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RECYCLASS TECHNICAL REVIEW

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The RecyClass High Density Polyethylene Technical Committee (HDPE TC) has concluded that there is the need to provide further recommendations to the industry regarding the usage of PE closures on PE containers.

PE injection moulding grades used for closures can have high Melt Flow Rate (MFR). Recyclates obtained from HDPE containers using this type of grades could negatively impact the process of blow moulding bottles due to low viscosity of the melt.

In that regard, the HDPE TC has decided to endorse the recommendations given by the Association of Plastics Recyclers[1] (APR). Those recommendations are as follows:

HDPE, LLDPE, and LDPE closures are preferred when the Melt Flow Rate (MFR) of the blend of the closure and base resin employed for the container is less than **4.00 g/10 min** (190 °C and 2.16 Kg).

The reason for the value of 4.00 g/10 min, defined in APR Guidance[2], is given in the Critical Guidance method HDPE-CG-01[3] , where the MFR of a 50/50 blend of control resin with an innovation should vary by less than 0.75 g/10 min compared to the control alone. The following calculation is offered and can be employed as an alternative to laboratory testing to determine the MFR of a blend of two different polyethylene resins:

$$log(MFR_{blend}) = \sum w_i \, log(MFR_i)$$

Being:

W_i the weight fraction of each element of the blend.

MFR_i refers to the Melt Flow Rate of each PE resin (ISO 1133, 190°C, 2.16 Kg)

MFR_{blend} refers to the final MFR of the blend consisting of the PE closure resin and PE bottle/container resin.

[1] https://plasticsrecycling.org/

[2] https://plasticsrecycling.org/hdpe-guidance-table

[3] https://plasticsrecycling.org/hdpe-test-methods

Using the lowest MFR control choice (worst case scenario) in the O-P-01 of 0.25 g/10 min and targeting 1.00 g/10 min (0.25 + 0.75 = 1.00 g/10 min) as the maximum MFR of the blend of closures and container base resin, one solves to determine the MFR for the blend of closures with base resin:

$$Log\ (MFR_{blend}) = 0.5 \log (MFR_{Closure + base\ resin}) + 0.5 \log (MFR_{\text{Control}})$$

$$\Rightarrow Log\ (1) = 0.5 \log (MFR_{Closure + base\ resin}) + 0.5 \log (0.25)$$

$$\Rightarrow MFR_{\text{Closure + base resin}} = 4.00 \text{ g/10 min}$$

The Table 1 below gives some illustrative closure/container blends that do not exceed the < 4.00 g/10 min limit.

TABLE 1. ILLUSTRATIVE CLOSURE/CONTAINER BLENDS.

Cap (wt %)	*Cap MFR (g/10min)*	*Bottle (wt %)*	*Bottle MFR (g/10min)*	*Blend final MFR (<4 g/10 min)*
10	*15*	*90*	*0.25*	*0.38*
20	*20*	*80*	*0.70*	*1.37*
30	*30*	*70*	*0.35*	*1.33*
40	*15*	*60*	*0.25*	*1.29*
50	*15*	*50*	*0.25*	*1.94*

Of course, the MFI of the blend can be measured experimentally as well employing ASTM D1238 or ISO 1133 (190 °C/2.16 kg).

This recommendation will be applied in the recyclability assessment as follows:

- MFR of the blend (closure + container) equal or less than 4 g/10 min (190 °C, 2.16 Kg): Full compatible with HDPE recycling.
- MFR of the blend (closure + container) higher than 4 g/10 min (190 °C, 2.16 Kg): Limited compatible with HDPE recycling (1 class deduction). This recommendation can be challenged through testing using the HDPE Recyclability Evaluation Protocol, specifically the blown bottles converting test.

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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

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