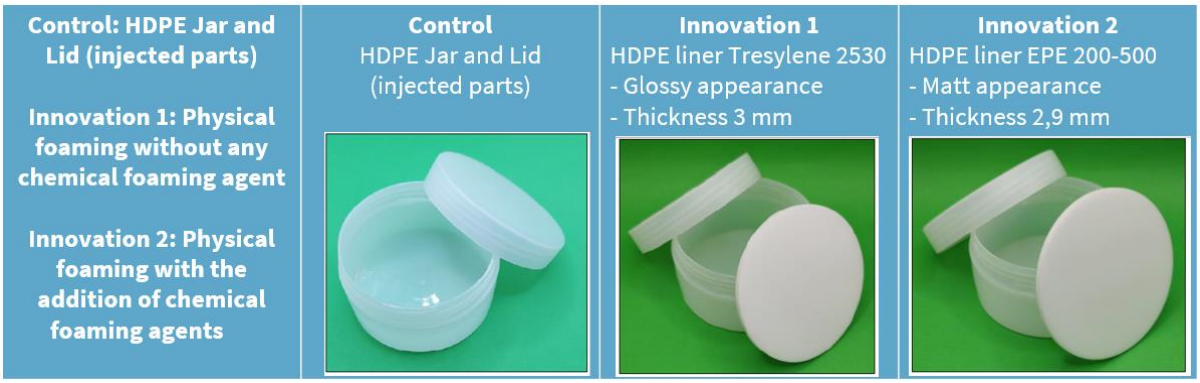

Figure 1: Samples and foamed liners used for the test campaign.

Annex II

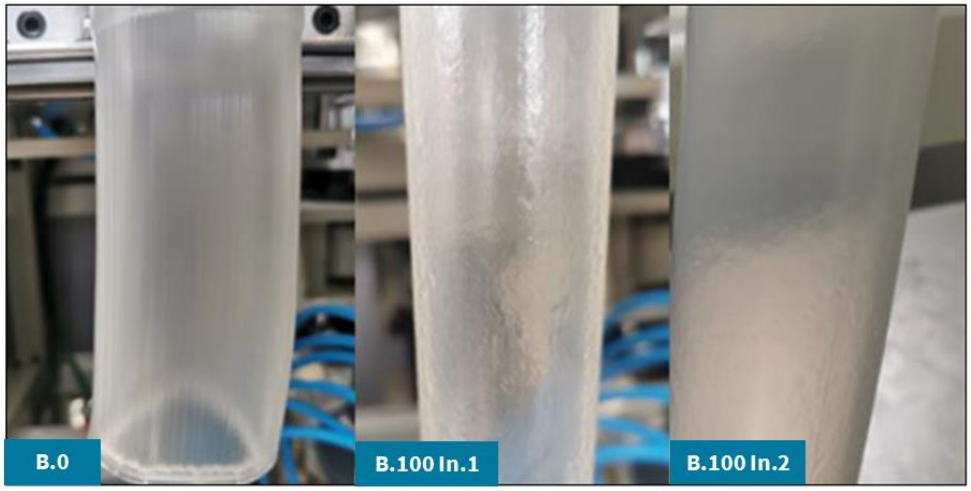

Figure 2: Parison defects during blow moulding process for samples containing foamed liners.

Annex III

Figure 3: Blow moulded container (left) and foamed PE liner (right).

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