

# Issues and technology in food grade recycling of plastics packaging

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**19 Jan 2021**

Decoupling  
material inputs &  
growth - Plastics  
& Packaging



  
**nextek**

SUSTAINABLE SOLUTIONS  
FOR POLYMER & RECYCLING

# NEXTEK LTD

## WHAT WE DO

Recycling plant design and Feasibility studies.

Strategic advice to Multi-National Corporations and Recycling Co's.

Food-grade recycling of post consumer plastics – process development.

Research and development of novel materials and processes including plastics and bioplastics.

Business support, productivity improvement and problem solving.

Ground breaking projects for governments and major commercial organisations in the [EU](#), [UK](#), [India](#), [Malaysia](#), [USA](#), [South America](#), [Middle East](#), [North Africa](#) and [Australia/NZ](#).

Strong ties to Universities and Scientific Centres of Excellence in the UK and Europe.

# AWARDS



## Circular Economy for Food-Grade Plastics

- **The Circular Economy = USE "WASTE" to make NEW MATERIALS**
- The recycling of waste is undergoing a revolution with a growing demand for high quality post consumer recycled materials.
- The pathway to the circular economy is blocked by the old way of designing products and the mechanisms of material collection and recycling.
- Technology can unlock the potential built into materials that have been used and then "discarded" without impacting the planet.
- **Recycled materials can be more expensive than first-use materials**

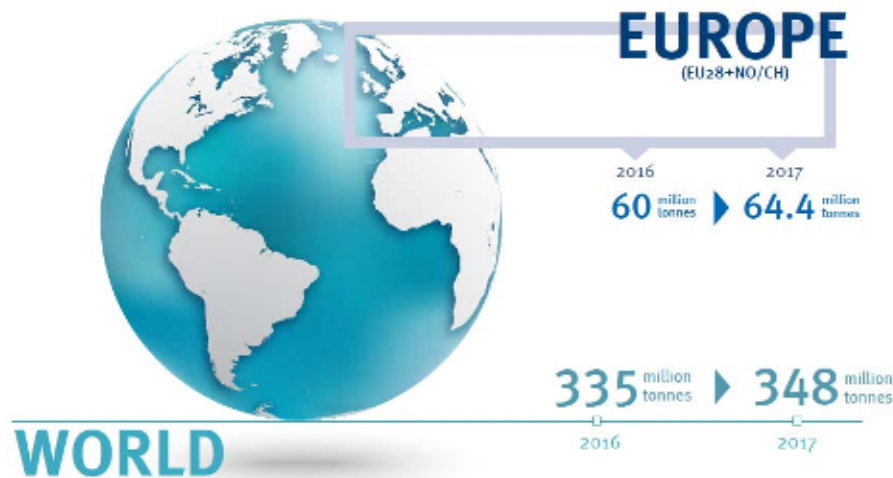


## Worlds Plastic Production and Distribution - 50% in Asia (Plastics Europe 2018)

### World and EU plastics production data

The world plastic\* production almost reached 350 million tonnes in 2017.

Source: PlasticsEurope Market Research Group (PEMRG) / Conversio Market & Strategy GmbH



**Global Plastics Production**  
**Europe = 19%**  
**Nth America = 19%**  
**Asia = 50%**

**Plastics Production 1 million tonnes per day**  
**Plastics Recycling 150,000 tonnes per day**

# WRAP UK Plastics PACT Targets

## KEY Targets set for 2025

100% of packaging to be recyclable, reusable or compostable

Eliminate single use packaging (tax or ban?)

70% of packaging recycled or composted

30% average recycled content across all packaging

<https://youtu.be/tdgCUSPj1y8>

BY 2025  
**100%**  
of plastic packaging to be reusable, recyclable or compostable

BY 2025  
**70%**  
of plastic packaging effectively recycled or composted

BY 2025  
**ELIMINATE SINGLE-USE PACKAGING**

Take actions to eliminate problematic or unnecessary single-use packaging items through redesign, innovation or alternative (reuse) delivery models.

BY 2025  
**30%**  
average recycled content across all plastic packaging

EU (2021) and UK (2022) will “tax” Single Use Plastics with less than 30% recycled content €800/t and £200/t respectively

## Blockages to the Circular Economy

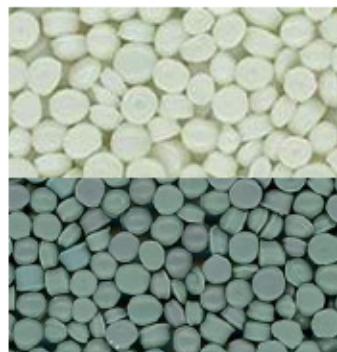
- The majority of materials have been designed to be processed once only. **Recycling friendly formulations are needed.**
- In the circular economy, you can only recycle what is put out by the retailers. **Printing and pigmentation limit re-use.**
- Not all packaging is recyclable. **Mono materials are more widely recyclable to high value.**
- Food grade recycling is very difficult to achieve in EU. **EFSA needs to interact with the track record of the plastics recycling sector.**

75% **collection** x 95% **sorting** x 85% **recycling** = **60% Recovery**

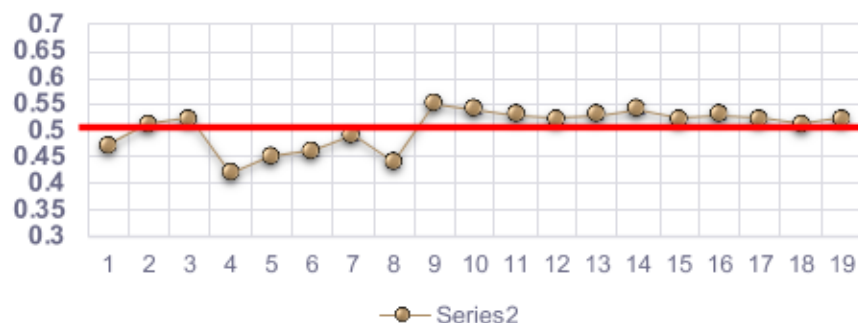


# CIRCULAR RECYCLED PLASTICS – QUALITY ATTRIBUTES

- Free of 260+ contaminants
- Reach, SVHC, Metal, PAH
- Free of odour (PE,PP)
- Consistent properties
- Consistent colour



Melt Flow Index  
HDPE



Characteristic	Description		
Product Name	HDPE / NATURAL / PELLET / DEODORISED		
Product Reference	rHDPE-WPR / 002		
Date of Testing	03 December 2019 by Intertek		
SVHC Testing	The item is free of hazardous substances listed in the SVHC candidate list of the REACH regulation in a concentration greater than 0.1%. There are no obligations according to article 33 of the REACH-regulation.		
Conclusion	The item is considered as marketable regarding the tested parameters (based on Regulation (EC) 1907/2006 / Regulation (EU) 2019/1021). PAH conclusions below.		
PAH Testing	No PAH compounds were observed at determinable levels above the limit of detection		
Test Method	APPS GS 2014-01 (2014-08)		
Limit of Detection	0.15 mg/kg		
Substance	CAS-No	Test result	Conclusion
Naphthalene	91-20-3	Not determinable	Pass
Acenaphthylene	208-96-8	Not determinable	Pass
Acenaphthen	83-32-9	Not determinable	Pass
Fluorene	86-73-7	Not determinable	Pass
Phenanthrene	85-01-8	Not determinable	Pass
Anthracene	120-12-7	Not determinable	Pass
Fluoranthene	208-44-0	Not determinable	Pass
Pyrene	129-00-0	Not determinable	Pass
Benzo(a)anthracene	56-05-3	Not determinable	Pass
Chrysene	218-01-9	Not determinable	Pass
Benzo(b)fluoranthene + Benzo(j)fluoranthene	205-99-2 + 205-82-3	Not determinable	Pass
Benzo(k)fluoranthene	207-06-9	Not determinable	Pass
Benzo(e)pyrene	192-97-2	Not determinable	Pass
Benzo(a)pyrene	50-32-0	Not determinable	Pass
Indeno(1,2,3-cd)pyrene	193-39-5	Not determinable	Pass
Dibenz(a,h)anthracene	53-70-3	Not determinable	Pass
Benzo(ghi)perylene	191-24-2	Not determinable	Pass

## Circular Economy Packaging – How fussy should we be?

- Brand owners want to use 100% recycled content.
- Brand owners don't want to see colour variation.
- Brand owners want to buy unpigmented (transparent) recycled plastics
- Brand owners typically don't make many unpigmented products.
- One of each of the pairs of bottle has 25% recycled content based on colour separated HDPE flake.





## Circular Economy Packaging – self-coloured bottles could be the norm



- It is possible to use sleeves to deliver the important marketing and consumer advice on “grey” packaging with little visible change to the appearance.

# Principles Food Grade Circular Plastics Packaging



The plastic resin has been manufactured to food grade specifications for all monomers and additives

Ideally the package has been used for food applications

The package about to be recycled has not been contaminated by abnormal use by consumers

The recycling process has powerful decontamination steps to remove ALL migrating molecules to > 95%

The recycling process is being used on a commercial basis preferably on a large scale

The package is designed to be recycled

USFDA focus is on extent of what and how much migrates into food

EFSA focus is on feedstock from food application + migration into food

## The package has to be **designed to be recycled**

- **Bottles are widely used for food products**
- **RESIN** - ideally unpigmented
- **CAPS**
  - Many colours are used and can affect final colour of the resin
  - Ideally should stay with the bottle
  - Should be recycling compatible
  - Made of one polymer per packaging type
- **Label with printing inks**
  - The label should be recycling compatible and separable or self-peeling from the bottle
  - Inks must not come off during hot washing
- **Adhesives/Glue**
  - Stay with the label when they peel off
  - Ideally do not leach plasticisers



## TETHERED CAPS - required by EU from June 2024



(ALPLA designs)

## PET water bottles

- Cap HDPE with no pigment
- Resin – 50% recycled content (blue tint added to counter yellowing)
- LLDPE sleeve
- Minimal adhesive in one strip at overlap of label

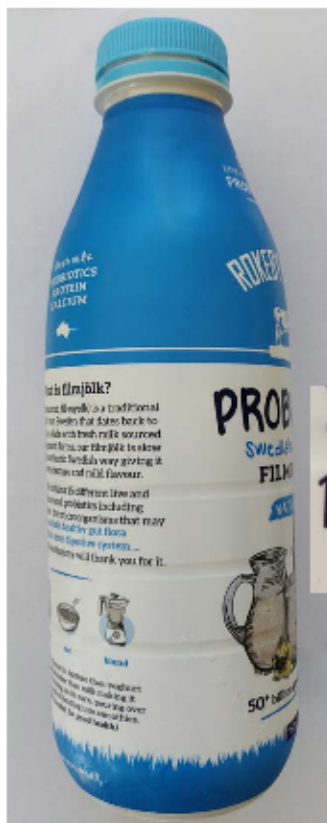


- Cap with pink pigment
- Resin – 100% recycled content  
No label
- No adhesive



## Milk Bottle with external sleeve

- External sleeve is PET
- Bottle is white PET
- Cap is HDPE pigmented blue
- This bottle has some but very few destinations at this time except landfill or waste to energy
- The label has a recycling logo and a deposit message
- White PET is very damaging to PET beverage recycling



MADE IN AUSTRALIA BPA FREE NON GMO

10¢ REFUND AT COLLECTION DEPOTS/  
POINTS IN PARTICIPATING  
STATE/TERRITORY OF PURCHASE.



**ARL is not compulsory**

## POTS, TUBS AND TRAYS - PP

- **Trays with pigments are common**
- **Clear or unpigmented trays are preferred**
- **Coloured recycled plastics have lower market value and less likely to be recycled into food grade packaging**
- External labels should be easy to remove in recycling
- **In-mould labels are impossible to remove in simple recycling operations**
- Any adhesive labels should be easy to remove

Pigmented trays vs clear



## Food grade PP recycling is just beginning but designs need to adjust



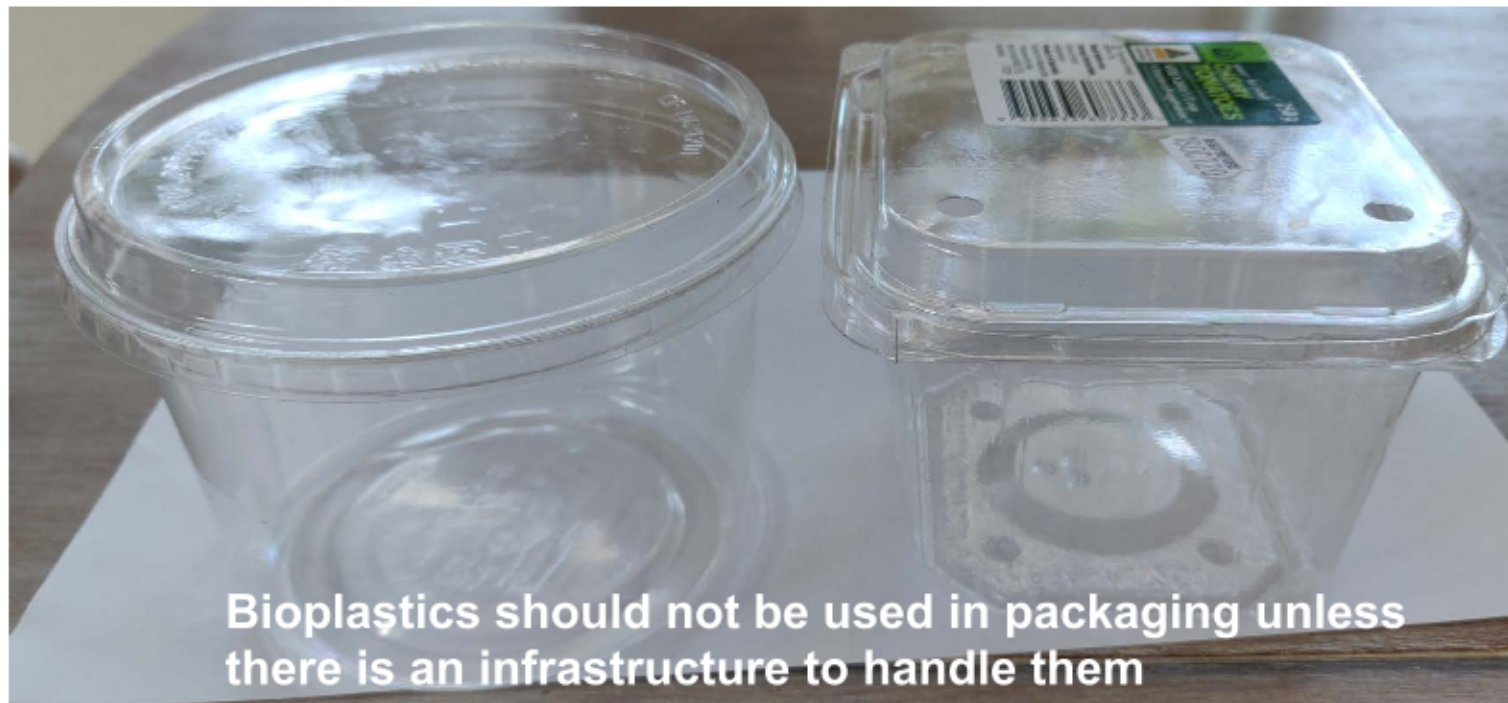


## POTS, TUBS AND TRAYS - PET

- PET trays are nearly always made as three layers
- Top and bottom are virgin PET (10% each layer) and the mid layer (80%) is recycled PET.
- Frequently the mid layer has not been through a food grade process meaning the mid layer does not comply with food contact requirements.
- The EU is considering classifying thermoformed PET trays as not suitable for food grade recycling input material



## Two clear packages - PLA and PET - Common sense needed

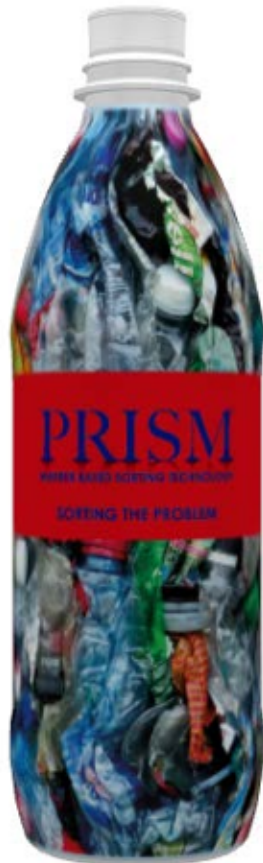


PLA is degradable but not compostable.

The PLA tub will go into the recycling system but will contaminate the PET stream

# PRISM - Intelligent sorting of packaging using fluorescent markers on labels

What if bottles could talk to the auto detectors!



## Circular Economy Recycling starts with Design

- The best food grade recycling options evolve when every aspect of the products are designed to be recycled back to food grade.
- Recycling technologies have evolved to ensure that recycled plastics are safe to use but they can be expensive to operate if products are badly designed via material selection.
- Big gains can be made by following simple design steps
- The recycling collection system needs to be integrated
- The recycling system needs the capability to sort food-grade packaging from non-food packaging and to ensure hazardous materials are excluded from post consumer packaging.



EVERY PLASTIC ITEM CAN HAVE A CIRCULAR DESTINY

*If we can imagine a solution, then we can do it; indeed we must do it.*

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NASA Moon  
Mission  
1961-1969