

**O&F WG: WHITE
OPAQUE PET – FROM A
RECYCLING ISSUE TO A
VALUE CHAIN OPPORTUNITY**



Opaque White PET Market

(O&F WG – TF1 - market research results presented at PETCORE Annual event 2019 updated to 2022)



Global plastics
demand 360 mio tons



Global PET packaging
consumption ca30 mio tons

ca 60 mt
plastics demand in Europe 2022

PET demand
is still ahead other resin types



ca 5.1mio tons PET packaging consumed in EU27 + UK
ca 6% CAGR in PET bottles, 61% recycling rate
ca 11% CAGR in PET trays, 21% recycling rate

CAGR

Stable
in the EU
2.5 – 3.0%,
globally

3.0 mio tons vPET
1.3 mio tons RPET
0.8 mio tons net imp PET

49% collect and sorted

min 350
ktons
white opaque
PET
bottles

ca 1-2% of total
EU PET bottles

3.6 mio ton
PET bottle
EU 2020

1.0 mio ton
PET trays
EU 2020

rPETo Design for recycling

Targeted applications – concept for DfR criteria

- Bottle to bottle white opaque applications
- Only direct food contact substances
- Circularity - closed loop food packaging
- Preventive contamination from/to other streams

rPETo Design for recycling

DfR white opaque PET bottles – steps

- Review existing EPBP guidelines for opaques by masterbatches expert team members of PETCORE
- Proposal presentation and approval to EPBP Technical Committee
- Alignment with Recyclclass processes/documents update

“RecyClass will integrate the DfR guidelines for ‘white’ opaque PET bottles.”

- *EPBP website update - pending*
- *Joint Press Release: PETCORE, EPBP, Recyclclass – work in progress*

EPBP: White opaques design for recycling

- Only relevant sessions are revised
- Sessions not mentioned in this review were not in the scope of WG O&F review

Current

<u>Colours</u>	all transparent colours; opaque colours without a layered structure	opaque in layered structure	<u>fluorescence</u> ; metallic
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Proposal

<u>Colours</u>	White opaque	White opaques in bi/multilayered structure with white outer layer; Pastel opaque colors	Any other non white outer layer color
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Transparent clear and light blue design for recycling guidelines can be found [here](#)

Transparent colors design for recycling guidelines can be found [here](#), including amber and green (mixed)

EPBP: Opaques design for recycling

Current

Barrier	<u>SiOx coating; carbon plasma-coating; Nylon-MXD6 in a 3-layer structure with up to 6 wt% Nylon-MXD6 and no tie layers; PTN alloy</u>	<u>Nylon-MXD6 in a multilayer structure with up to 6 wt% Nylon-MXD6 and tie layers; EVOH multilayer with up to 3 wt% EVOH and no tie layers; monolayer Nylon-MXD6 blend; PGA multilayer</u>	<u>Nylon-MXD6 in a multilayer structure with > 6 wt% Nylon-MXD6; EVOH multilayer with >3 wt% EVOH or with tie layers</u>
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Current

Additives		UV stabilisers; AA blockers; optical brighteners; oxygen scavengers	bio-/oxo-/photodegradable additives; nanocomposites
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NOTE: list not exhaustive. New technologies have to apply to EPBP to come on the positive listing. In case of doubts, please refer to footnote of every DfR guidelines at [Design Guidelines - EPBP - European PET Bottle Platform](#)

EPBP: White opaques design for recycling

Current

<u>Other Components</u>	base cup, handles or other components which are separated by grinding and float/sink - all with density $<1 \text{ g/cm}^3$; PET		materials with density $>1 \text{ g/cm}^3$ (e.g. metal , RFID tags); non-detaching or welded components
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Proposal

<u>Other components</u>	Base cup, handles or other components which are separated by grinding and float/sink – all with density $<1 \text{ g/cm}^3$, uncolored PET or white PET		Same as above
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Guidelines for rPETo Specification(1/2)

	Group	Characteristic	Limits	Test Method	Importance
General Requirements (applies to any form)	Essential Parameters	TiO2 amount	measured and disclosed amount of TiO2	Ash Test	Very high
		Intrinsic Viscosity (IV from MFR)	0.8 dl/g +/- 0.02	Solution of melt equivalent. No specific ASTM/ISO methods exists for the measurement of IV in PET. Major suppliers have internal methods, these should be validated before use.	Polymer molecular weight, which is a measure of the mechanical strength capability of the material and allows converters to control their drying and injection molding processes.
		AA (Acetaldehyde)	3 ppm max	ASTM F2103 or validated internal method.	Acetaldehyde imparts a green apple odour to the contents, this is of concern for water bottle applications.
		Moisture content	< 0.5 % wt	Weight loss. Validated internal, Karl-Fischer method.	Material needs to be fully dried at convertor prior to preform injection via local dryers and so values above this can be validated in practice.
		Fines particle content	< 0.1% (through 30micron mesh) > 500	Sieve analysis Validated internal method.	Excessive fines can burn and result in back specks
		Bulk density	880 Kg/m ³	ASTM D1895 or equivalent	Throughput
		Glass transition temp	76-80 c	Differential scanning calorimetry	Processing during injection
	Non-Essential Parameters	Melting point (peak)	245-250 c	ASTM D3148 or equivalent	Processing during injection
		Crystallinity	> 50%	ASTM E793 or equivalent	Throughput / flowability. Low crystallinity/amorphous PET tends to clump together.
		Pellet length	1.5-3 mm	ASTM D1921 or equivalent	
		Pellets > 3mm length	< 0.2%	ASTM D1921 or equivalent	Flowability / pourability

Guidelines for rPETo Specification(2/2)

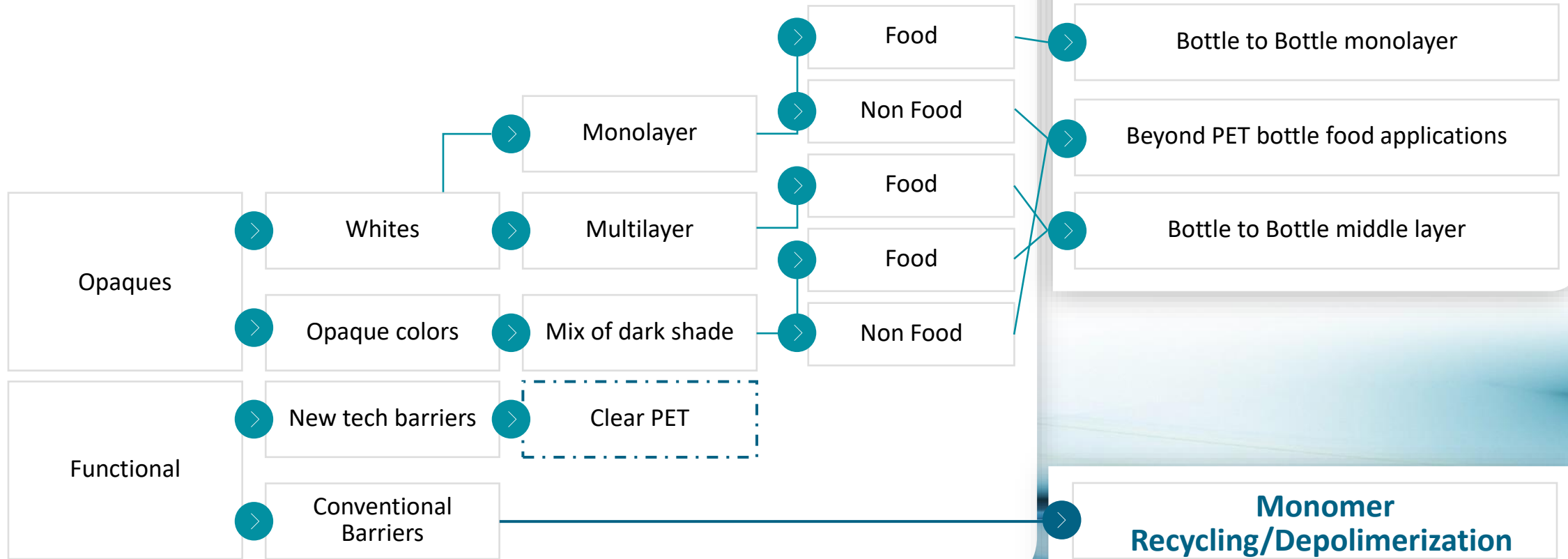
Min Flakes Requirements	Colour (pellets)		<p>MONO: Typical values L >70 for PELLETS ; Bottles L >80</p> <p>MULTILAYER: L-values of 100% repeletized ML-flakes L >40; NOTE: This means that to keep L-values for the bottle at target values (>70), the amount of ML-input likely is very low (TBC %); recommendation is to only use on black-fraction of again ML-bottles.</p>	Colour spectrophotometer	<p>Recyclability and FMOT.</p> <p>L* is a measure of the "lightness" of the material, L=100 is white, L=0 is black.</p>		
		L* value (crystallised)					
	Contamination		b* value (amorphous or crystallised)	-3 > b < 2	Colour spectrophotometer	<p>FMOT.</p> <p>color component, rPET tends to yellow due to material degradation and repeated melt/cool steps.</p>	
			PREFERRED	Number of specks:	ASTM D5577		
			Black speck count on moulded plaque.				<p>Larger black specks pose the risk of a hole in the bottle during the blowing process. Some plants (e.g. Logoplaste London) employ vision systems to reject preforms with black specks (resulting in high scrap rates), however this is only effective on transparent preforms.</p>
			To be used to characterise solid stated (crystallised) pellets.	> 0.1 mm ² : max 10			
				< 0.1 mm ² : max 100			
			PVC Content	< 30 ppm		NIR sorting QC output	PVC can degrade PET and can burn and blacken into specks during the pelletization.
			Others (metals/polymide/				<p>Other contaminates must be strictly controlled in direct flake applications. In the case of pelletised material, this is mechanically filtered out. There however should not be excessive amounts as this will clog the filter and present process issues on the pelletization line.</p>
film/silicone/rubber/etc)	n/a			Sorting various QC output			
	Total dark or colored flakes	100-1000 ppm range			Dark coloured flakes significantly impact the L*a*b* values and this cannot be present in anything but minor amounts.		

OUTLETS RPETo QUALITY REQUIREMENTS

Sorting technologies (TF2-Johan Kerver)



Outlets



WG O&F core actions executed in 2022

- EPBP Design for Recycling website for white opaques and colored PET bottles - updated upon technical review and approval of expert panels from O&F and EPBP
- EPBP pop up website for opaque PET bottles and for colored PET bottles published
- Proposal of a RPETo spec for recyclers and outlets
- Matrix consolidation of RPETo outlets
- Request Recyclclass to reflect the EPBP website updates in their rating scorecard for opaque white PET bottle
- Press Release of PETCORE, EPBP and Recyclclass on new DfR guidelines – on going
- *Webinar on sorting – postponed by PETCORE due to priorities/personnel*
- *LCA peer reviewed for white opaque dairy bottles – pending due to budget and to be managed via*

WG LCA

WG O&F scope for LCA study in whites

- Peer reviewed study
- Independently done, although mandate via PETCORE
- Scope: Europe, focus on EU countries, however the tool shall allow us to select the EU+ member states
- Packaging size: 250mL and 1L
- Use same rules and criteria the EC uses
- Value chain: from raw material extraction to supermarket (consumer) or according to PEF EoL - TBC
- Packaging types: Mono and multilayer PET white opaque bottles, full body sleeve (PETG), HDPE 3 layers and HDPE 6 layers (HDPE, adhesive, lacquer, EVOH, adhesive, HDPE)
- Carton beverage milk bottles (Tetrapack and alike)
- Glass – nice to have but not mandatory

WG O&F core actions planned for 2023

1. Updated **EPBP website** Opaque white PET bottles and Opaque colored PET bottles
2. **Press Release** on the updated DfR guidelines of RPETo jointly with EPBP and Recyclclass
3. **Sorting webinar** for PETCORE members and external stakeholders
4. Webinar with existing RPETo recyclers – to be confirmed interest and planned
5. Continue to **collect outlets and recyclers of RPETo whites** and **connect** them
6. **LCA** analysis with focus on white opaque PET bottles – reduced scope focused on CO2 emissions – working together and aligned with LCA WG
7. Work on **DfR guidelines and EoL** preferred options for **Functional bottles**
8. Work together with WG Thermoforms to **evaluate PET trays and Colored PET bottles** as a single stream

Definition:

WG O&F stands for the non-clear PET bottles. These are divided into the below described subgroups:

- Opaque white PET bottles (food and non-food)
- Opaque coloured PET bottles (any colour shade that does not qualify as clear or light transparent)
- Full body shrink sleeved PET bottles
- Functional bottles (e.g. O2 barrier, AA scavengers, etc)

Special note:

The working group is focusing its effort according to the market presence relevance of each of the above subgroups of O&F PET bottles being firstly the white opaques (90%), followed by the coloured and the functional

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