COORDINATOR IPC

HORIZON-CL6-2021-CIRCBIO-01 - GA NUMBER : 101059923

buddie Pack

WP5 update - May 2026

Quality and safety

📦 Deliverables

- D5.1 – Decontamination equipment and technologies (design and specifications) ✅
- D5.2 – Post use functional properties of RPP with materials database ✅
- D5.3 – Report on migration modelling, contaminants abs., barrier evaluations ✅
- D5.4 – Database of microplastic properties and relationship modelling exterior ✅
- D5.5 – Pilot line for cleaning of reusable packaging ✅

🎯 Objectives

- Development of the approach for risk assessment and management of reusable packaging after use.
- Assessment of the functional properties and safety of reusable packaging after multiple cycles of reuse/cleaning.
- Quantification of microplastic release throughout the life cycle.
- Optimisation and integration of cleaning technologies in a cleaning pilot line which will demonstrate the capacity of packaging developed in WP3 and tested in WP5 to remain functional after at least 20 cycles of reuse up to 300 cycles.

🛠️ Key Activities

- 1st design of decontamination equipment based on specifications from T1.3.
- Safety / Successful decontamination of RPP after use with the target of 100 ppm (contamination level to be achieved after washing and disinfection stages).
- Identification of mitigation measures for microplastics, particularly regarding exposure of RPP and cleaning water.
- Cleaning Pilot Line engineering and commissioning

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? Key Research Questions

· What are the factors influencing the ageing of reusable packaging over the course of different use cycles?
· Is it possible to use new technologies to detect the most dangerous substances, especially on washing lines?
· How can we safely manage the misuse and use of detergents?
- Do chemicals (IAS and NIAS) from the packaging migrate into food?

Results

Task 1

·Used packaging has been collected from each use case to characterize the organic residues and the microbiological contamination.
·Based on these results, specific cleaning and disinfection procedures have been developed and tested by visual inspection and against microbial contamination by microbiological analysis for each use-case.
·The best protocol has been selected to completely remove organic material and achieve a reduction of microbial contamination of more than 90%.

General proposed protocol:

Ausolan & Vytal UC

Product	Dose (%w/w)	Temperature (°C)	Contact time (s)
Mida Flow 127 NA	1.0	60	≥60

Dawn Meats & Uzaje UC

Product	Dose (%w/w)	Temperature (°C)	Contact Time (s)
Mida Flow 127 NA	1.0	60	≥60
Mida San 329 EA	1.0	60	≥120

Accurate speed data is essential to ensure minimum contact times are achieved

Task 2

Aging tests based on environment : Thermal / Immersed (H2O) / Chemically Immersed (1%v detergent in H2O)
It aims to evaluate the evolution of raw materials in different aging environment that can be encountered during its usage.
Those evolutions will be compared to some materials aged by LNE in order to explain some of the degradation that could be seen.

Aging test: accelerated and worst-case conditions
· Simulant: Oil + Sudan III at 0.1 g/L (for DawnMeat) and 0.5 g/L (for others)

Use-case	Materials	Contact with simulant (Oil + Sudan III)	Washing	Drying
Dawn Meat 20 cycles	PETg (tray)	3.02 h @ 65 °C at 0.1 g/L	Laboratory protocol (45 min up to 50 °C) including pre-wash (cold), wash (50°C), rinse (cold) and final rinse (50°C) Getinge Lancer Detergent LLL (NaOH base)	10 min @ 70°C
Ausolan single and Vytal 50 cycles	PBT (Bowl)	58.8 h @ 55°C at 0.5 g/L		
	PPc (Lid: no simulant)	1.7 h @ 100°C no simulant		
Ausolan multiple 5 cycles	cPET (bowl and lid)	2h @ 175°C at 0.5 g/L		
Uzaje 20 cycles	Tritan	3.47h @ 90°C at 0.5 g/L		

Task 3

1. Migration of substances into food

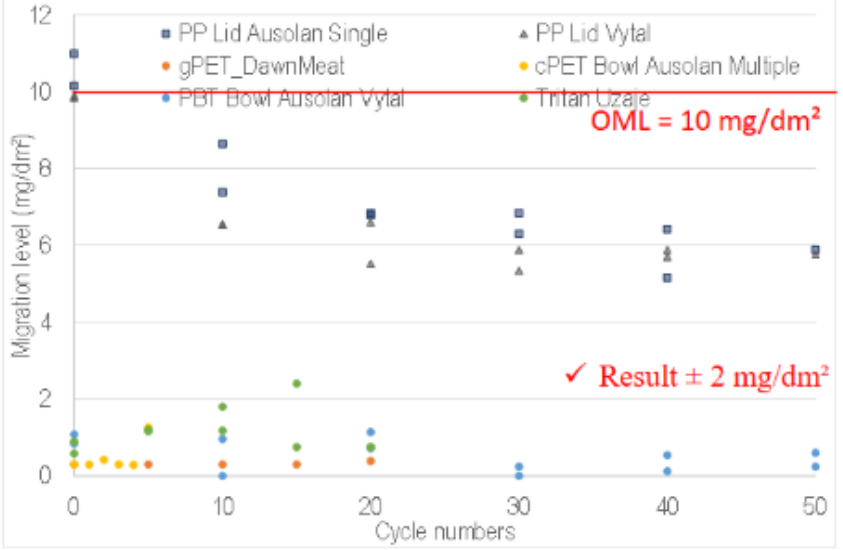
- Perform migration tests in food simulants for new and aged materials
- Compare results with European safety limits for food contact materials

✓ Results help verify that migration levels remain below regulatory thresholds.
Overall migration tests on new and aged materials / packaging
·Simulant: isooctane
·Ratio 6 dm²/ 1kg

Ex. Overall migration tests on new and aged materials / packaging

- Simulant: isooctane
- Ratio 6 dm²/ 1kg

Use-cases	Materials	Test conditions
Dawn Meat 20 cycles	PETg (tray)	24h @ 20°C (equivalent to OM1)
Ausolan single and Vytal 50 cycles	PBT (Bowl) PPc (Lid)	2h @ 60°C (equivalent to OM5)
Ausolan multiple 5 cycles	cPET (bowl and lid)	4h @ 60°C (equivalent to OM7)
Uzaje 20 cycles	Tritan	2h @ 60°C (equivalent to OM5)



2. Non-Intentionally Added Substances (NIAS) analyses

Some substances are not intentionally added but may appear due to:

- Chemical reactions during manufacturing
- Material ageing
- Repeated washing cycles
- Contamination during use

To detect them, researchers use advanced analytical techniques:

- High-resolution mass spectrometry
- Chemical fingerprinting methods

✓ Identified substances are then assessed for potential health risks.

Absorption and release of contaminants
Reusable plastics can sometimes absorb chemicals from food, detergents or the environment.
The project evaluates:
How contaminants enter the material
How efficiently washing removes them
Whether they could migrate back into food

Ex. Migration modelling for determination of required residual concentrations in RPP for chemical safety
Worst-case scenarios
Molecular weights ranging from 100 to 1000 g·mol-1
Threshold determined based on the TTC approach for genotoxic substances (0.15 ppb for food application and 83 ppm for house-case products)

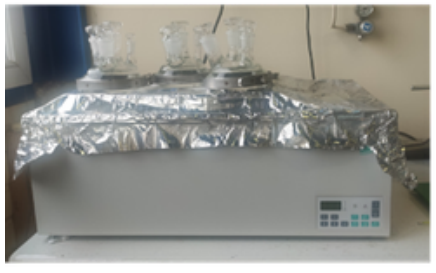
Maximum residual content (mg/kg) of substances in packaging after washing / decontamination step to be compliant with threshold (0.15 ppb) derived by TTC

substances	Vytal_tray	Vytal_lid	Ausolan$_S$_tray	Ausolan$_S$_lid	Ausolan$_M$_tray	Ausolan$_M$_lid	Dawn Meat	Asevi_bottle	Asevi_cap	Uzaje
M1	6.1E-01	1.8E-02	1.2E+00	1.1E-01	1.4E-02	1.6E+03	1.7E+02	1.2E+03	1.4E+03	2.1E+01
M2	1.0E+00	4.1E-02	4.7E+00	3.4E-01	3.1E-02	6.5E+03	7.1E+02	1.4E+03	2.5E+03	8.4E+01
M3	6.7E+00	8.7E-02	1.4E+01	9.0E-01	6.5E-02	2.0E+04	2.2E+03	2.2E+03	4.3E+03	2.6E+02
M4	1.7E+01	1.8E-01	3.8E+01	2.2E+00	1.3E-01	5.4E+04	5.8E+03	3.5E+03	7.0E+03	7.0E+02
M5	4.2E+01	3.6E-01	9.1E+01	5.1E+00	2.6E-01	1.3E+05	1.4E+04	5.4E+03	1.1E+04	1.7E+03
M6	9.2E+01	7.0E-01	2.0E+02	1.1E+01	5.1E-01	2.9E+05	3.1E+04	8.1E+03	1.6E+04	3.7E+03
M7	1.9E+02	1.4E+00	4.2E+02	2.3E+01	9.8E-01	6.0E+05	6.5E+04	1.2E+04	2.4E+04	7.8E+03
M8	3.8E+02	2.5E+00	8.4E+02	4.5E+01	1.8E+00	1.2E+06	1.3E+05	1.7E+04	3.4E+04	1.6E+04
M9	7.4E+02	4.7E+00	1.6E+03	8.6E+01	3.4E+00	2.3E+06	2.5E+05	2.3E+04	4.7E+04	3.0E+04
M10	1.4E+03	8.5E+00	3.0E+03	1.6E+02	6.1E+00	4.3E+06	4.6E+05	3.1E+04	6.5E+04	5.5E+04

> Invalidation of the initial indicator of 100 ppm residual concentration
> Case-by-case indicator for residual content

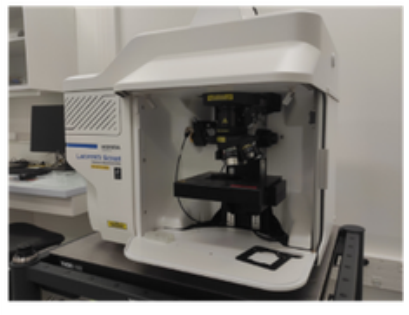
Task 4

A method has been developed and validated for the collection and detection of microplastics (≥5 µm) released during the washing of food packaging at laboratory scale, using Raman microscopy as a robust analytical technique.



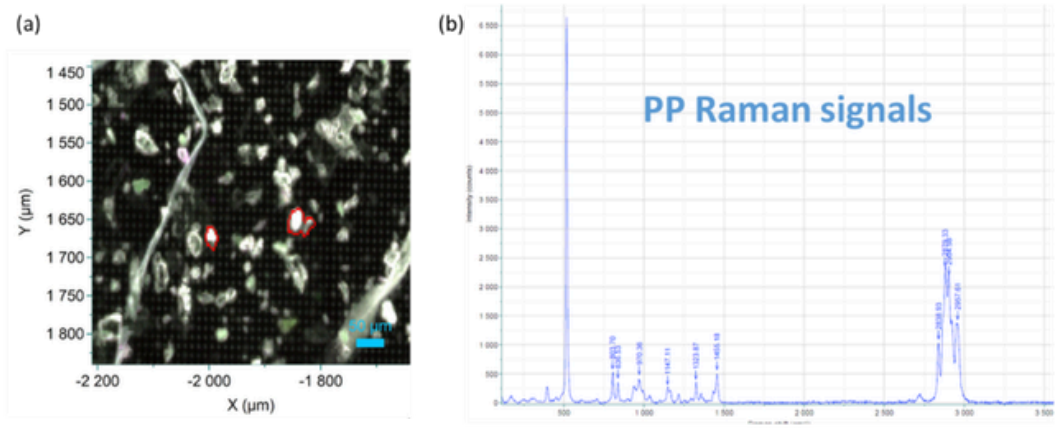
1L glass reactors containing washing water and RPP material in a shaking water-bath at 80 °C

Square silicon membrane set in the vacuum filtration unit to collect microplastics



Raman microscope used to detect and quantify microplastics

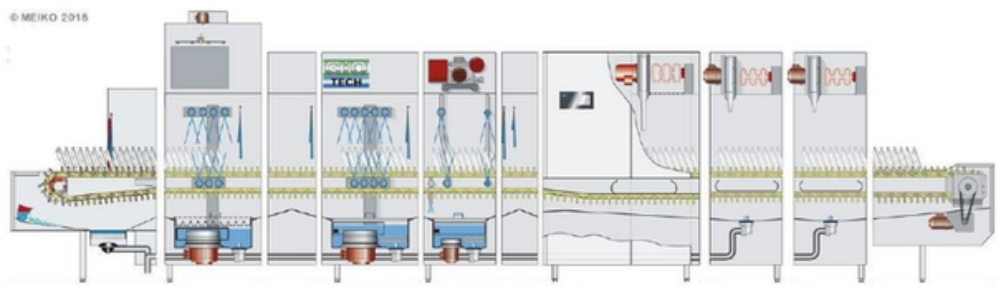
- The developed method was applied to assess the risk of microplastics released from new and aged RPP materials during washing (simulating the maximum number of use cycles), using washing conditions optimized by Christeyns in Task 1:
- PP, PBT and Tritan showed a very low release of microplastics during 50 washing cycles (for PP and PBT) and 20 cycles (for Tritan).
- PET materials (CPET and PETg) showed a higher release, which was further accentuated by ageing, during 10 washing cycles for CPET and 20 cycles for PETg.



Example of PP microplastics (in red) identified in Raman microscopy: particles were detected using microscope images (a), and the chemical nature of the material was confirmed using Raman analysis (b)

1- Pilot line set up
A complete washing pilot line was installed at the ETERNITY Systems Lisses facility to support the BUDDIE-PACK project, operating within the CPS area dedicated to washing food-contact primary packaging.

- The washing process consists of multiple stages — two pre-wash phases, two main washing phases, high-temperature pre-rinse and final rinse, neutralization, and three drying steps — all carried out under HACCP principles and in compliance with DIN 10534 hygiene requirements.

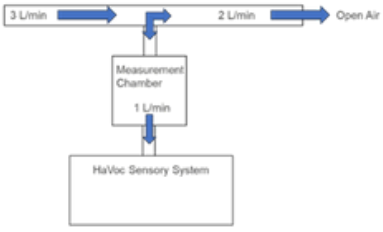


Schematic sectional view of machine

The site applies reinforced microbiological monitoring, including ATP testing, agar strip analysis, and external laboratory assessments. After washing, the packaging is transferred into a clean room for reconditioning, where controlled air quality, temperature, and humidity, combined with a unidirectional flow, prevent any risk of recontamination.

These standards have been implemented to perform Buddie-Pack protocol testing and support WP6 washing operations under real-life conditions.

Detection of Volatile Contaminants and Off-flavors
System for on-site measurements completed
Method was developed and proof of concept measurements were carried out



Impact & Outcomes

TThis WP will contribute to the work of European standardization bodies by improving knowledge and sharing lessons learned from the plastic packaging reuse project":

- Cleaning efficiency
- Material ageing during reuse
- Chemical migration and NIAS
- Microplastic release during washing

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