RecyClass

RECYCLABILITY EVALUATION PROTOCOL

FOR LABELS & ADHESIVES ON PET BOTTLES

STANDARD LABORATORY PRACTICE

REP-PETbot-02

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DISCLAIMER

"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. The Recyclability Evaluation Protocols will promote recyclability by encouraging the industry to test new plastic technologies, materials or product, providing recommendations on improving their recyclability before market launch.

The Recyclability Evaluation Protocols are freely available for download in the *RecyClass website*. Companies developing new plastic concepts are encouraged to use them to self-assess the impact of their solutions on recyclability and highlight potential issues. **However, compliance with a Recyclability Evaluation Protocol is not a replacement for an official assessment and may not be used as a marketing tool.** The RecyClass Steering Board, following the recommendations of the Technical Committees, will decide on the compatibility of the innovation with recycling according to the evaluation results, granting Recyclability Approval Letter to the Applicant.

All tests must follow the Evaluation Protocols recommended by the RecyClass Technical Committees and must be conducted by an independent laboratory recognised by RecyClass which has no legal affiliation to the applicant.

More information is reported in the RecyClass Internal Procedures available in the *RecyClass website*."

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1. INTRODUCTION AND PURPOSE OF THE PROTOCOL

The "Recyclability Evaluation Protocol for Adhesives & Labels on PET Bottles" referred to in this document as "The Protocol" describes the methodology the applicant must follow at a laboratory scale in order to determine if label and adhesive combinations are compatible with the post-consumer PET bottle recycling streams, meaning transparent clear/light blue, transparent coloured and opaque coloured PET streams. The Protocol targets companies responsible for introducing a packaging product into the market. The applicant shall proceed with the Protocol as established in the Assessment Process for Applicants of Recyclability Evaluation in the RecyClass Internal Procedures[1] and "RecyClass Recyclability Approval Quality Management & Procedures document[2]

The Protocol aims to evaluate the behaviour of labels, and adhesives during the washing process by performing a quick test at laboratory scale. It aims to guarantee recyclability[3] of plastics packaging while encouraging innovation in the label & adhesives market used for PET bottle applications. The overall goal is to ensure the removability of the label/attachment of the PET bottle without obstructing the proper functioning of the PET bottles recycling process. RecyClass protocol targets benchmarks that are based on requirements for bottle-to-bottle closed loop applications.

This document provides guidance on the tests methodology that shall be followed, including benchmark recommendations to guide the interpretation of the results.

PET bottle terminology, as it is used in this document, is defined as a rigid plastic bottle predominantly used for packaging liquids, beverages and detergents or cosmetics.

[1] *RecyClass Internal Procedures*

[2] *RecyClass Technology & Product Approval Quality Management & Procedures*

[3] *Recyclability definition according to PRE & APR: Plastics must meet four conditions for a product to be considered recyclable: 1. The product must be made with a plastic that is collected for recycling, has market value and/or is supported by a legislatively mandated program. 2. The product must be sorted and aggregated into defined streams for recycling processes. 3. The product can be processed and reclaimed/recycled with commercial recycling processes. 4. The recycled plastic becomes a raw material that is used in the production of new products.*

2. SCOPE OF THE PROCEDURE

The scope of the Protocol covers any labels, adhesives, attachments introduced to the existing packaging solutions for PET bottles. Before initiating the evaluation, the applicant shall review the Design for Recycling Guidelines for transparent clear/light blue PET bottles, transparent coloured PET bottles and white opaque PET bottles[4] to confirm that the PET innovative bottle is compatible with the recycling stream for PET bottles.

1. The scope of this Protocol covers the following non-exhaustive list of packaging solutions and/or innovations: Adhesives for labels (pressure sensitive adhesives, non-pressure sensitive hotmelts, wet labelling adhesives)
2. Unprinted labels
3. Printed labels

The Protocol provides guidance on the behaviour of the labels, and adhesives during the PET recycling process. The label should detach from the packaging and with no adhesive remaining on the washed PET flakes. The adhesive layer should remain on the label. Adhesive dissolving in the water represents extra effort for water treatment and are therefore not recommended. While adhesive remaining on the PET flakes may lead to discoloration of the recycled PET material. Printed labels must be tested additionally according to the bleeding inks procedure to evaluate the potential issue coming from the inks.

3. DISCLAIMER

The Protocol is created to represent as accurately as possible how the actual PET bottles recycling works at an industrial scale. RecyClass Technical Committee reserves the right for further testing, if necessary, to issue a final opinion on the recyclability of the tested innovation. The Recyclability Evaluation Protocol for Adhesives & Labels applied on PET Bottles establishes some benchmark recommendations to guide the decision-making process. However, only some of the properties listed in the protocol are provided with a benchmark recommendation, given that the evaluation also based on the technical expertise of the Technical Committee (TC).

Sorting behavior of PET bottles is also important to consider, since some labels/decorations can negatively affect the sorting efficiency to the right PET stream. Therefore, it is recommended to perform a sorting test according to RecyClass Sorting Evaluation Protocol for Plastic Packaging to ensure that packaging presenting a risk of missorting is sorted in the right PET stream.

4 Design for Recycling Guidelines

4. LAB EQUIPMENT

The following equipment are necessary to perform the full Protocol:

Table 1: Equipment necessary for the procedure

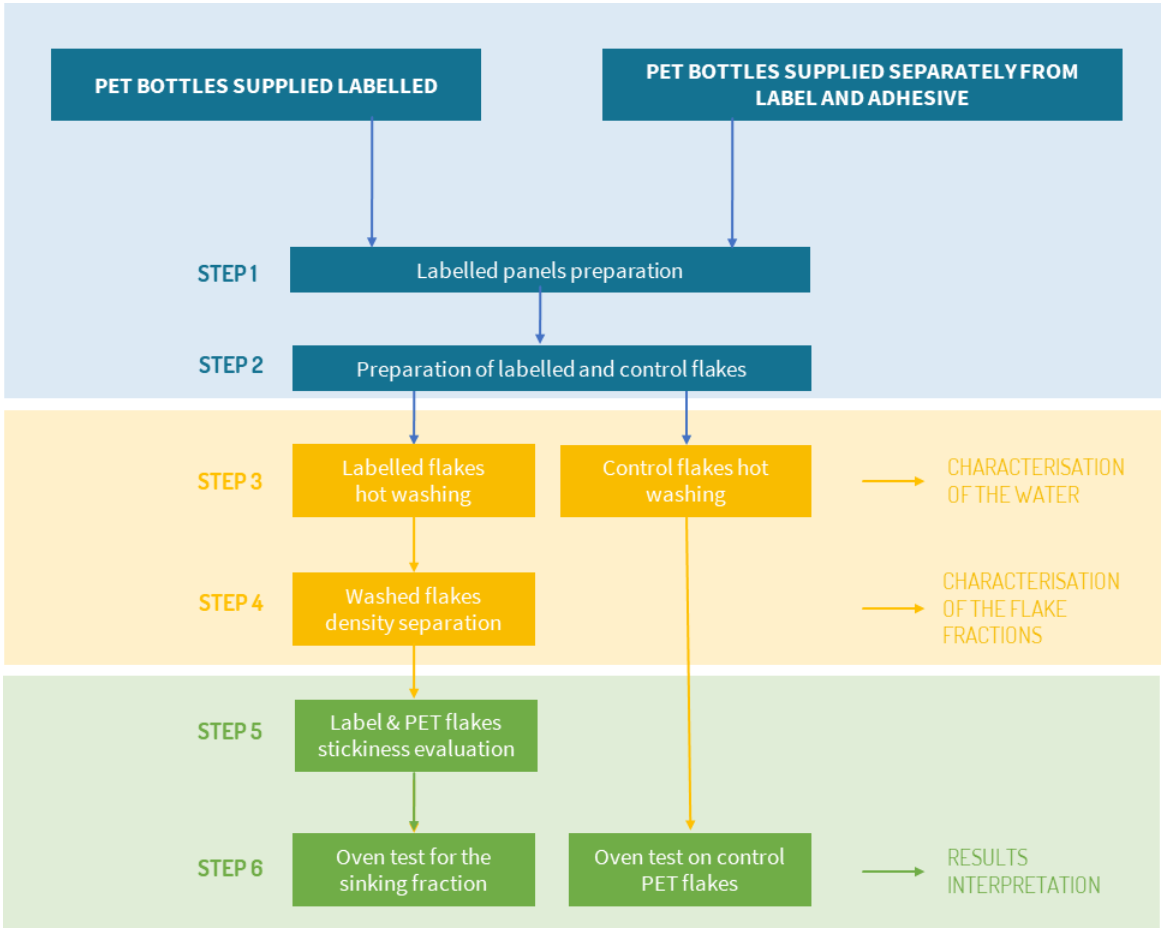
GLASSWARE	CHEMICALS	OTHER EQUIPMENT
250 ml glass crystallizers	Caustic Soda (NaOH)	Hot plate capable of heating up to 90 °C with thermocouple
600 ml beakers (diameter: 8 cm, height: 15 cm) & 800 ml beakers (diameter: 10 cm, height: 13.5 cm)	Surfactant: MacDermid Master RP24 or RP 34 / BASF Gardoclean S 5150/2 / CHT Tubiwash SKP Distilled or deionized water (referred to as “distilled water”, below)	Analytical balance with an accuracy of 0.01 g Clamping device to install overhead 600 rpm stirrer.
Ceramic funnel with vacuum filtration (10 to 13 cm diameter with holes size of about 2 mm	Acetone for cleaning purposes (technical grade)	Overhead stirrer with freely selectable rotation speed; Stirrer shaft (see Annex 1 for allowed geometries)
		Oven that allows temperatures up to 250°C
LAB TOOLS		
Accurate cutting device (scissors, blade, scalpel)	Manual stirrer (i.e., glass rod)	Metal weight with flat surface (150 g, max 5,5 cm^2)
Strainer (with holes of 1 to 3 mm diameter)	Paper filter : Whatman, grade 1 (11 µm porous size)	Clean white tile/toughened glass tile to be used as non-sticky, dry, even and free of dust and fibres solid surface
	Metal tweezers	Digital camera

5. LABORATORY TESTING METHODOLOGY

This methodology aims to reproduce the washing step of the PET bottles recycling process at laboratory scale to determine the suitability of an innovative adhesive or label with the PET bottle recycling streams. The methodology described below shall be followed precisely and any modifications or problems must be noted by laboratory technicians during the testing phase. Additional tests may be requested by the PET TC for specific cases requiring particular attention. A Laboratory Evaluation Report compiling objectively all the results obtained shall be prepared and submitted to the RecyClass PET Technical Committee which will interpret the final results and define the compatibility or not with recycling. Any remarks during the laboratory tests described in the Protocol shall also be noted down.

See below in Figure 1 a diagram describing methodology.

Figure 1: Methodology Diagram



5.1 CONTROL SAMPLE

The control PET bottle must be the same as the PET bottle with the applied label and adhesive. In order to minimise the deviations in the mass balance approach, the exact same PET bottles should be used for both labelled and not labelled samples. A list of recommended PET bottles is presented in Annex 2.

5.2 INNOVATION SAMPLE

For the purpose of the tests, the Applicant must provide at least 5 labelled PET bottles, with a total of glued surface representing about 1,000 cm^2 for a Pressure-Sensitive Label and about 300 cm^2 for Wrap-Around Labels. At least 5 non-labelled PET bottles must also be provided. If the label coverage is not sufficient to obtain the amount of labelled flakes and/or if additional tests are required, more labelled material may also be required.

While both transparent and coloured labels can be used for this recyclability assessment, coloured polyolefin labels (mass coloration or cavitated) are preferred to facilitate the separation and identification of the bottle and label flakes after washing. Preferably, the bottle should be tested with only one label. In the case of a final packaging, all labels should be used for the testing. Finally, it is preferable to test unprinted label to be able to dissociate the behavior of the inks and adhesives.

The Applicant must also provide at least 5 pieces of label, without any adhesive, with the exact same dimensions as the ones labelled on PET bottles. The laboratory will be then measuring the mass of these label facestock (without adhesive) and refer to it as $m_{Facestock}$.

6. LABORATORY TEST PROCEDURES

6.1 SAMPLE PREPARATION

6.1.1 STEP 1: PANELS PREPARATION

Two different procedures can be used depending on the nature of the label.

All weight measurement must be performed on bottles and flakes that stayed minimum 24h within standard lab room conditions (20-25°C and 30-50% relative humidity).

Procedure for Pressure-Sensitive Labels:

- Evaluate the number of bottles to be cut to obtain a minimum label surface of 600 cm^2. This number will be reported as Nb in the following instructions. Please note that Nb must be a whole number, which means that the entire label must be used for the assessment.

- Weigh at least 5 non-labelled PET bottles to obtain an average weight that will be reported as “A1”. Report as well standard deviation.

- Weigh the same number of labelled PET bottles to obtain an average weight that will be reported as “A2”. Report as well standard deviation.

- Report label size and structure, including the label facestock and the amount of adhesive per surface unit. Document the label design with one or more photographs.

- Cut out panels from the labelled area to obtain a minimum surface of 600 cm^2. Uncovered panel margins surrounding the applied label must have a maximum width of 1 mm on each margin side. Please note that the number of cut bottles (Nb) must be a whole number, which means that the entire label must be used for the assessment. These panels will further be referred to as innovation panels. For clarity, look at Figure 2.

- Record the total weight of the labelled panels as "B".

- Document labelled panels with one or more photographs.

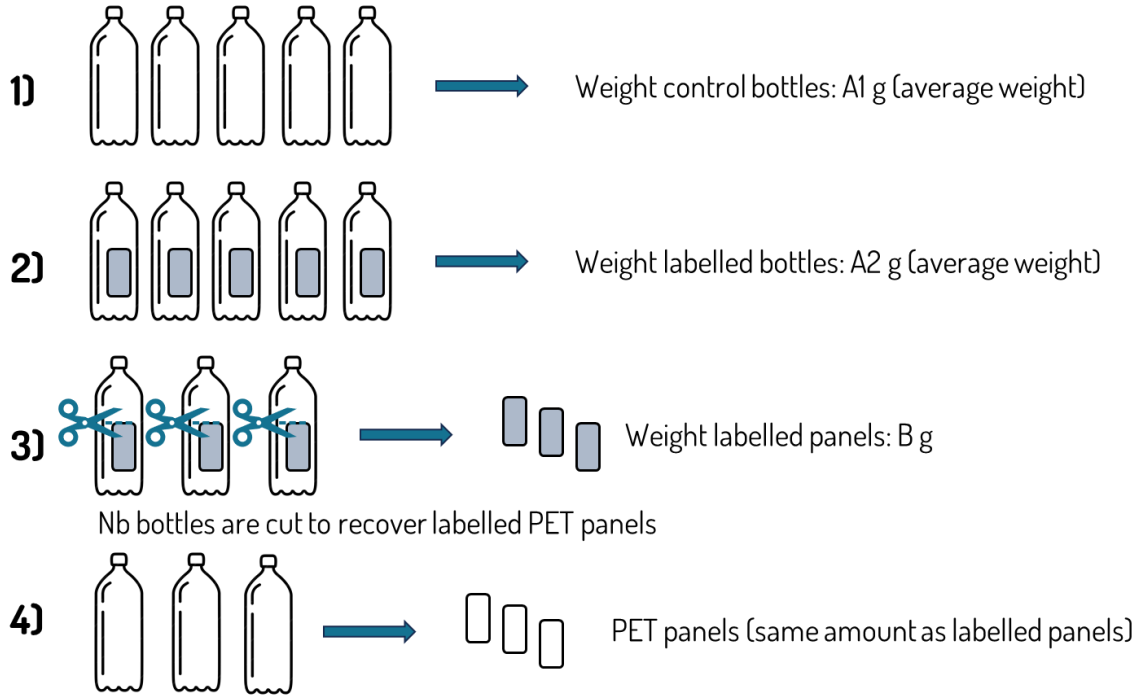
- Cut out panels from the non-labelled PET bottles to match the same area as that of the labelled bottle to obtain a minimum surface of 600 cm^2. These panels will further be referred as control panels.

- The weight of the PET present on the innovation panels, must be reported as "A" (in Annex 3) and calculated as following:
$A = Nb*(A1 - A2)+B$

- Determine the total weight of the label and adhesive present on the innovation panels, reported as "C", as following:
$C = B - A = Nb*(A2-A1)$

- Finally, verify that the 5 pieces of labels sent by the Applicant are as large as the ones labelled on the PET bottle. Weigh the 5 labels (without adhesive) and record the average weight as $m_{Facestock}$.

Figure 2: Illustration of sample preparation for Pressure-Sensitive Labels



Procedure for Wrap-Around Labels:

- Find the glued area of the Wrap-Around Label, and draw a line on the label, about 5 mm far from the glued area.

- Cut the label following these lines and remove the non-glued part of the wrap-around labels from the bottles.

- Evaluate the number of bottles to be cut to obtain a minimum labelled/glued surface of 200 cm^2. This number will be reported as Nb in the following instructions.

- Weigh at least 5 non-labelled PET bottles to obtain an average weight that will be reported as "A1". Report as well standard deviation.

- Weigh at least 5 labelled PET bottles (after removal of the non-glued part of the label) to obtain an average weight that will be reported as “A2”. Report as well standard deviation.

- Report label size and structure, including the label facestock and the amount of adhesive per surface unit. Document the label design with one or more photographs.

- Cut out panels from the labelled and glued area to obtain a minimum surface of 200 cm^2. Uncovered panel margins surrounding the applied label must have a maximum width of 1 mm on each margin side. Please note that the number of cut bottles (Nb) must be a whole number, which means that the entire label must be used for the assessment. These panels will further be referred as innovation panels. For clarity, look at Figure 3.

- Record the total weight of the labelled panels as “B”.

- Document labelled panels with one or more photographs.

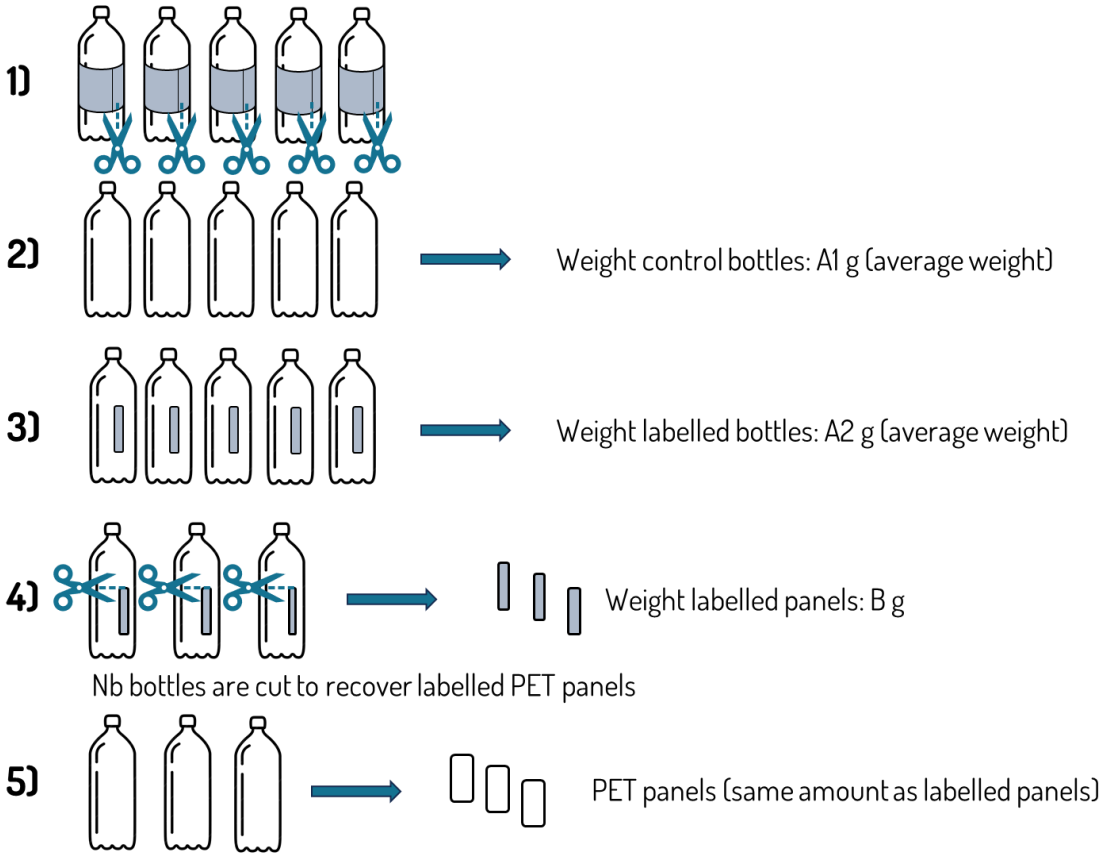
- Cut out panels from the non-labelled area of the side of the PET bottles to obtain a minimum surface of 600 cm^2. These panels will further be referred as control panels.

- The weight of the PET present on the innovation panels, must be reported as “A” (in Annex 3) and calculated as following:
$A = Nb*(A1 – A2)+B$

- Determine the total weight of the label and adhesive present on the innovation panels, reported as “C”, as following:
$C = B – A = Nb*(A2-A1)$

- Finally, using the virgin wrap-around labels provided by the Applicant, cut 5 pieces as large as the remaining labels attached to the PET bottle. Weigh the 5 pieces of labels (without adhesive) and record the average weight as $m_{Facestock}$.

Figure 3: Illustration of sample preparation for Wrap-Around Labels



6.1.2 STEP 2: FLAKES PRODUCTION

Control and innovation samples are separately cut in order to prepare controlled-size flakes.

Procedure:

- Cut control panels in a controlled environment. Avoid generating fines. Flakes should be shaped approximately as squares with an edge length of about 10 mm. These flakes will constitute the control flakes.

- Cut innovation panels in a controlled environment. Avoid generating fines. Flakes should be shaped approximately as squares with an edge length of about 10 mm. These flakes will constitute the innovation flakes.

- Weigh the innovation flakes after cutting, and report the value as "B2". The weight loss after cutting innovation panels should be inferior to 0.02 % by weight, meaning that: $\Delta B=(B2-B)/B < 0.02$ %.

- Document the innovation and control flakes with one or more photographs.

6.2 WASHING & SEPARATION BY DENSITY STEPS

6.2.1 STEP 3: WASHING

At the state of the art, European PET recycling lines typically use hot washing conditions (about 85 °C), caustic soda and surfactant, in a multiple step washing process. The following procedure must be applied to both control and innovation flakes, separately.

Procedure hot-washing:

- Prepare the washing beakers (600 mL) for a 1:4 ratio (100 flakes vs 40 mL solution) at 85 °C with a solution of 1 wt% NaOH and 0.3 wt% of a surfactant listed in Table 1.

- Wash each control and innovation sample separately at a 1:4 ratio (100 flakes vs 40 mL solution) at 500 rpm for 15 minutes. Position the stirrer at about 5 mm from the bottom of the beaker. Only overhead stirrers listed in the Annex 1 can be used.

- Make sure that the labels do not stick to the stirrer, nor the side of the beaker. It is important to ensure free agitation of flakes and label particles.

- Record the washing process with a series of photographs. Any stickiness, odour, suspended particles, or discoloration shall be recorded, and illustrated with pictures. In case of strong curling effect of the PET flakes, not allowing labels to be removed, tests should be repeated with another PET bottle.

- For both control and innovation flakes, about 5 mL of the washing solution should be collected at the end of the agitation using a pipet or a syringe without needle. This solution should be transferred within a glass vial. Take a picture of the solution in the vial after shaking it and after 1 day at rest.

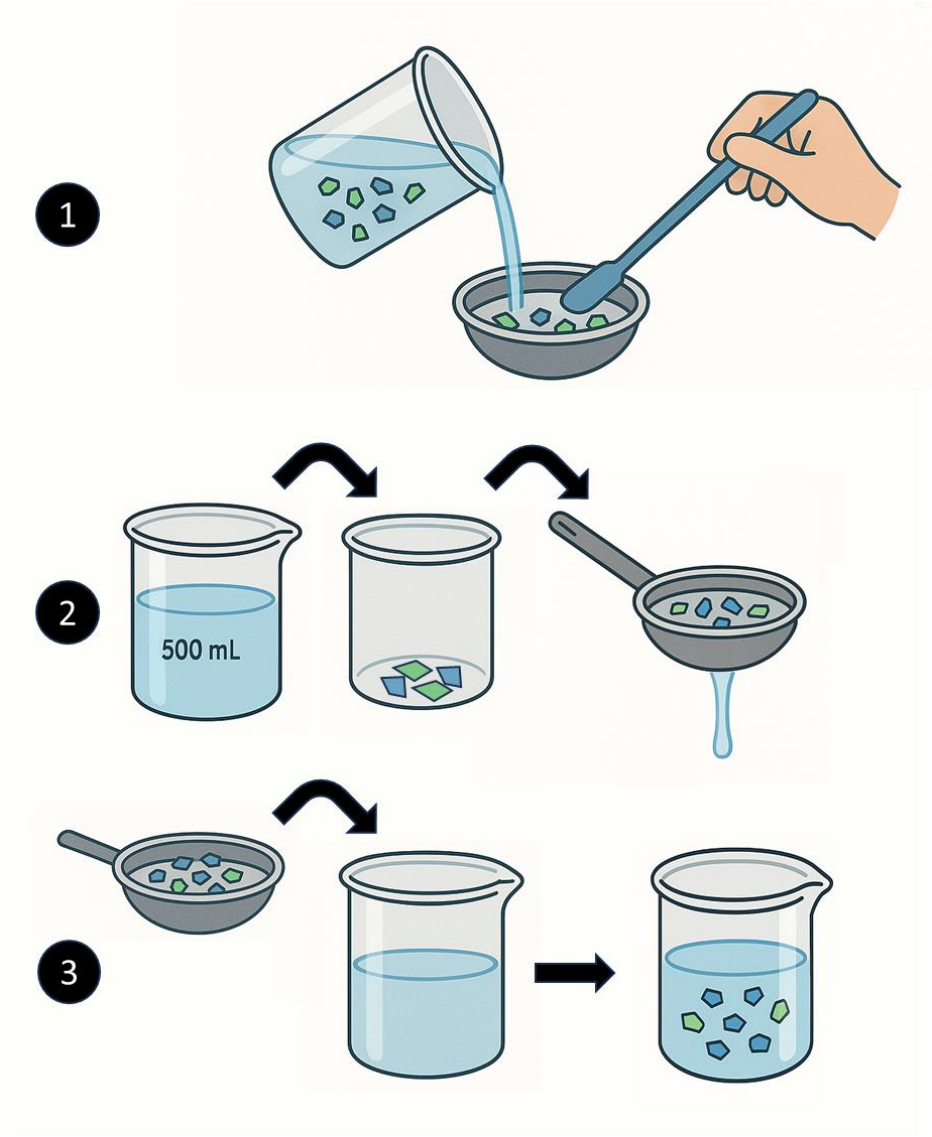
- In the case of discolouration of the washing water, a bleeding ink quick test is recommended to be performed. Take pictures of the washing solutions used for innovation and control flakes side by side. Note that an increase of turbidity can be the sign of dispersed adhesive in the water solution.

- Collect the floating and sinking fractions together by pouring the solution on a strainer (see figure 4). Use about 500 mL of distilled water and a suitable tool to collect any remaining flakes at the bottom of the beaker or on the stirrer. No flakes must be lost in the transfer process. Flakes should then be immediately transferred in the solution prepared for density separation to avoid deposit of adhesive back on PET flakes (step 4).

- Use a Whatman, grade 1 filter to collect any particle present by filtering the recovered washing solution. Take a picture of the filter for both control and innovation samples after filtration.

- About 5 mL of the solution should be collected after filtration using a pipet or a syringe without needle. This solution should be transferred within a glass vial. Take a picture of the solution in the vial after shaking it and after 1 day at rest.

Figure 4: Illustration of the recovery of the flakes after hot washing



6.2.2 STEP 4: DENSITY SEPARATION

Since no density separation is expected for the control sample, only innovation sample should be going through the density separation step.

Procedure density separation:

- Prepare the beakers (800 mL) for a 1:8 ratio (100 flakes vs 80 mL distilled water) at room temperature with distilled water.

- Gently stir the solution manually for about a minute, and let the solution settle for 5 minutes. Ensure that no flakes or labels remain on the element used to stir, and that no flakes are lost in the process.

- After the settling process, take pictures of the beakers containing the flakes/labels.

- Carefully collect the floating fraction, and place it on filter paper to partially dry it. Then, transfer the floating fraction within a crystallizer.

- If some labels remain within the sinking fraction, gently stir manually the sinking fraction for 10 seconds and let the solution settle for 2 minutes. Ensure that no flakes or labels remain on the element used to stir, and that no flakes are lost in the process.

- After repeating the settling process, take pictures of the beakers containing the flakes/labels.

- Carefully collect the floating fraction, and place it on filter paper to partially dry it. Then, add it to the floating fraction recovered in previous steps.

- Repeat the 3 previous steps a maximum of 2 times to recover any trapped label under PET flakes.

- Collect the sinking fraction by filtration on a ceramic funnel connected to a vacuum pump. Place the collected flakes on filter paper for gross removal of water. Then, transfer the sinking fraction within a crystallizer.

- Dry both fractions separately in an oven at 85 °C for 2 hours. Then, let the flakes come back to room temperature for 24h at standard lab room conditions (20-25°C and 30-50% relative humidity).

- In the case of the oven test (section 6.3.1.) shows flakes with presence of degraded adhesive (class 3) or with entire surface showing discoloration/degradation, perform the stickiness evaluation after drying for the floating fraction according to the procedure reported in section 6.3.2.

- Record the total weight of the floating fraction as “Df”. Take photos of the fraction.

- If any labels are trapped within the sinking fraction, or if some labels are only partially removed, take picture of the corresponding flakes. Then, carefully try to separate these labels from the PET flakes. Do not force if the label cannot be separated from the PET flake.

- Record the total weight of labels that could be separated from the sinking fraction as “Ds”. Take photos of the fraction. This fraction can then be added to the floating fraction.

- PET flakes that were easily separated from the remaining labels in the sinking fraction can be added to the clean PET flake sinking fraction.

- Keep separated the 3 following fractions: 1) PET flakes with non-separable label, 2) Labels that could be easily removed or were already removed from the PET flakes in the sinking fraction, 3) Clean PET flakes from the sinking fraction, or that were easily separated from labels trapped in the sinking fraction.

- Record the total weight of the PET flakes with non-separable label from the sinking fraction as “X”. Take photos of the fraction.

- Record the total weight of the clean PET flakes from the sinking fraction, as “E”. Take photos of the fraction.

- Determine the weight of the corrected floating fraction, reported as “D”, as following: D = Df + Ds.

6.3 CHARACTERISATIONS

6.3.1 STEP 6: OVEN TEST

An oven test will need to be performed for the remaining clean PET flakes sinking fraction (both for control and innovation) to see any potential discoloration of the PET flakes and presence of remaining adhesives.

Procedure:

- Preheat the oven at 220 °C.

- Take about 10 grams of the control material, and the clean PET flake sinking fraction from the innovation sample and put them on two different crystallisers. Spread the fractions evenly in the crystallisers avoiding superpositions of flakes.

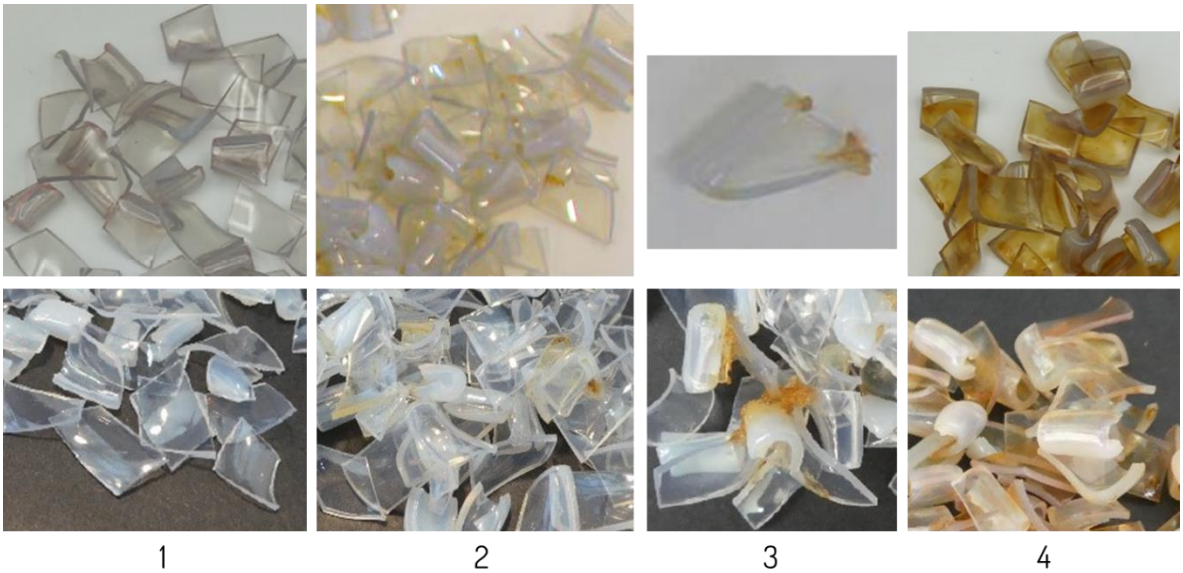
- Place the samples in the oven at 220 °C for 1 hour.

- Let the samples cool down at room temperature.

- By transferring each fraction on a white surface, evaluate flakes for any discolouration, black specks, stickiness, curling behavior.

- Flakes should be categorised into the following groups to quantify any degradation that happened during the oven test: 1) Clean flakes with no sign of degradation, 2) Flakes with sign of degradation on edges, 3) Flakes with presence of degraded adhesive, 4) Flakes with entire surface showing discoloration/degradation (see Figure 5).

Figure 5: Categories of flakes after oven test



- Weight each fractions for innovation and control samples and report the weight in the Annex 5 table.

- Document the innovation and control flakes with photographs on a white and black background. For both control and innovation flakes separately, photographs should show the different category of flakes separately after the oven test.

6.3.2 STEP 5: STICKINESS CHARACTERISATION

In the case of oven test results showing PET flakes in categories 3 or 4, the stickiness of label flakes after washing must be evaluated to identify any remaining traces of adhesives, or any re-activation of the adhesive after drying. Results generated with this test will only be used for informative purposes. The following procedure must be followed for such evaluations:

Stickiness characterization procedure:

- Spread flakes with clean tweezers on a clean surface, and avoid superposition of flakes.

- Attach a clean PET flake with strong adhesive tape to the part of the metal weight that will be in contact with PET flakes to be tested, in order to test PET-label contact instead of metal-PET.

- Place the 150 g metal weight on the surface of ten randomly chose different label flakes for 5 seconds each, without applying additional pressure. Make sure that the entire surface of the flake is in contact with the PET attached to the weight. The label flakes must be flattened for this evaluation. This test must be done on both sides of 10 label flakes.

- The PET flake attached to the weight shall be cleaned with a slight amount of acetone after testing each flake. For each test, the PET flake attached to the metal weight should be dry and free of any adhesive or acetone residual.

- When lifting the metal weight, if the label flake does not remain attached to the weight, this is considered as a positive result. On the opposite, if the label flake remains attached to the weight, this is considered as a negative result.

- Report the amount of negative results on top of the 10 flakes (vice-versa) tested, and fill the Annex 4 with the result.

7. MASS BALANCE & RESULTS INTERPRETATION

7.1 MASS BALANCE

7.1.1 RECOVERY & DISSOLVED ADHESIVE RATIO CALCULATIONS

Additional ratios and efficiencies shall be calculated based on the weight measured during the testing. The following calculations presented in Table 2 shall be followed for the innovation material.

Table 2: Calculation of recovery & dissolved adhesive ratios.

PARAMETER	REFERENCE	DESCRIPTION	CALCULATION
Non-recovered label and adhesive (g)	**α**	Amount of label and adhesive not recovered in the floating fraction	**α** = C - D
Adhesive detached from label facestock (%)	**β**	Proportion of adhesive removed from the label facestock after hot washing and separation by density	**β** = (C-D-X*C/B2)/(C- Nb*$m_{Facestock}$) $m_{Facestock}$ calculated in section 5.2.
Label/PET separation efficiency (%)	**γ**	Efficiency of separation of the label from the PET flakes, based on the non-separated fraction X	**γ** = (1 – (X/B2))*100

PET flakes loss (%)	**δ**	Amount of PET material loss in the testing process (non-sinking, fines removed by the washing process, …)	**δ** = ((A-E-X*C/B2)/A)*100

7.2 RESULTS INTERPRETATION

All results coming from the mass balance approach as well as the different characterisations must be reported in the Annex 3.

Ideally, E should be equal to A, D equal to C, and X equal to 0, which would mean that PET and labels were perfectly separated with all adhesive remaining on the label facestock. Nevertheless, due to moisture uptake, loss of fines, measurements error, some small deviations can be observed.

As success criteria for this recyclability evaluation, the following conditions shall be met:

Table 3: Success criteria for labels & adhesives evaluation on PET bottles

PARAMETER	LIMITED COMPATIBILITY	FULL COMPATIBILITY
Label/PET separation efficiency (%) - **γ**	**γ ≥ 95 %**	**γ ≥ 99 %**
PET flakes loss (%) - **δ**	**δ < 2 %**	
Adhesive detached from label facestock (%) - **β**	**β < 50 %**	**β < 50 %**
Flakes discoloration after oven test	≥ 90 % of the flakes as category 1 No flakes classified within category 3 & 4	≥ 95 % of the flakes as category 1 No flakes classified within category 3 & 4
Discoloration of the washing water	No discoloration of the waste water No presence of fibre loss	No discoloration of the waste water No presence of fibre loss

Note that all the parameters will be considered by the RecyClass PET Technical Committee to assess the recyclability of the solution tested.

8. REPORT CONTENT

The report should contain the following information:

- Reference to the Procedure and its version: *REP-PETbot-02 – v. 2.0*

- A full and complete identification of the material tested, including:

    - **Label**: size, structure, and density.
    - **Adhesive**: amount per surface unit and technology (wet labelling adhesive, pressure sensitive adhesive, or non-pressure sensitive hotmelt).

- Description and photographs of the testing equipment.

- Description of the samples during each step (especially on colour changes, haze, deposits, sinking or non-detached label fragments, residual stickiness, …).

- The photographs indicated in the test procedure. Additional photographs are welcome whenever useful for documenting specific situations.

- Details of any deviation from the test method, as well as any incident which may have influenced the results.

- Summary tables present in Annex 3, Annex 4 and Annex 5, filled with results.

- Date and place of the test.

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DOCUMENT VERSION HISTORY

VERSION	PUBLICATION DATE	REVISION NOTES
1.0	January 2024	RecyClass Recyclability Evaluation Protocol for Labels & Adhesives Applied on PET Bottles release
2.0	December 2025	Corrections of typos & addition of images Different procedures for Wrap around labels and PSL Clarification on stirrer pales and surfactants to be used Amendment of flake:water ratio and recovery procedures Modification of success criteria Update of annexes

ANNEX 1 – ALLOWED STIRRER PALE GEOMETRY

Table 4: Acceptable stirrer pales geometry

GEOMETRY TYPE	PICTURE	STIRRER DIMENSIONS
Cross shaped paddle with four 45° angled angular blades (ref: https://www.bola.de/en/Propeller-Stirrer-Shafts-with-4-Blades-BOLA)		L = 40 - 50 mm H = 18 - 20 mm

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ANNEX 2 – RECOMMENDED PET BOTTLES

RecyClass strongly recommend using bottles that will not suffer from an intense curling effect during the hot washing step, to avoid labels remaining trapped within curled PET flakes. Because curling is dependent on the bottle format, geometry but also from the production process, **RecyClass recommends to always test a virgin bottle before to prepare the innovation samples.**

In general, RecyClass is recommending the following references:

- Amcor – MH-4256
- Amcor – MH-4036
- Berlin Packaging – Marasca PET bottles 500 mL 31.5 ROPP
- Berlin Packaging – Dorica PET bottles 500 mL 31.5 ROPP

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ANNEX 3 – SUMMARY TABLE

Table 5: Flake characterisation before and after washing.

VARIABLE0	VALUE	REFERENCE IN THE PROCEDURE
Total weight of the panels	X,xxxx ± 0.xx g	A = A1 – (A2 – B/Nb)
Innovation sample weight	X,xxxx g	B
Total weight of labels and adhesives	X,xxxx g	C = B - A
Weight of the floating fraction	X,xxxx g	Df
Weight of the removable labels from the sinking fraction	X,xxxx g	Ds
Corrected weight of the floating fraction	X,xxxx g	D = Df + Ds
Weight of the PET flakes in the sinking fraction	X,xxxx g	E
Weight of the non-separable labels/PET fraction	X,xxxx g	X
Non-recovered label and adhesive (g)	X,xxxx g	α = C – D
Adhesive detached from label facestock (%)	X,xx %	β = (C-D-X*C/B2)/(C- Nb*mFacestock)
Label/PET separation efficiency (%)	X,xx %	γ = (1 – (X/B))*100
PET flakes loss (%)	X,xx %	δ = ((A - E-X*C/B2)/A)*100

ANNEX 4 – STICKINESS RESULTS

Table 6: Stickiness characterisation summary table

VARIABLE	NUMBER OF NEGATIVE RESULTS	LEVEL OF REACTIVATION*
Stickiness level of floating fraction after drying	0 to 20	No reactivation/Light reactivation/Strong reactivation

* If 0 negative results: No reactivation; if 1 to 4 negative results: Light reactivation; if more than 4 negative results: Strong reactivation.

ANNEX 5 – COLOR MEASUREMENTS RESULTS

Table 7: Flake characterisation after oven test: Summary table

CATEGORIES	Control After Oven		Innovation After Oven	
	Fraction weight	wt%	Fraction weight	wt%
1) Clean flakes with no sign of degradation				
2) Flakes with sign of degradation on edges				
3) Flakes with presence of degraded adhesive				
4) Flakes with entire surface showing discoloration/degradation				
TOTAL				

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