RecyClass

FLOTATION QUICK TEST PROCEDURE

FOR ATTACHMENTS ON PS CONTAINERS

STANDARD LABORATORY PRACTICE

VERSION 1.0

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RecyClass

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DISCLAIMER

"RecyClass is an initiative aiming at enhancing and evaluating the recyclability of plastic packaging through a technical perspective. The Plastics Recyclability Evaluation Protocols and Quick Test Procedures will promote recyclability by encouraging industry to test new plastic technologies, materials or product before market launch and giving advice and recommendations to the companies.

The Recyclability Evaluation Protocols and Quick Test Procedures are available for download in the RecyClass website. Companies providing plastic packaging concepts are encouraged to use them to self-assess the impact of their solutions on recyclability and highlight potential issues. **However, compliance to a Recyclability Evaluation Protocol is not a replacement for an official assessment and may not be used as a marketing tool.**

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

The Quick Test Procedures can be either performed internally for R&D purposes or performed by external bodies such as independent laboratories or certification bodies to assess the results.

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

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1. INTRODUCTION AND PURPOSE OF THE PROCEDURE

The "Flotation Quick Test Procedure for attachments on PS Containers" referred to in this document as "The Procedure" describes the methodology that may be followed by the Applicant at a laboratory scale in order to determine if non-PS attachments combined to PS packaging are separable by the post-consumer PS recycling stream.

The Procedure aims to evaluate the separability behaviour of closure systems, lids, valves, decorative technologies, or any other non-PS components attached to PS containers during the flotation process by performing a quick test at lab scale. The results of the quick test may not be considered as a formal approval by RecyClass. For a complete assessment, further tests are required to highlight all possible effects of non-PS components on the recyclability[1]. The Recyclability Evaluation Protocols of RecyClass prevail over the other side-procedures, as the following flotation procedure. Please contact RecyClass for more information on protocols for complete assessment[2].

In case the non-PS component tested with the Procedure does not meet the requested assessment criteria, the combination can be submitted to the Recyclability Evaluation Protocols of RecyClass to demonstrate that, even though not separable, the combination does not negatively affect PS recyclability in terms of process and recyclate quality.

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

1 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] Recyclability Evaluation Protocols & Quick Test Procedures: https://recyclass.eu/recyclability/test-methods/

2. SCOPE OF THE PROCEDURE

The scope of the Procedure covers any materials related to closure systems, lids, valves, decorative technologies, or any other non-PS components introduced to the existing PS packaging solutions. Prior to initiating the evaluation, the Applicant is required to review the Design for Recycling Guideline for PS containers[3] in order to confirm that the material is compatible with these requirements.

The following materials are covered by the scope of this Procedure:

1. LLDPE, LDPE, MDPE, HDPE
2. PP
3. TPE
4. EVA
5. Paper, cardboard
6. Foams
7. PET, PETG, PLA
8. Aluminium lidding

The procedure provides guidance on the separability behaviour of the non-PS components during the PS recycling process. Non-PS components should be separable after grinding by density from the PS packaging during the flotation step. Welded non-PS components to PS packaging should be avoided as not separable by the recycling process. **Washability of adhesives used on labels or any other attachments must be tested additionally according to the washing QT procedure to evaluate the potential issue coming from the adhesive.**

3. LAB EQUIPMENT

- Accurate cutting device (scissors, blade, scalpel)
- Round beaker of 600 mL (diameter: height ratio of 1, wide form, 9 cm diameter)
- Paddle stirrer (30 mm x 15 mm and 2 rectangular paddles). *See picture.*
- Overhead stirrer with freely selectable rotation speed
- Dish detergent
- Sodium chloride (or other similar salt)
- Analytical balance with an accuracy of 0,0001 g
- Strainer (mesh size of 0,5 x 0,5 mm)

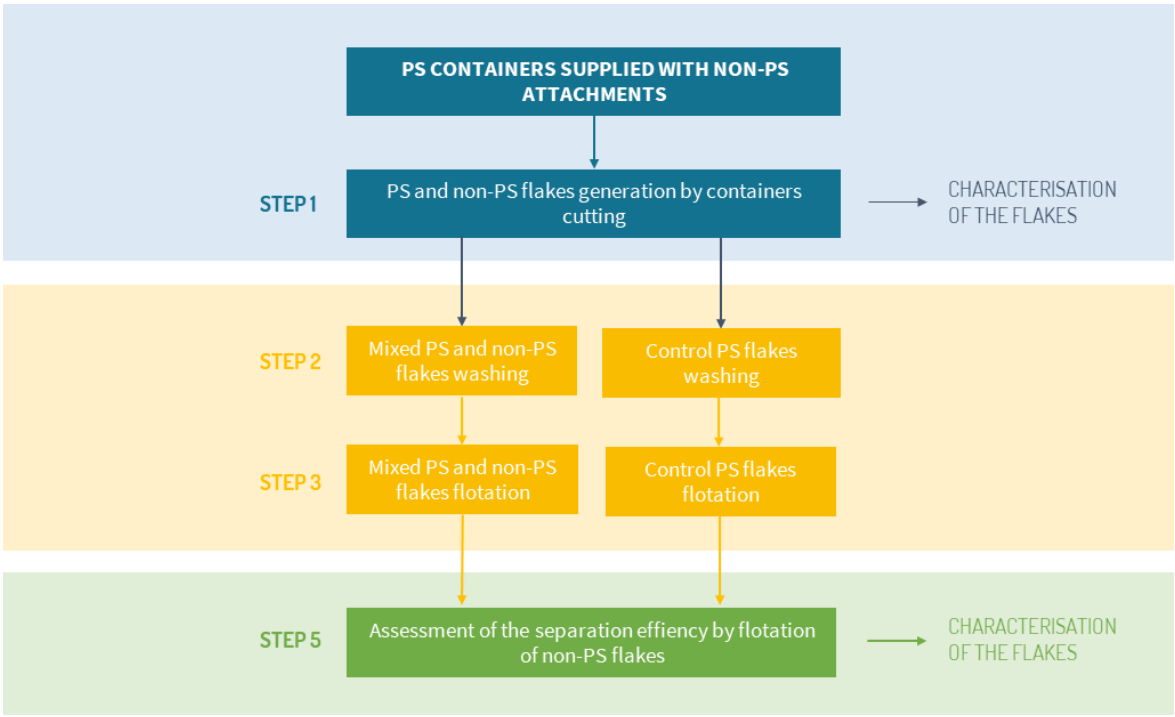
3 Design for Recycling Guidelines https://recyclass.eu/recyclass/design-for-recycling-guidelines/

4. LABORATORY TEST METHODOLOGY

This methodology aims to reproduce the flotation step of the recycling process at a small scale to determine the separability of non-PS components in the PS recycling stream. The methodology described below shall be followed precisely and any modifications or problems must be noted during the testing phase. A Laboratory Evaluation Report compiling all the results obtained shall be prepared. Any remarks during following the Procedure shall be also noted down.

See below in Figure 1 a diagram where the flow of the methodology is described.

Figure1: Methodology Diagram



4.1 SAMPLES SELECTION

The control container for use following the Procedure must be the same (or similar) PS container without any non-PS attachments. For the purpose of the tests, the Applicant should provide at least 500g of containers containing non-PS attachments and 500g of control containers. If feasible, the PS control flakes may also be generated from the container with the attachments. In this case, a larger amount of containers may be needed to obtain a sufficient amount of control material.

4.2 PROCEDURE

4.2.1 STEP 1: CONTAINERS CUTTING & FLAKES CHARACTERIZATION

The first step consists in generating PS flakes from the containers. Both control and printed flakes must be cut.

Procedure:

- Cut out with scissors PS and non-PS parts of the containers. Avoid generating fines. Flakes should be shaped approximately as squares with an edge length between 10-12mm. Proportion of PS and non-PS flakes must be representative of the containers' composition. These flakes will constitute the mixed sample.

- Cut out with scissors PS part of the containers. Avoid generating fines. Flake should be approximately as squares with an edge length between 10-12mm. These flakes will constitute the control sample.

- A minimum of 50 flakes for each mixed and control samples must be generated. Mixed flakes must be cut in different locations of the container and cut from different containers. Record the total weight of the mixed flakes as "A_M" and the weight of control flakes as "A_C".

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

- Count and record as "B_{PS}" the number of PS flakes within the mixed fraction; as "$B_{NON\text{-}PS}$" the number of non-PS flakes within the mixed fraction; and as "B_C" the number of control flakes.

4.2.2 STEP 2: WASHING

At the state of the art, European PS recycling lines typically use cold washing conditions, no detergents nor strong chemicals. The following procedure must be applied to both control and mixed flakes, separately.

Procedure:

- Prepare the washing solution, that is tap water, in a beaker (50 flakes in 200 mL water in a 600 mL beaker). Determine the current pH-value of the water. Do not add detergents or caustic soda.

- Heat the washing solution to 40 °C.

- Wash each sample separately by stirring at 1.000 rpm for 5 min with a paddle stirrer.

- Filter the wash with a strainer, collect the wash water and rinse the flakes with cold running tap water for 5 minutes under vigorous stirring with a manual stirring bar.

- Determine the pH-value of the wash water. Be aware of the correct temperature for measuring. If necessary, first cool down the wash water to room temperature (20 – 23 °C).

Observe the colour of the two wash water solutions. If any noticeable change of colour or transparency occurs, report it, and document the colour with a photograph. In order to highlight the differences, take a photograph of both solutions in the beaker alongside each other in front of a light (white) and dark (black paper) background.

4.2.3 STEP 3: FLOTATION

Following the washing, the flotation process allows flake separation by density as occurring in the float/sink tank used in an industrial recycling line. The following procedures must be applied to both control and mixed flakes, separately.

Procedure: step 1 - The targeted material (PS) shall sink, whereas all non-PS flakes (with d<1 g/cm^3) shall float.

- Prepare the flotation solution, that is tap water, in a beaker (50 flakes in 300 mL water in a 600 mL beaker). Boil the water for 10 minutes, and then cool at room temperature.

- Add a drop of dish detergent.

- Put the innovative sample in the water and stir at 500 rpm for 4 minutes.

- Stop the magnetic stirrer and allow the water to rest for 2 minutes.

- Take photo of the beaker.

- Remove all particles that float at the surface with a sieve.

- Rinse the flakes with cold running tap water for 5 minutes.

- Take photos of the floating and sinking fractions separately. Save the wash for visual evaluation.

Procedure: step 2 - The targeted material (PS) shall float, whereas all non-PS flakes (with d>1 g/cm^3) shall sink.

- Prepare the flotation solution, that is tap water, in a beaker (50 flakes in 300 mL water in a 600 mL beaker). Boil the water for 10 minutes, and then cool at room temperature.

- Add a drop of dish detergent and add 12% of sodium chloride to the water solution (or any other salt) to increase the water density up to 1.08 g/cm^3.

- Put the sank samples from STEP 1 in the water and stir at 500 rpm for 4 minutes.

- Stop the magnetic stirrer and allow the water to rest for 2 minutes.

- Take photo of the beaker.

- Recover all particles that float at the surface with a sieve.

- Rinse the flakes with cold running tap water for 5 minutes.

- Take photos of the floating and sinking fractions separately. Save the wash for visual evaluation.

Observe the colour of the wash water solutions of both steps. If any noticeable change of colour or transparency occurs, report it, and document the colour with a photograph. In order to highlight the differences, take a photograph of both solutions in the beaker alongside each other in front of a light (white) and dark (black paper) background.

4.2.4 STEP 4: FLAKES SEPARATION & ASSESSMENT

As validation of the test, an assessment on the control flakes is necessary to determine that PS flakes successfully passed the flotation step. Then, the evaluation on the separation efficiency of non-PS attachments can be performed.

Procedure (control flakes):

- Count the number of PS flakes recovered after the flotation step. Report the total number of these PS flakes as "C_C".

- Document the flakes with one or more photographs.

- Calculate the efficiency of the flotation step as follow:

$$Separation\ efficiency\ _{control} = \left(\frac{B_C - C_C}{B_C}\right) * 100$$

Validation criteria: The separation efficiency for the control flakes should be 0%, as composed only by PS flakes, in order to validate the success of the lab test.

Procedure (mixed flakes):

- Separate the PS flakes from the non-PS flakes (if not entirely separated by flotation).

- Count the number of PS flakes and non-PS flakes recovered after the flotation step. Report the total number of these PS flakes as "C_{PS}" and the total number of non-PS flakes as "$C_{NON\text{-}PS}$". Please note that "C_{PS}" should be equal to "B_{PS}" (no PS flake losses).

- Document the flakes with one or more photographs.

- Calculate the efficiency of the flotation step as follow:

$$Separation\ efficiency\ _{non-PS\ flakes} = \left(\frac{B_{NON-PS} - C_{NON-PS}}{B_{NON-PS}}\right) * 100$$

Assessment criteria: The separation efficiency for the non-PS flakes after flotation process should be 100%, to avoid any contamination of the PS recycling stream.

5. REPORT CONTENT

The report should contain the following information:

- Reference to the Procedure: *Flotation Quick Test Procedure for attachments on PS Containers – v. 1.0*

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

  - **Container**: size, PS grade, and density.
  - **Non-PS attachment(s)**: type of material(s), density, size, proportion compared to the overall container, connection type to the container, component type (e.g., closure system, lid etc.)

- Description and photographs of the set-up.

- Description of the samples during each step (especially on the flakes behaviour during the flotation step and their repartition in the beaker).

- 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. Report the pH measurements.

- Test figures. Use the table 1 below as reference.

Table 1: Washing results

VARIABLE	VALUE	REFERENCE IN THE PROCEDURE
Total weight of the mixed flakes after cutting	X,xxg	A_M
Total weight of the control flakes after cutting	X,xxg	A_C
Total number of PS flakes within mixed fraction after cutting	XX	B_{PS}
Total number of non-PS flakes within mixed fraction after cutting	XX	B_{NON-PS}
Total number of control flakes after cutting	XX	B_C
Total number of control flakes after flotation	XX	C_C
Total number of PS flakes within mixed fraction after flotation	XX	C_{PS}
Total number of non-PS flakes within mixed fraction after flotation	XX	C_{NON-PS}
Separation efficiency of PS flakes (control)	XX%	
Separation efficiency of non-PS flakes	XX%	

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