

RecyClass



Science behind Recyclability

Adhesives for packaging labels

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Annika Pommeres, Recycling Product Compliance Manager, Veolia

Meet our speakers



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Plastics Recyclers Europe

Sara Bergendorff, Head of Sustainability and Quality
Returpack AB

Annika Pommeres, Recycling Product Compliance Manager
Veolia

RecyClass

RecyClass

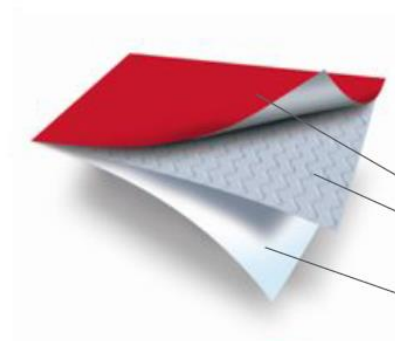
The background features two large, light teal line-art graphics. On the left is a hexagonal molecular structure, possibly representing a polymer or a specific chemical ring. On the right is a laboratory flask, partially filled with a wavy line representing liquid. These graphics are positioned behind the main text.

Labels and adhesives on HDPE containers

Augusto Bruno, Technical Manager, Plastics Recyclers Europe

RecyClass | Pressure Sensitive Labels (PSL)

- Several decoration technologies are available in the market for HDPE containers: one of the most used are Pressure Sensitive Labels.
- Around 30 to 40 % of all rigid plastic packaging use a PSL
- What is a PSL?



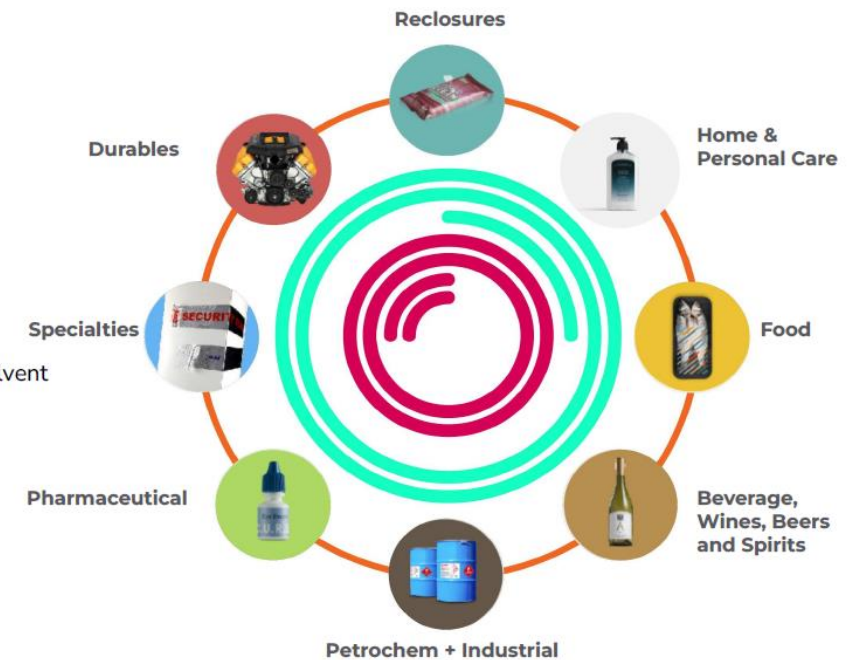
Topcoat

Face stock: Paper, Film or Foil

Adhesive: Emulsion, Hotmelt or Solvent

Release Coating Silicone

Release Liner: Paper or Film

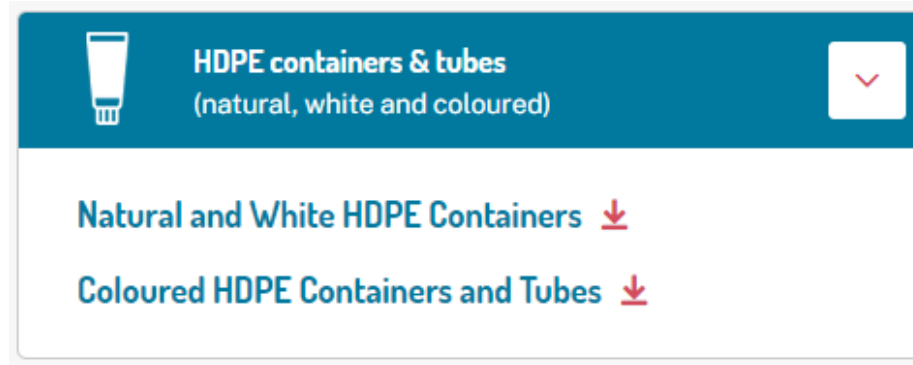


RecyClass | PSL CHEMISTRIES

Adhesive Coating Technology	Emulsion 			Hotmelt 		Solvent 			
	Acrylic			UV Acrylic	Rubber	Acrylic	Rubber	Hybrid	Silicone
Adhesive Chemical Composition	Acrylic			UV Acrylic	Rubber	Acrylic	Rubber	Hybrid	Silicone
	Acrylic			UV Acrylic	Rubber	Acrylic	Rubber	Hybrid	Silicone
Applications	Food, Beer & Beverages Home & Personal care Electronics & Appliances Pharma, Shipping labels			Wine, Spirits & Beverages Petrochemical & Industrial Tyres Pharma, Chilled & Frozen Food		Auto/Transportation Electronics & Appliances Outdoor/Power tools Petrochemicals			
									

RecyClass | LABELS AND ADHESIVES ON HDPE

RecyClass Design for Recycling Guidelines



<https://recyclclass.eu/recyclability/design-for-recycling-guidelines/>

Natural and White HDPE Containers

- ✓ Label must be removed during the recycling process.
- ✓ HDPE flakes must be free of any adhesive residues.

Coloured HDPE Containers

- ✓ The preferred option is a removable label.
- ✓ Label can stay with the container as long as the label and adhesive are compatible with recycling.



RecyClass | COLOURED HDPE PACKAGING



- ✓ Label and adhesive can enter the extrusion process, provided that the combination has been tested before by RecyClass.
- ✓ RecyClass has performed several tests on acrylic emulsion and hotmelt rubber chemistries (about 25 technologies tested).



- ✓ HDPE TC has concluded that acrylic emulsion and hotmelt rubbers in combination with a PO-based face stock can be considered as limited compatible with HDPE recycling.
- ✓ Full compatible section is reserved to those labels and adhesives combinations that will detach from the container, avoiding contamination of the HDPE flakes.

RecyClass | NATURAL AND WHITE HDPE

Objectives

- Maintain the value of natural and white rHDPE
- Ensure the quality and availability of white rHDPE on the market
- Avoid grey becoming the new natural/white in HDPE

Context

- Increase of the demand of recycled plastics in high quality applications by 2030 due to the PPWR proposed targets:
 - 35 % recycled plastics in packaging
 - 10 % recycled plastics in packaging other than PET (contact sensitive)

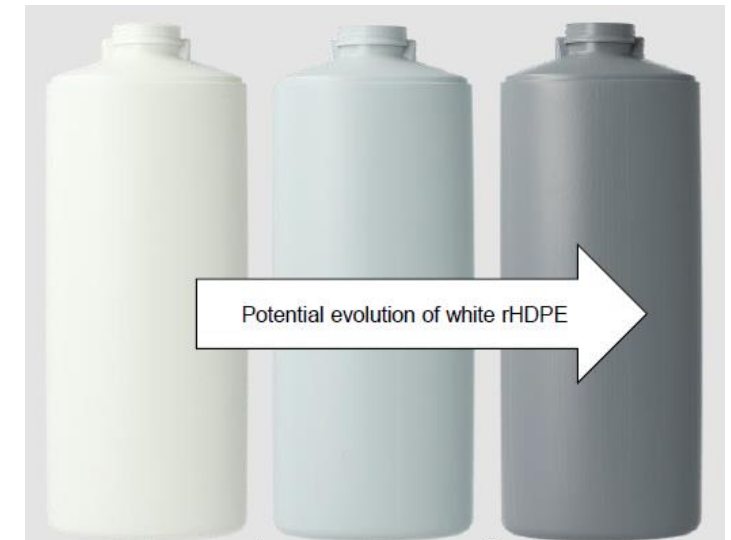


Figure courtesy of ALPLA

In order to maintain the value of natural and white rHDPE, decorations must detach from the container during the recycling process.

RecyClass | SAMPLES

SAMPLE 1



SAMPLE 2



SAMPLE 3



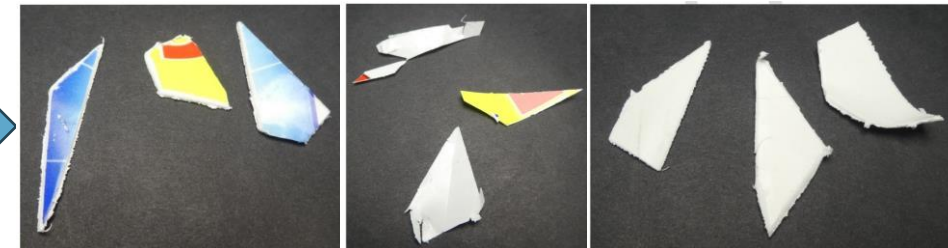
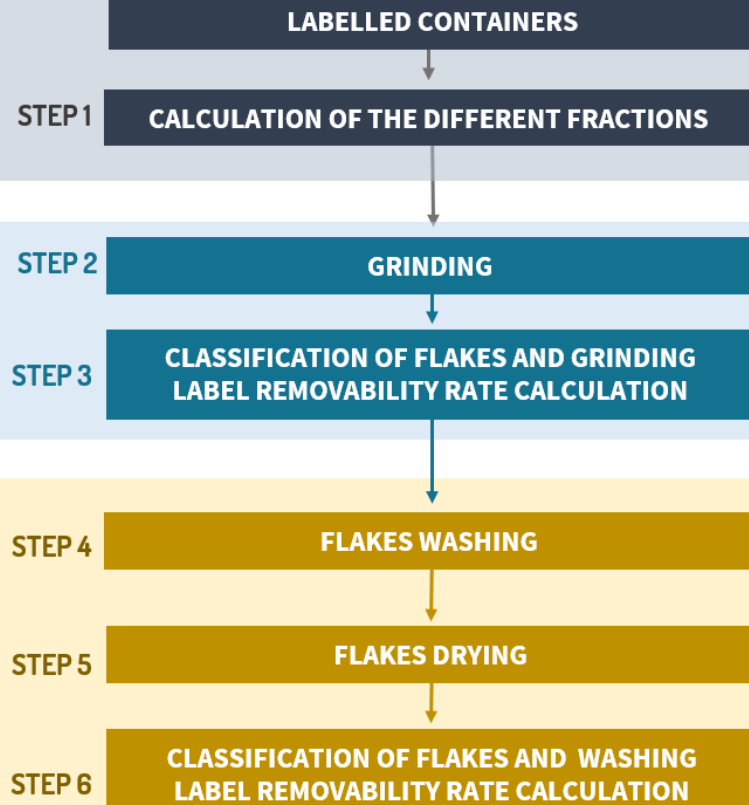
SAMPLE 4



Tests performed at
NTCP national test centre
circular plastics

Component	Sample1	Sample 2	Sample 3	Sample 4
Container	White HDPE	White HDPE	White HDPE	Natural HDPE
Adhesive	Non-tackified acrylic emulsion	Non-tackified acrylic emulsion	UV-Acrylic hotmelt	Modified acrylic emulsion
Facestock	PE White, 79 µm	PO clear, 52 µm	PE white, 120 µm	PP white, 50 µm
Weight [g]	115.8	25.5	135.9	44.4
Label coverage (wt%)	27.2	40.7	40.3	6.8
Wall thickness [mm]	1	0.65	1	0.45

RecyClass | PROCEDURES



Contaminated flakes

Clean label flakes

Clean container flakes



RecyClass | DRY GRINDING + COLD WASHING

Sample	Adhesive	Facestock	Type of grinding	Removability rate after grinding	Washing Temperature	Removability rate after washing
Sample 1	Non-tackified acrylic emulsion	PE White, 79 µm	Dry Grinding	81.1 %	40 °C	92.4 %
Sample 2	Non-tackified acrylic emulsion	PO clear, 52 µm	Dry Grinding	91.9 %	40 °C	91.5 %
Sample 3	UV-Acrylic hotmelt	PE white, 120 µm	Dry Grinding	96.8 %	40 °C	100 %
Sample 4	Modified acrylic emulsion	PP white, 50 µm	Dry Grinding	99.8 %	40 °C	100 %



RecyClass | WET GRINDING + COLD WASHING

Sample	Adhesive	Facestock	Type of grinding	Removability rate after grinding	Washing Temperature	Removability rate after washing
Sample 1	Non-tackified acrylic emulsion	PE White, 79 µm	Wet Grinding	84.5 %	40 °C	100 %
Sample 2	Non-tackified acrylic emulsion	PO clear, 52 µm	Wet Grinding	99.5 %	40 °C	99.5 %
Sample 3	UV-Acrylic hotmelt	PE white, 120 µm	Wet Grinding	100 %	40 °C	100 %
Sample 4	Modified acrylic emulsion	PP white, 50 µm	Wet Grinding	100 %	40 °C	100 %



RecyClass | CONCLUSIONS

- PSL are one of the most used decoration technologies on HDPE containers.
- In order to keep the value of natural and white rHDPE, PSL must be removed from the HDPE containers.
- The effect of friction must be considered. Current data indicates that the removal of labels due to GRINDING + WASHING can achieve more than 90 % removability rate.
- RecyClass will publish a new procedure to study the labels' removability from HDPE and PP containers in June 2024.



Impact of adhesives and labels on PET bottle recycling

Sara Bergendorff, Head of Sustainability and Quality, Returpack AB

Annika Pommeres, Recycling Product Compliance Manager, Veolia
PET Svenska AB





Introduction

Returpack operates the Swedish DRS for metal cans and plastic bottles. We collect, sort and bale the bottles.

Veolia recycles PET bottles, the clear bottles into food grade rPET.

In 2023, Returpack collected 25,900 tonnes of PET-bottles, representing a collection rate at 86,2%.

Design for recycling

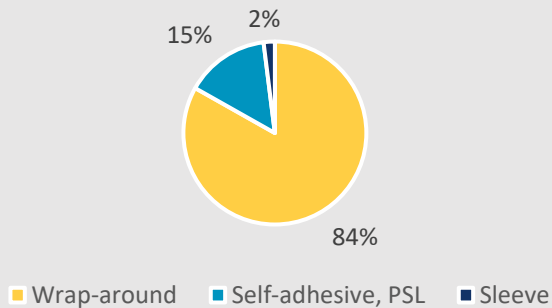
Circularity and high-quality recycling, from bottle-to-bottle, starts with the design of the packaging.

All bottles connected to our DRS must fulfil Returpack's design requirements.

In 2016-2017 we saw an increased in the use of PSLs by Swedish brand owners and all of them were not recyclable.

Today, the most widely used labels on the Swedish market are wrap-arounds, followed by PSLs and sleeves.

Labels on recycled bottles



RETURPACK



Requirement:

The adhesive shall be washable or soluble in 65°C water containing an 1% alkali solution.

The adhesive shall not be reactivated at lower temperatures.

No adhesive or label residue shall be left on the plastic after washing, and any loose pieces of label shall not be sticky.

Requirements for adhesives

The requirements for adhesives were updated in 2018 to improve recycling in Veolia's process and enhance material quality.

Our producers were given 2+1 years to fulfil the updated requirements, which entered into force in February 2021.

All connected bottles are evaluated using a test method that simulates the recycling process.

Conditions such as the amount of adhesive applied, the surface of the bottle, the label material, etc. all affect the performance of the adhesive in the recycling process.

It is a challenge to measure reactivation.

Impact of adhesives and labels on PET bottle recycling

Annika Pommeres
Recycling Product Compliance

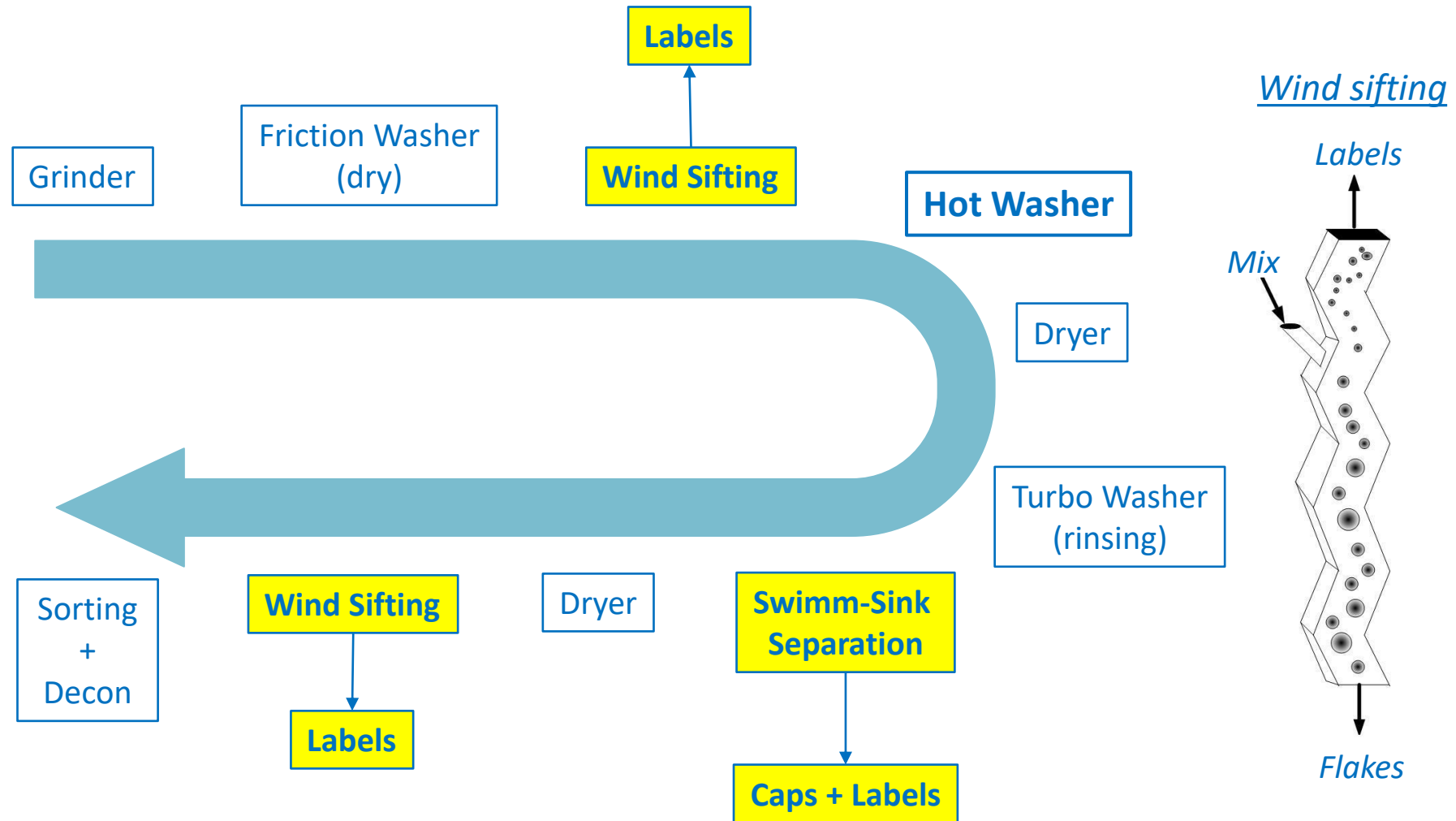
Veolia PET Svenska AB

Labels and adhesives on PET bottles:

- Behaviour in recycling process:
 - flake washing and label separation
- Influence on material quality
- Evaluation of wash-off performance at Veolia



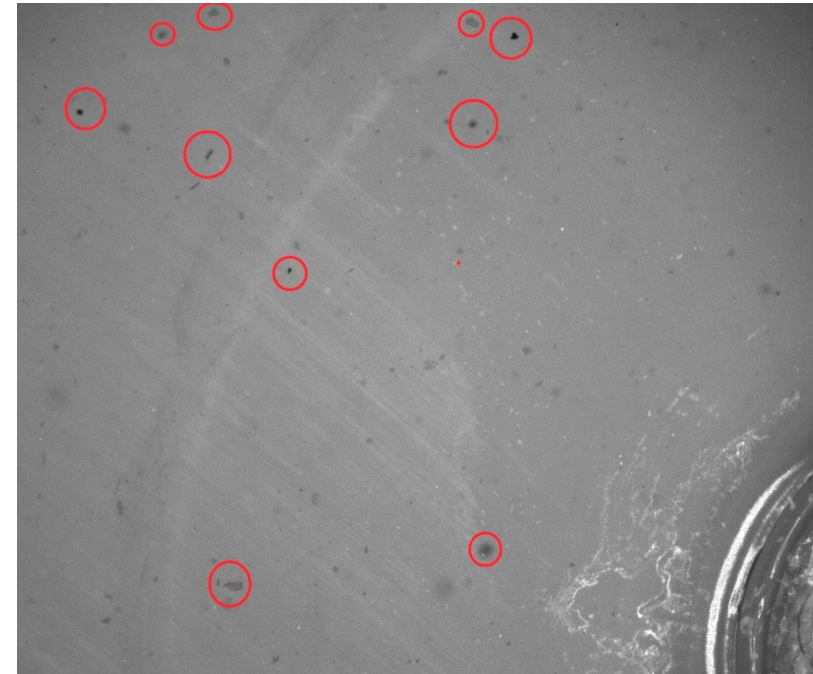
Recycling Process - Flake washing



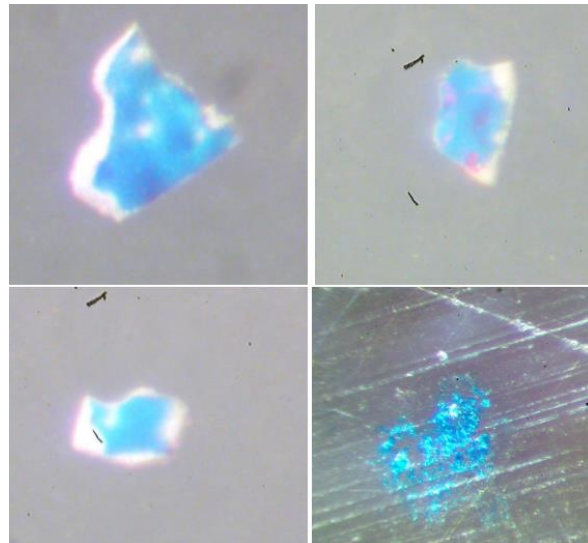
Incomplete wash-off



Glue residues on flakes

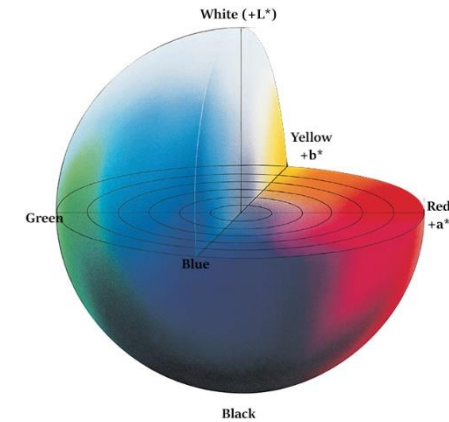
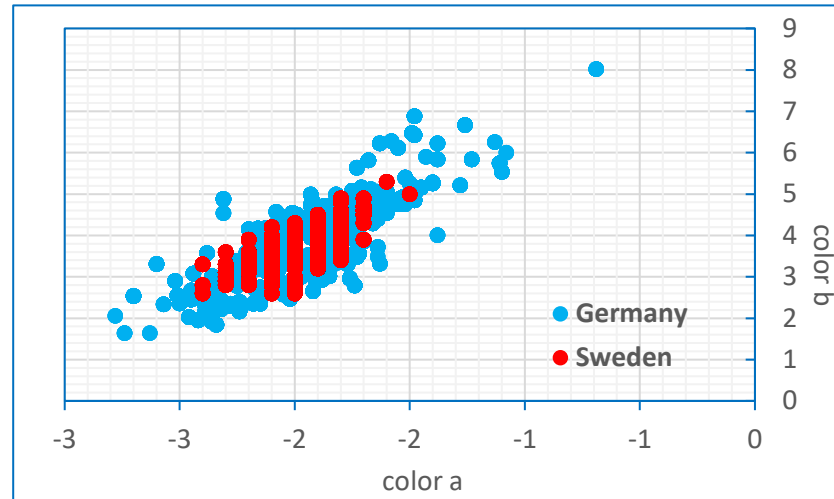


Particle contamination

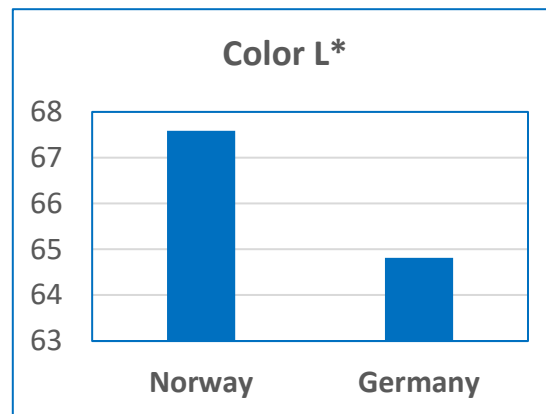


Metalized label fragments

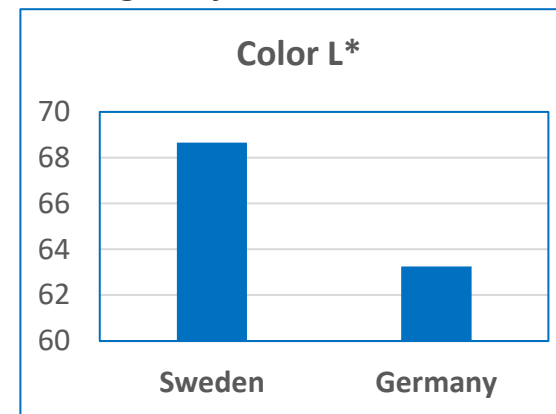
Material Quality – color properties



Food-grade pellets

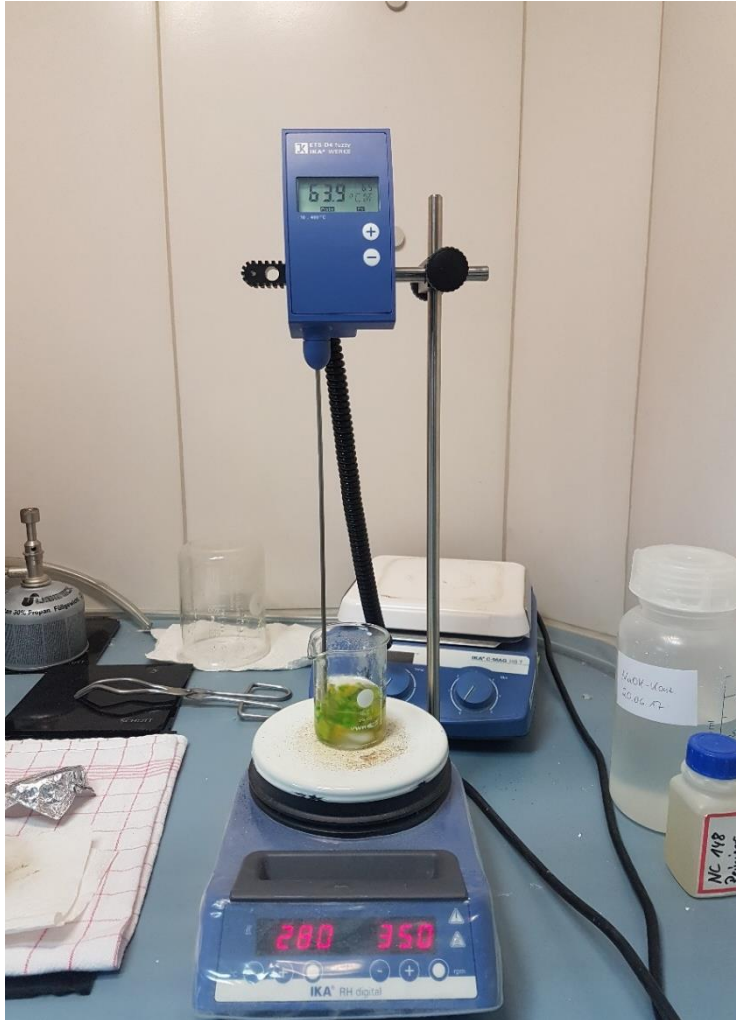


Food-grade flakes



Color L*
100 = white
0 = black

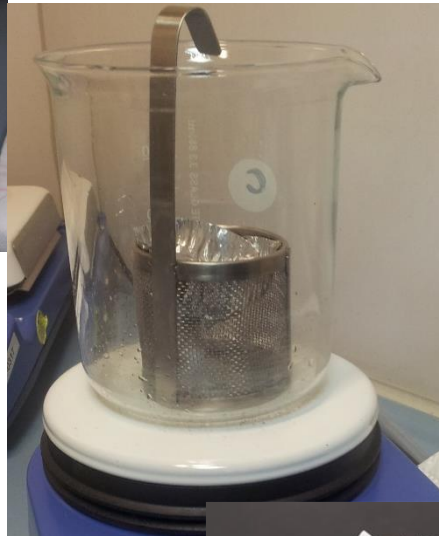
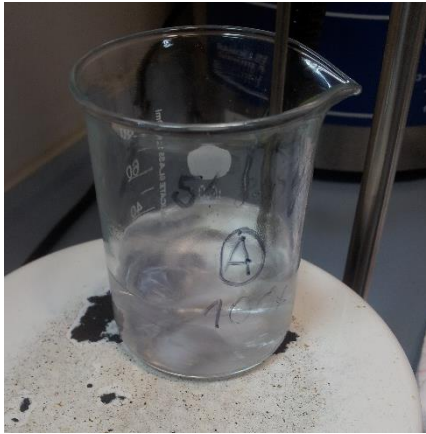
Label Test Procedure



Simulated hot wash-off in micro scale
(new applied labels will be aged for 3 weeks before testing)

Temperature	65 °C
Time	13 min
Flake size	1 x 1 cm
Total water volume	40 mL
Beaker size	80 mL
Number of flakes	100
Stirrer type/size	Magnetic, 2.5 cm, 350 rpm
NaOH concentration	1 %
Detergent concentration	0.5 % (<i>non-ionic tenside</i>)

Label Test Procedure



Simulated vertical friction (dryer) in micro scale

- Rinsing with 100 mL of cold distilled water
- Flakes transferred into a basket
- Two magnetic stirrer: 3.5 cm + 2.5 cm
- Basket covered with aluminium foil
- 500 rpm for 1 min

→ Formation of label agglomerates due to re-activation of glue

→ Separation by wind sifting impossible

KEY TAKEAWAYS

- In order to keep the value of rHDPE and rPET, labels must be removed from the packaging.
- For HDPE: the effect of friction must be considered. Current data indicates that the removal of labels due to GRINDING + COLD WASHING can achieve more than 90 % removability rate.
- RecyClass will publish a new testing procedure on the labels' removability for HDPE and PP containers in June 2024.
- For PET packaging, due to the food-contact target for the rPET, it is essential to have the labels fully removed independently by the color.
- For all packaging, the fate of the adhesive (remaining on labels, dispersed in the water, remaining on the bottle) is important as this will have an impact on the recycling process or the applications for the recycled material,

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The background features two large, light teal line-art graphics. On the left is a hexagonal molecular structure, possibly representing a benzene ring or a honeycomb lattice. On the right is a laboratory flask, specifically an Erlenmeyer flask, which is partially filled with a wavy line representing liquid.

Questions & Answers

Use the Q&A box in the top-right corner of your screen

RecyClass

Thank you for participating!

Sign up for the next session!

RecyClass for Beginners: Recyclability Certifications

 9 October, 15h

RecyClass.eu/events

