



LE CENTRE DE PLASTURGIE  
TECHNIQUE LA ET  
INDUSTRIEL DES COMPOSITES

# Reusing plastic packaging: a catalyst for an ambitious circular economy - strategy and advances of the Industrial Technical Center for Plastics and Composites (IPC)

*Brunet Juliette – IPC*

Pour une plasturgie éthique, performante et durable

# NATIONAL TECHNICAL CENTER FOR PLASTICS AND COMPOSITES



Enhance the competitiveness of French plastics and composites converters by carrying R&D and technological transfers and generate knowledge to be shared amongst stakeholders

## Plastics extrusion

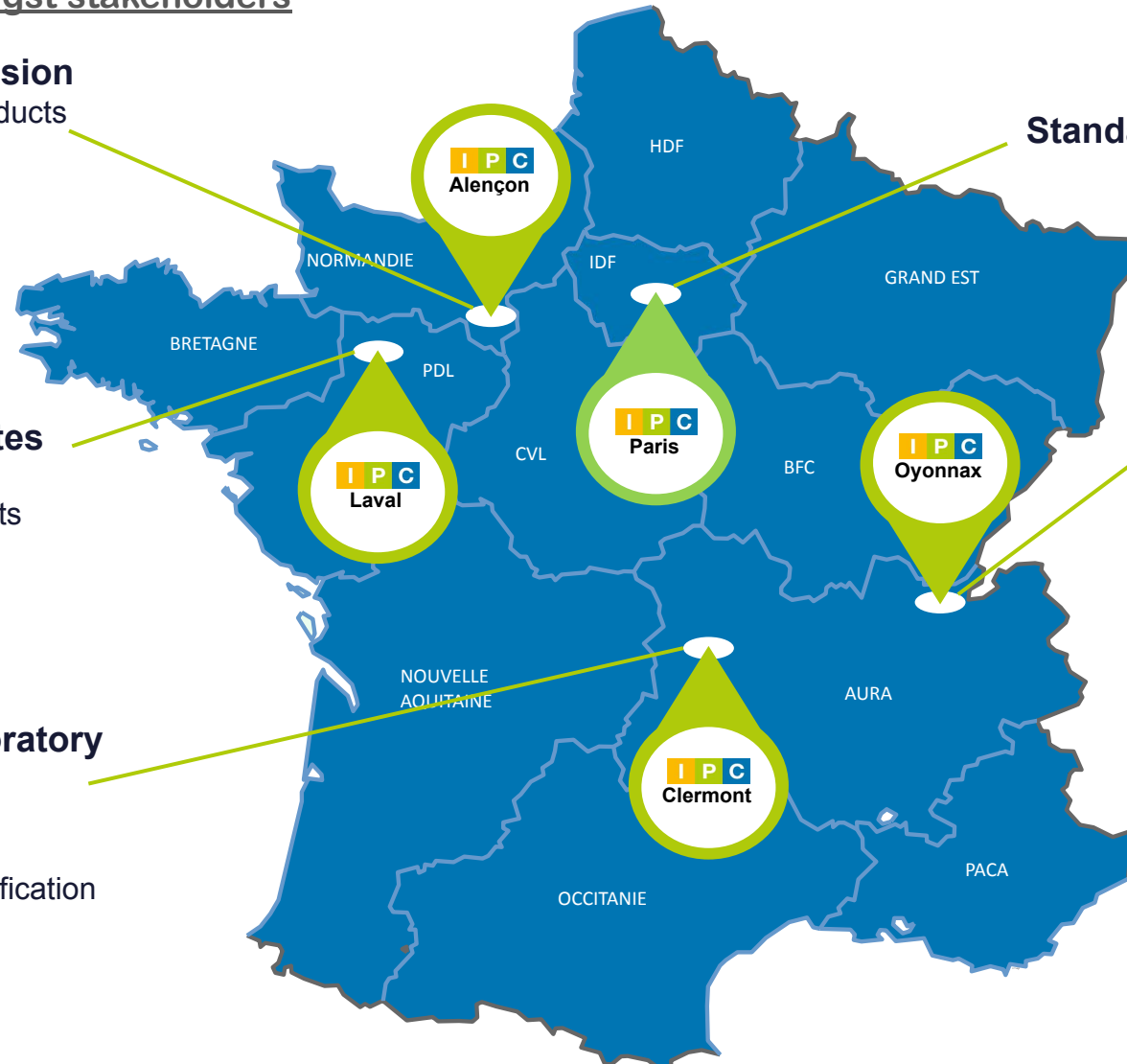
- Development of extruded plastic products
- Plastics processing by extrusion processes
- Bio-sourced materials

## Composites

- Composites materials selection
- Development of composites products
- Conception/Design/Simulation
- Industrialization support
- Composites processing

## Laboratory

- Biodegradability (TUV Austria)
- Food Contact
- Migration Tests
- Substances identification and quantification
- Safety
- LCA / LCC
- Reuse line



Standard Office



via



## Plastics Processing

- Plastics product development
- Design/Simulation
- Plastics processing using injection moulding and thermoforming techniques
- Industrialization support
- Rheology, thermal optimization of tooling
- Process digitization
- Plastics materials selection
- Plastics formulation
- Recycling, recyclability, eco-design
- Plastic and composite materials characterization and testing laboratory
- Additive manufacturing (polymers, composites)

# REUSE : A LEVER FOR REDUCING WASTE PRODUCTION, FULL OF TECHNICAL AND SANITARY CHALLENGES

## Regulatory framework

French level : 10% of packaging re-used by 2027.

Packaging and Packaging Waste Regulation (PPWR) :

- Beverages (except wine, spirits, milk...) : 10% reuse for 2030 and 40% for 2040.
- HORECA : must propose a reuse option for take away in 2028 and 10% of reuse in 2030.

## Advantages of plastics in reuse

- **Cheap, lightweight and highly resistant**, plastic remains one of the most efficient materials for reusable packaging.
- Its durability and low cost make repeated use both practical and economically viable.
- As reuse systems scale up, plastic is likely to remain a material of choice thanks to its unique performance-to-cost ratio.

## Projects lead by IPC on reuse theme



*PRO<sup>2</sup>REUSE  
PROLOOP*



*BUDDIE-PACK*

## Technical and sanitary challenges

- **Lack of knowledge** about the ageing of plastics over multiple reuse cycles: thermal treatments, handling/sealing operations, transport, intensive and high-temperature washing...
- **Diversity of risks to be assessed**: reduction in packaging performance, changes in appearance, alteration of the organoleptic properties of the contents, substance migration, microplastics, effectiveness of the washing and drying process...
- **Microbiological risk**: difficulty in drying plastic materials.
- **Unsuitability of current designs**: frequent presence of water-retention areas



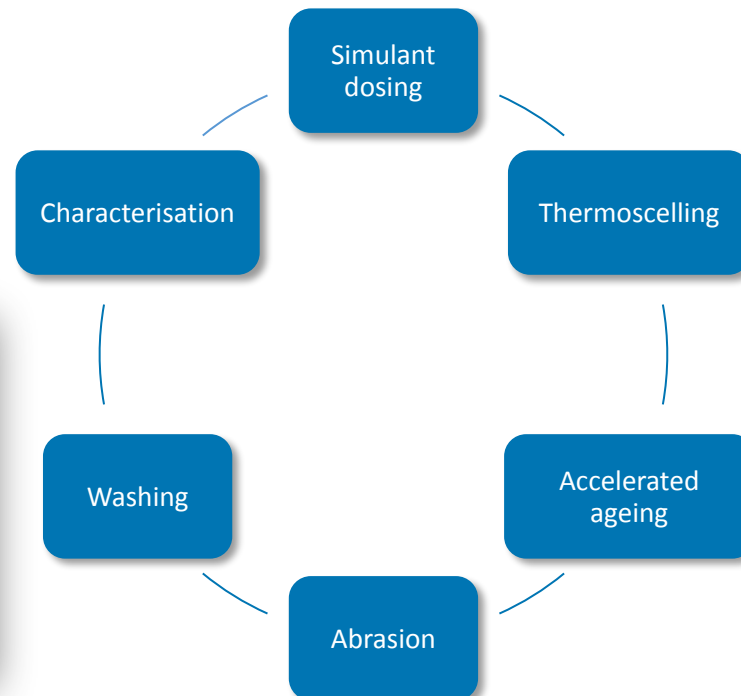
# PROLOOP, A KEY PROJECT FOR PLASTIC REUSE



*Establish a standard protocol for assessing the reuse suitability of food pots and trays*

A set of tests designed to qualify a packaging solution for reuse. The testing programme covers new packaging, packaging at the end of the accelerated ageing protocol, and intermediate stages to assess potential performance changes throughout its service life.

***A plastic reuse pilot line enabling the simulation of all stages of the reuse loop at a single site.***



## STEP 0 – PACKAGING PREPARATION

### Visual inspection

Ensure the physical integrity of the packaging and the absence of visible defects

Determination of the number of packages needed

Several hundred packages to ensure destructive analyses at the beginning, during and at the end of the ageing protocol.

On the first tests: +400 packages

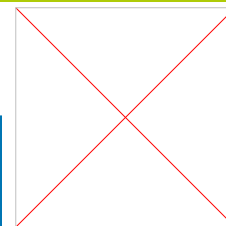


### Materials tested

Virgin materials in injection moulding

Initial tests with **injected packaging** in white and black PP and Copolyester.

No specific commercial grades, no barriers or additives, no surface treatment.



## STEP 1 - FILLING

### Representative filling

Mimic a classic use of trays with a representative simulant without food waste

Solenoid valve filling

Ensures repeatability to all macro loops, on all packaging

### « Universal simulant »

Microbiologically stable, allows you to simulate a fatty, acidic and watery food in one test.

Quantity of simulant

On the first tests, the quantity of simulant is more than a third of the total volume of the packaging for experimental constraints



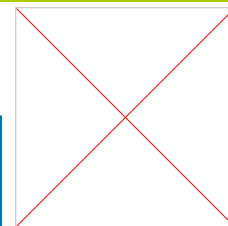
## OPTIONAL STEP 2 - SEALING

### Sealing

Films and process parameters (temperature, pressure) selected depending on packaging materials and producer recommendations.  
Visual and manual inspection  
Thorough inspection of the sealing integrity of all reusable packaging.

### Optional step depending on the use case targeted

- ☒ Ready meals
- ☒ Fresh dairy products
- ☒ Meat, processed meats and fish
- ☒ Takeaway food service



## STEP 3 - STORAGE AND ACCELERATED AGING

### Key step of the protocol

No standard exists regarding time-temperature conditions for simulating aging.  
Time-temperature conditions were selected based on reference values used for overall migration testing.  
The acceleration factor is calculated using a conservative (worst-case) activation energy.  
The test temperature is chosen to avoid crossing a transition threshold that could drastically alter the packaging's properties.

### Accelerated aging parameters depending on use case

Parameters chosen in the project to represent 4 real cycles with only one testing cycle.



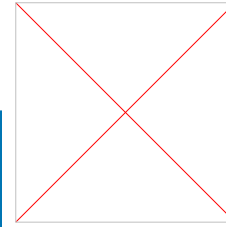
## OPTIONAL STEP 4 - ABRASION

### Simulating real-life use

Simulate packaging damage occurring during consumer use by means of an abrasion testing device fitted with spoon- and knife-type indenters.

### Optional step depending on the use case targeted

- ☒ Ready meals
- ☒ Fresh dairy products
- ☒ Meat, processed meats and fish
- ☒ Takeaway food service



## STEP 5 - WASHING

### Key step of the protocol

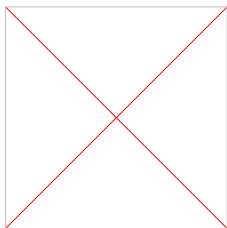
Simulate the damage incurred by the packaging during washing and reproduce the stresses most commonly experienced by plastic packaging.

The selected parameters are intended to represent a "median washing cycle".

### In practice

Washing parameters adapted from EN17735/2022



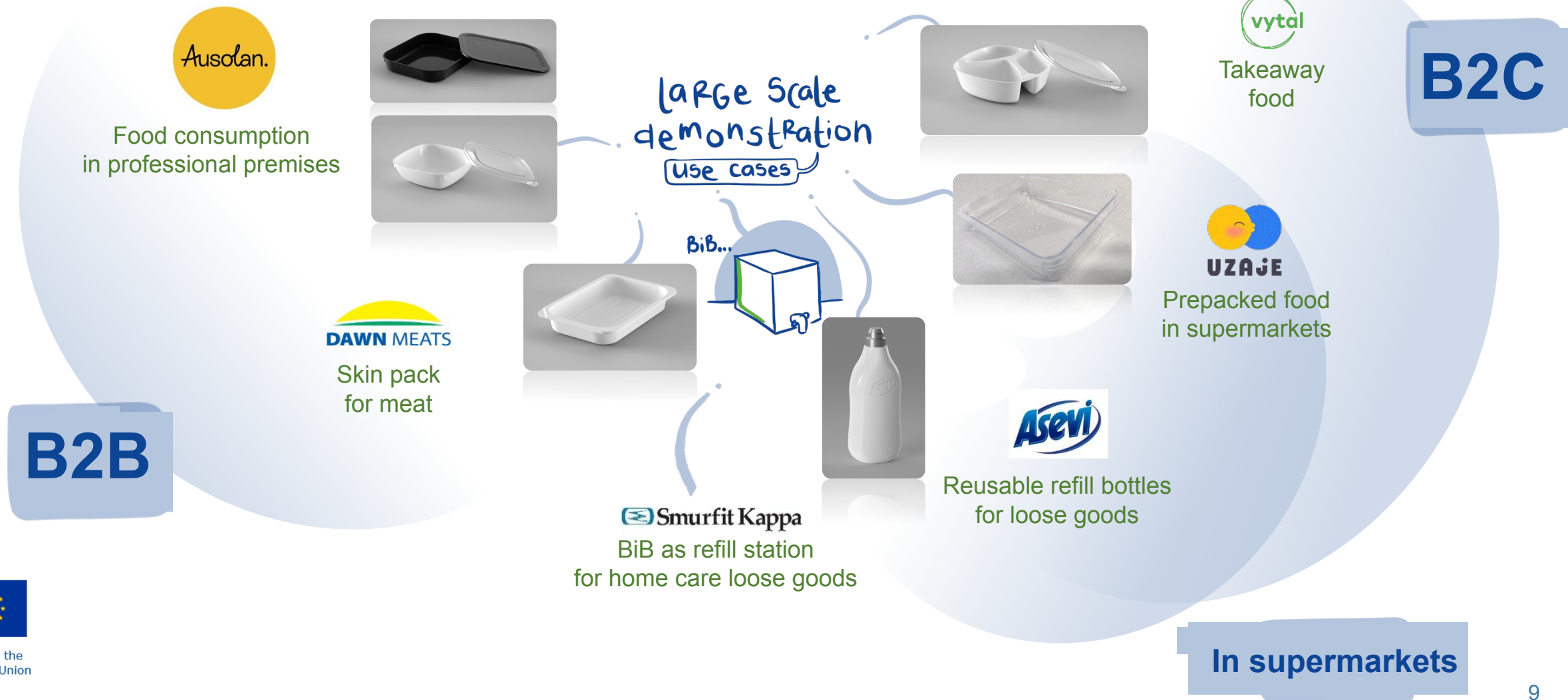


# ASSESSING THE REUSE POTENTIAL OF A PACKAGING

## OVERVIEW OF CONDUCTED TESTS AND CHARACTERIZATIONS

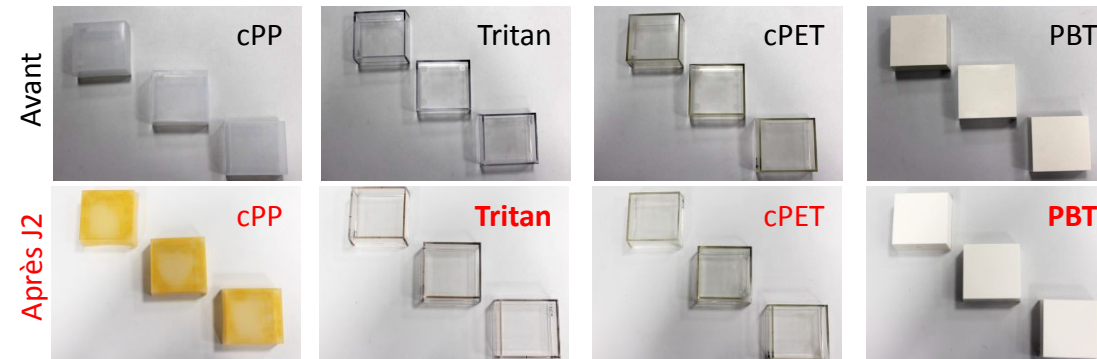
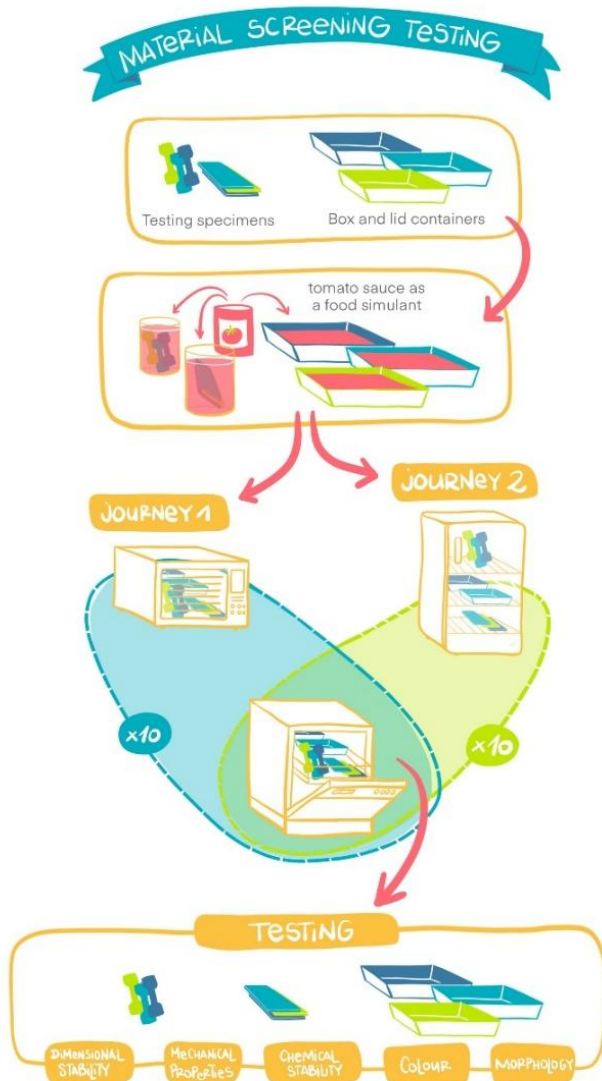
|                 | Packaging-product interaction                                                                    | Visual aspect                                                              | Packaging performance                                                                       | Cleanability                     |
|-----------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------|
| Non-destructive |                                                                                                  | Odor inspection<br>Visual inspection of general aspect<br>Haze measurement | Stackability and unstackability<br>Planarity<br>Dimensional measurements<br>Weight changes  |                                  |
| Destructive     | Global & specific migration tests<br>NIAS assessment<br>Chemical contamination & decontamination | Coloration<br>De-sealing                                                   | Vertical compression resistance<br>Sealing resistance<br>Gas permeability<br>Leaks analysis | Evaluation of surface properties |

# Buddie-Pack: Use Cases and addressed markets



Funded by the European Union

# Material assessment: 10 use/washing simulation



| Material | Journey 1                 |                    |                    |                    |                      | Journey 2                  |                    |                    |                    |                      |
|----------|---------------------------|--------------------|--------------------|--------------------|----------------------|----------------------------|--------------------|--------------------|--------------------|----------------------|
|          | Hot Packaging Application |                    |                    |                    |                      | Cold Packaging Application |                    |                    |                    |                      |
|          | Dimensional Stability     | Chemical Stability | Morphology Changes | Optical Properties | Mechanical Stability | Dimensional Stability      | Chemical Stability | Morphology Changes | Optical Properties | Mechanical Stability |
| CPET     | ++                        | ++                 | +++                | +++                | +++                  | +++                        | ++                 | +++                | ++                 | +++                  |
| PETG     | n/a                       | n/a                | n/a                | n/a                | n/a                  | +++                        | +++                | +++                | ++                 | +                    |
| PBT      | +++                       | +++                | +++                | +++                | +++                  | +++                        | +++                | +++                | +++                | +++                  |
| Tritan™  | ++                        | +++                | +++                | +++                | +++                  | +++                        | +++                | +++                | ++                 | +++                  |
| HDPE     | n/a                       | n/a                | n/a                | n/a                | n/a                  | ++                         | ++                 | +++                | -                  | +++                  |
| rPE      | n/a                       | n/a                | n/a                | n/a                | n/a                  | ++                         | ++                 | +++                | -                  | +++                  |

## Main conclusions:

- Marginal impact of aging on the mechanical properties.
- Main impacts: **dimensional stability and colorimetry.**
- **Best results for Tritan, PBT and PETg.**

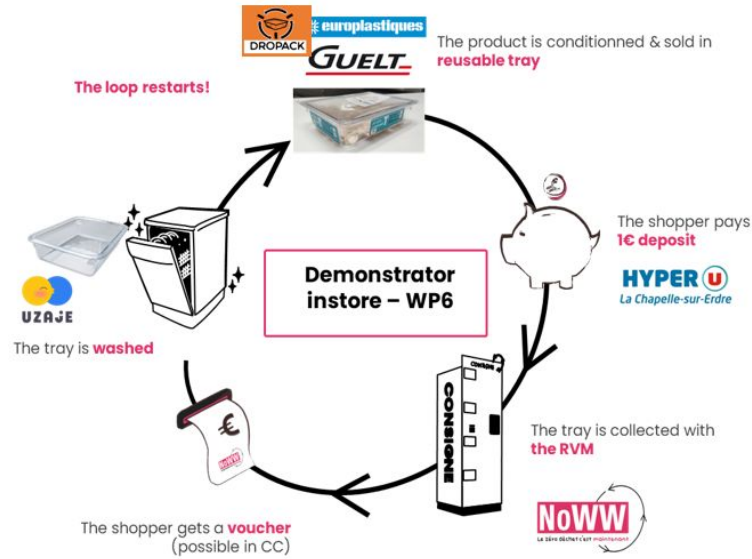


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# Buddie-Pack: Demonstration results



*Large-scale demonstration: UZAJE reusable packaging system for supermarket takeaway ready-made meals.*



**HYPER U**  
La Chapelle-sur-Erdre

**NoWW**  
LA ZÉRO DÉCHET C'EST MAINTENANT

**GUELT**

**europlastiques**  
Un goût certain pour l'innovation

**DRO'PACK**

- Local approach (store) to accelerate decision making process
- Approx 200 semi manual terminal chosen for Citeo Reuse West
- Complete RVM offer
- Strongly implicated on reuse R&D
- Synergies & scaling Dro'Pack

Supply chain of the UZAJE case study

5

**6-month experiment in 1 supermarket** in the West of France: Hyper U La Chapelle/Erdre

New catering offer for the supermarket

1235 trays injected into the circuit, 616 sales - 371 returns

**59% return rate (good level of commitment for a B2C use case)**

1 cleaning cycle at Uzaje Neuilly-sur-Marne

Tracking + collection via the **NoWW** solution : 80% of returns are made up of 1 tray – 20% of 2 to 3 trays

1 euro deposit well accepted

Fully operational loop



# LE CENTRE DE LA TECHNIQUE INDUSTRIELLE ET DES PLASTURGIE COMPOSITES

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