
Poly
materia™
INTRODUCTING
BIOTRANSFORMATION NEXT-GEN
BIODEGRADATION TECHNOLOGY

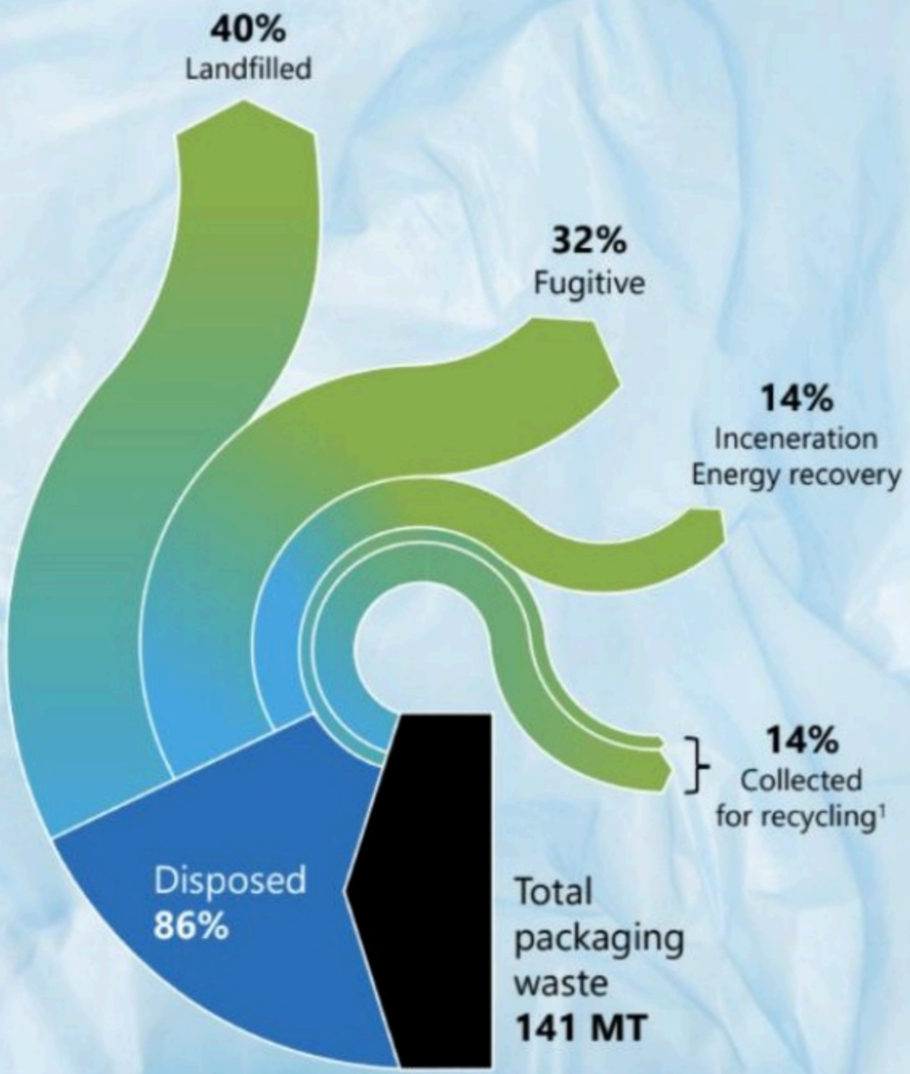
Poly materia™

POLYMATERIA:

ABOUT US

- London based privately held Advanced Technology Development Company.
- Focused on new gen environmental solutions for the global plastic value chain.
- Joint-development with Imperial College University London.
- State-of-the-art R&D facilities at the Imperial College Innovation I-Hub, London, UK.
- Multi-disciplinary team of researchers from biologist, polymer scientist to chemist.

GLOBAL FLOW OF PLASTIC PACKAGING WASTE 2015



Source: Project mainstream analysis, Ellen MacArthur Foundation; World Economic Forum, 2016
[1] 8% recycled into lower value app. 2% recycled into the same app.; 4% process losses

Poly materia™

FUGITIVE PLASTICS:

THE PROBLEM & OUR SOLUTION

- **Fugitive plastic**, littered plastic or plastic leaked out of waste collection system into the natural environment.
- **4 billion tonnes** of fugitive plastic estimated by 2050.
- **80%** of plastic found in the ocean which stemmed from unmanaged waste on land.

POLYMATERIA:

OUR PURPOSE & BUSINESS AT A GLANCE

- Our purpose is advancing science to help nature deal with plastic pollution.
- Biotransformation is a credible and scalable solution for the **fugitive plastic problem**, full & safe biodegradation, without impacting recycling.
- We therefore fully support the circular economy and the three-Rs (reduce, reuse, recycle) but through our innovative new **Biotransformation** technology have also embraced a fourth R: **redesign**.

Member of UK Plastic Pact & HRH Prince Charles's Sustainable Markets Council with the World Economic Forum

wrap · World Economic Forum · Sustainable Markets Council

Imperial College London

impact solutions
independent plastic experts

imperial innovations

bsi.

ASTM INTERNATIONAL

END STATES OF PLASTICS:

UNDERSTANDING THE LANDSCAPE

(Bio)degradation of Polymers

THE FRAGMENTERS	LANDFILL	INDUSTRIAL COMPOSTING	HOME COMPOSTING	BIOTRANSFORMATION
LOW CREDIBILITY AND SCALABILITY	LOW CREDIBILITY BUT SCALABLE	MEDIUM CREDIBILITY, BUT LIMITED SCALABILITY	MORE CREDIBLE THAN #3 AND SCALABLE	THE MOST CREDIBLE AND SCALABLE TECHNOLOGY

KEY PLAYERS

Polymateria is the only company in the world who has the breath and depth of evidence via credible 3rd party data

OUTCOME

PE films fully biodegrading (CO_2, Water, Biomass) under real world conditions in 226 days and PP rigids fully biodegrading in 336, at 3rd party labs

Polymateria™

BIOTRANSFORMATION

WHERE THE ISSUE IS BIGGEST AND SCALE IS POSSIBLE

- Unique ability to Biotransform the hard crystalline and amorphous structure into a wax like material hence **no microplastic**
- Proprietary use of **"prebiotic"** to attract microbes, funghi and bacteria to fully consume the wax like material
- Time controlled aspect to allow for recycling and unique "Recycle By Date" to empower consumers
- Only technology in the world that has proven full biodegradation of Polyolefins (Water, CO_2 and Biomass) on a range of commonly used packaging without any ecotox issues
- Utilising existing ISO standards and **going beyond** to add rigorous pass fail criteria. Working with BSI to create a **new standard**

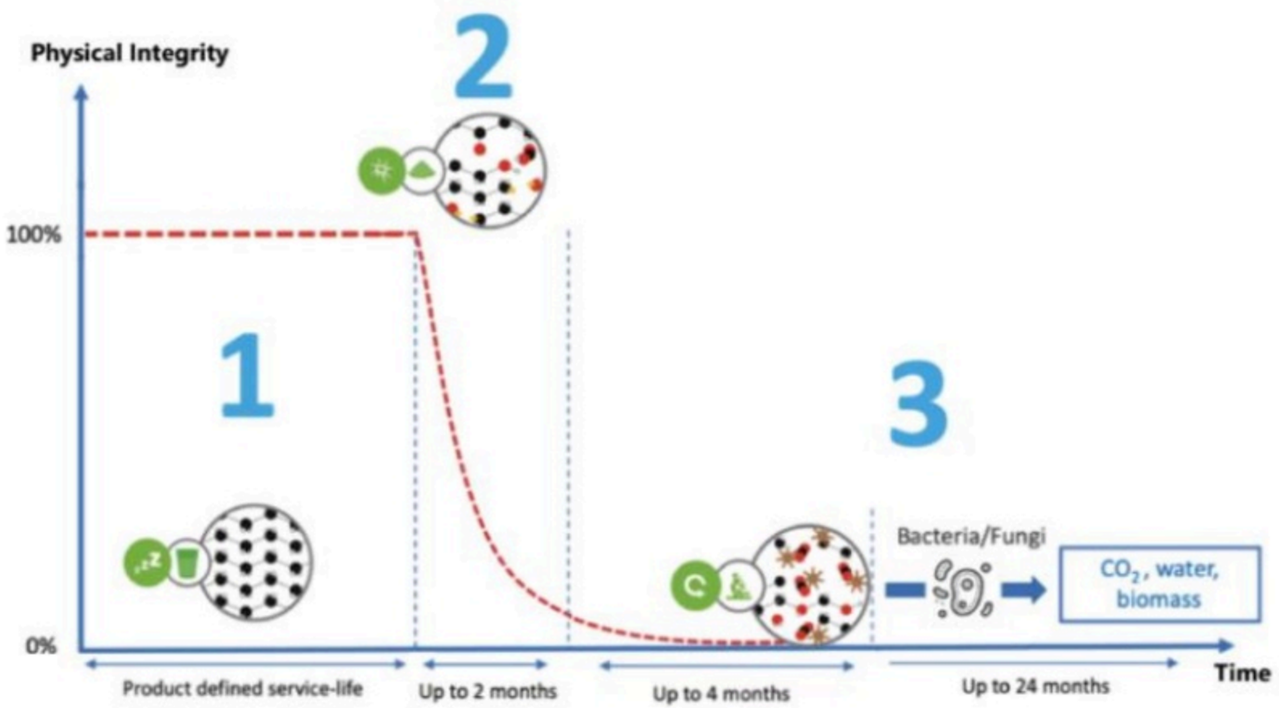
FUGITIVE PLASTICS:

GIVING RECYCLING EVERY CHANCE

① Packaging service life can be uniquely set, so that its dormant during use life, retains all its functionalities **and also gives recycling every chance** to happen.

② The packaging rapidly loses its physical integrity as the polymer chains are rapidly cleaved into much smaller molecules across both the amorphous and crystalline structure of the plastic material, **avoiding microplastic**.

③ Through our **unique "prebiotics"** naturally occurring bacteria and fungi colonize, eat and digest the molecules. It is now not a plastic anymore but bio-compatible residues whose very low molecular size and hydrophilic nature makes it possible for full assimilation.



PRODUCTS:

Food & Ecotox Safe

- All constituents of the Masterbatch are GRAS for N American purposes.
- Migration Certification performed by 3rd Party Laboratory for EU purposes.
- Degraded materials independently tested for Acute and Chronic clearance of Ecotoxicology issues
- No Microplastics created and the inert plastic polymer is converted into a bioavailable material for microbes

GRAS statement

Approved food contact for plastic packaging in US market

Migration certification

Declaration of compliance under EU regulation 1 for food contact materials and articles

Eco-toxicity declaration

Tested for land acute and chronic effects on earthworms – OECD 207 & 222
Tested for freshwater toxicity – OECD 202

PRODUCTS:

Cycle+ and DegrAid

- Formulated as a drop-in Masterbatch (MB).
- Each MB is tailored to the resin's footprint, application profile and required use life.
- Compatible with the normal plastic conversion processes.
- Typical loading rate: 2% weight percentage (wt%).
- Commercialised under two brands

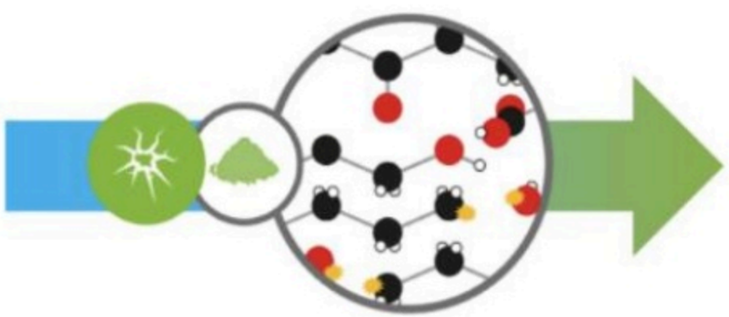
VERIFICATION PROCESS

SETTING HIGH STANDARDS IN DEGRADABILITY PERFORMANCE

Test methods based on international standards[3] augmented with stringent time-frame and pass/fail criteria on CI*, Mw and Mn ensuring full bio-availability and microplastic-free process.

Degradability Performance Pass/Fail Criteria

- Elongation at break ≤ 5%
- *Carbonyl Index (CI) > 1
- Reduction in Mw (1) > 90%
- Mn (2) < 5000 Da



End Product of the Degradation

- ✓ Loss of > 95% of physical integrity
- ✓ Loss of > 90% of the "links" in the polymer chains
- ✓ Ultra-low molecular weight oligomers Bacteria and Fungi can absorb and digest
- ✓ Increase in hydrophilic anchor points (C=O) for the microorganisms to easily mass colonise

1 Weight average molecular weight
2 Number average molecular weight

The end product of the degradation is in such a form that naturally-occurring Bacteria and Fungi will be able to absorb, digest and convert into CO_2, Water and Biomass.

3 ASTM D2565 or ISO 4892-12, ASTM D5208: Standard test methods for the weathering exposure of degradable plastic materials; ASTM D5988: Standard test method for determining the biodegradation of plastic materials in contact with soil. OECD 202, 207 and 222 Ecotoxicity standards.

ECO-TOXICITY COMPLIANCE

FULLY MET THE REQUIREMENTS OF OECD STANDARDS

SHORT-TERM / **NO ACUTE TOXICITY**

Soil – Earthworms

Water – Daphnia

PASSING OECD 202 & 207 PROVES:

- No heavy metals
- No toxic compounds
- No acute effects due to presence in land / water

LONG-TERM / **NO CHRONIC TOXICITY**

Soil – Earthworms

PASSING OECD 222 PROVES:

- No chronic effects due to longer term exposure in neither land nor water

Next Gen Sustainable

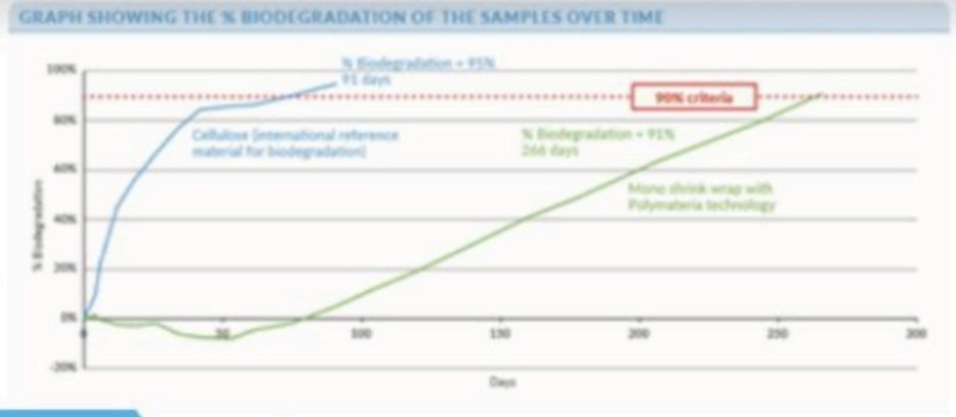
Rigid Packaging: Cups, Straws, Detergent Bottles & Containers

Thin –walled containers, thermoformed and injected molded applications as well as detergent bottles made from high quality recyclable food grade Polypropylene (PP) Polymers

Only company in the world to fully and safely biodegrade rigid PP applications in 336 days, at independent labs under real world conditions.

Next Gen Sustainable

Flexibles: Bread, Produce bags & Collation Shrink



New generation PP+PE bread, produce bags and collation shrink can be made to specification in a variety of designs. Multi-layer and monolayer bags are optional.

Only company in the world to fully and safely biodegrade flexible PE applications in 226 days, at independent labs under real world conditions.

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