RecyClass

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The RecyClass HDPE Technical Committee (TC) investigated the impact of direct printing on the recyclability of HDPE coloured rigid containers. The recommendations in the guidelines at the beginning of 2025 requested systematic testing of packaging when using more than 1 wt% of direct printing ink on coloured rigid packaging. For this reason and from the start, the main objective of the tests campaign was to understand the impact of the amount of ink on recycling and quality of the recycled material in order to provide better guidance to the industry. In addition, the use and impact of various organic and inorganic masterbatches for mass colouration of the packaging was also investigated. After analysing the reality of the market, the TC decided to focus on two series of HDPE samples, one containing 2 wt% and the other containing 2.5 wt% of UV curable ink combined with different masterbatches, as described in Table 1.

**TABLE 1. DIFFERENT SAMPLES TESTED.**

| Sample code | MB | MB Colour | Ink wt % |
|---|---|---|---|
| 1 | None | None | 2 |
| 2 | None | None | 2.5 |
| 3 | Azo (Mono/Diarylide) - PR 57:1 | Red | 2 |
| 4 | Azo (Mono/Diarylide) - PR 57:1 | Red | 2.5 |
| 5 | Phthalocyanine - PG7 | Green | 2 |
| 6 | Phthalocyanine - PG7 | Green | 2.5 |
| 7 | Isoindolinone - PY139 | Yellow | 2 |
| 8 | Isoindolinone - PY139 | Yellow | 2.5 |
| 9 | TiO2 | White | 2 |
| 10 | TiO2 | White | 2.5 |

Tests were carried out following the procedures described by RecyClass Recyclability Evaluation Protocols for HDPE containers[1]. In order to achieve high ink percentages, flexo printing and silk screen technologies were combined. The samples with 2 wt% of ink were tested at the CRITT and the one with 2.5 wt% of ink at Interzero, both RecyClass recognised testing facilities. The control material used for the tests corresponded to one-time processed ENI Versalis Eraclene BC82 HDPE resin.

For all the tested samples, the extrusion process was not affected by the presence of the ink and masterbatch. The process ran steadily over 30 minutes at a melt temperature of 220 °C, without any increase of the pressure and any sign of build-ups in the filter. Slight odours and fumes were reported

[1] RecyClass Recyclability Evaluation Protocols

by the laboratories, but these did not interfere with operations and the work of operators in the surrounding area. The extruded pellets, namely blends A.0 (control material), A.50 (50 % of innovation) and A.100 (100 % of innovation) were coloured but did not show any sign of thermal degradation (see Annex 1). The properties of the pellets were within the benchmark recommendations for all the samples.

Each pellet sample obtained by the extrusion process was injection moulded into tensile test bars and test plaques without any dilution with virgin material . The plaques did not show any particular defects, inclusions or black spots. The mechanical properties of A.50 blends were within the benchmark recommendation, except for the Charpy impact test strength for the samples with red and green masterbatches (tests 3, 4 and 6). A decrease in the flexural modulus of all A.100 injection moulded specimens beyond recommended limits (more than 25 % deviation) was recorded.

The results were also submitted to the RecyClass PP Technical Committee. Based on the test results, the RecyClass HDPE Technical Committee and RecyClass PP Technical Committee have issued the following Design for Recycling recommendations:

- Inks and lacquers for direct printing are **fully compatible** with coloured HDPE and PP recycling when used at a concentration of up to **1 wt%**.
- Inks and lacquers for direct printing are **limited compatible** with coloured HDPE and PP recycling when used at a concentration above **1 wt%**.

The insights provided by these tests contributed to the development of RecyClass Design for Recycling Guidelines for HDPE and PP and this means that, a company using direct printing on an HDPE or PP containers, can now proceed directly with a certification of their packaging without the need to perform a RecyClass Recyclability Evaluation Protocol.

*About RecyClass*

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

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Annex I

FIGURE 1. HDPE containers tested (Samples 2, 4, 6, 8 and 10 from left to right)

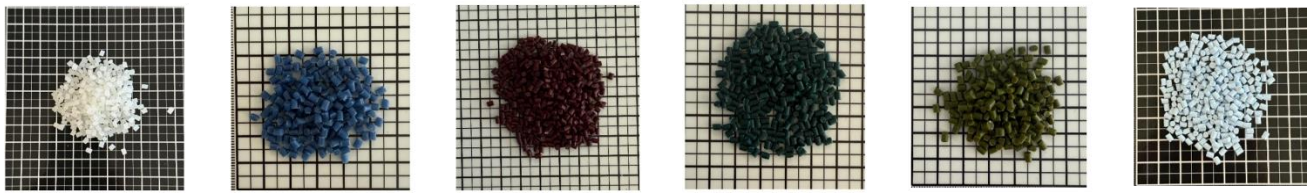

FIGURE 2. Pellets produced after extrusion (A.0, A2.100, A4.100, A6.100, A8.100 and A10.100 from left to right)

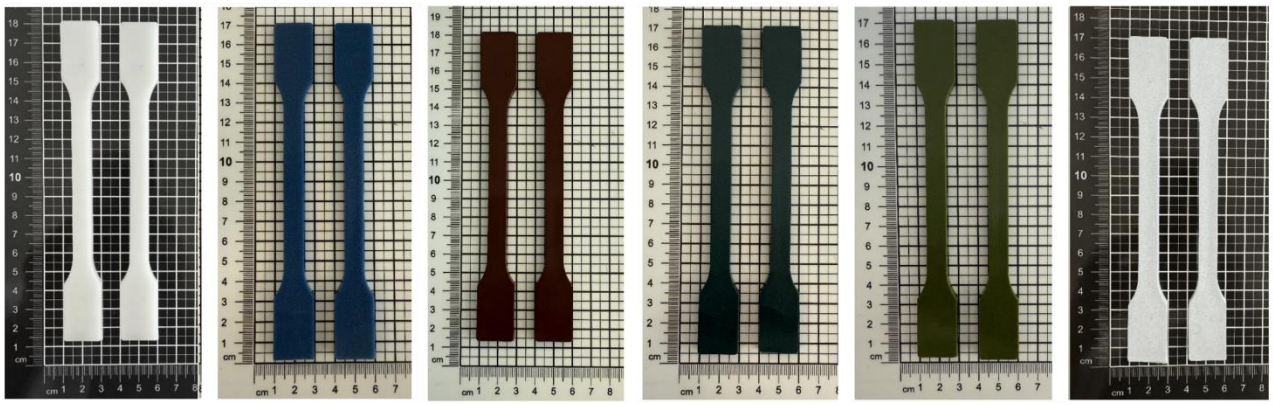

FIGURE 3. Injected bars produced by injection moulding (A.0, A2.100, A4.100, A6.100, A8.100 and A10.100 from left to right)