IMPACT OF PET CONTENT ON FEEDSTOCK RECYCLING YIELDS

BASED ON PYROLYSIS TECHNOLOGY FROM ARCUS GREENCYCLING TECHNOLOGIES

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The Challenge

1,000,000 tonnes of flexible packaging laminates (up to 25% of the market) rely on the unique set of properties provided by BOPET films. Re-designing these structures to polyolefin laminates will

- lead to an increase in material usage,
- a significant drop in packing efficiency,
- and is unlikely to increase the rates of mechanical recycling due to the lack of end markets for the low quality recyclate.

Mono PET structures are a viable alternative for many of these applications, but for a number of end use applications there is still a need for the complimentary mix of material properties provided by PET and polyolefins.

Is feedstock recycling the answer to recycling these difficult to recycle but resource efficient structures? BOPET Films Europe and ARCUS Greencycling Technologies worked together to find out!

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Analysis of typical household flexible waste

Mixed plastic waste after sorting (DSD-352)

Element	DSD-352	Unit (Dry)
C	58.2	wt.%
H	7.0	wt.%
N	0.9	wt.%
O*	18.0	wt.%
S	0.1	wt.%
Cl	1.6	wt.%
Ash @ 550°C	14.2	wt.%
Ash @ 815°C	12.0	wt.%
Al	36000	mg/kg
Ba	130	mg/kg
Ca	23000	mg/kg
Fe	1800	mg/kg
K	1800	mg/kg
Mg	1600	mg/kg
Na	5300	mg/kg
P	570	mg/kg
Ti	1500	mg/kg

Real waste according to a typical standard from a German sorting facility

- Up to 10% impurities in the form of organic material such as food waste etc.
- Humid material with high inorganic and inert contaminants "ash" such as flame retardants, pigments, plasticizers

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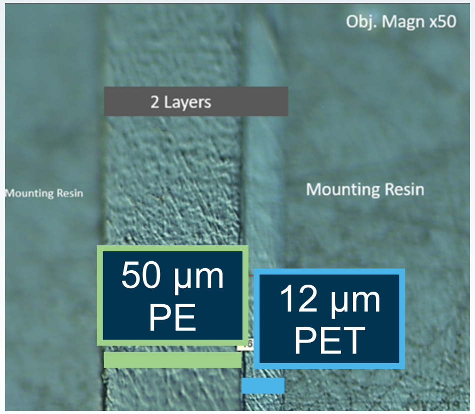
The experiment

- **PET/PE laminates** were collected and processed through **ARCUS' state of the art feedstock recycling process** to assess
  - the **conversion efficiency** and the
  - **composition of the resulting product**
- **Three concentrations** of PET were selected:
  - **First** to mimic the **average percentage weight of PET** in post consumer waste (7% EU average)
  - **Two higher levels** (14% and 27%) to assess the **impact on yield** and **efficiency** by the presence of higher concentrations of PET.
- Results were **compared to typical data** from **real life waste** as well as a **theoretical scenario of 100% virgin PE**

Feedstock characterisation

Element	PET-Laminate	Unit (Dry)
Ash @ 550°C	0.9	m/m %
Ash @ 815°C	0.9	m/m %
C (Carbon)	78.1	m/m %
H (Hydrogen)	11.7	m/m %
N (Nitrogen)	<1.0 (0.3)	m/m %
O (Oxygen)	8.8	m/m %
S (Sulfur)	100	mg/kg
Cl (Chlorine)	1800	mg/kg
Al (Aluminium)	293	mg/kg
Ca (Calcium)	285	mg/kg
Mg (Magnesium)	276	mg/kg
Si (Silicium)	977	mg/kg
Ti (Titanium)	3820	mg/kg

Illustration



Cross-sectional microscopy of PET-Laminate

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The results

Composition	**Share pyrolysis oil** (% of feed)	**Conversion to useful products** (%)
Typical waste mixture	~60	80-90
7% wt PET	~65	95
100% virgin PE	~70	>98

Interpretation

- **In all cases the process was a success** with **high yields of liquids and high value gas**, and low amounts of solids produced.
- The **yield** achieved with **7%wt PET** (which closely resembles the current post consumer waste material) delivered
  - the **highest yield** of pyrolysis oil at **65% of feed**
  - with **95%** of the feed converted into **useful products**.
- This **result** is **comparable to data from real life post consumer waste** and very close to known testing of 100% virgin polyethylene material.
- **Comparing to 100% polyethylene provides a useful benchmark** but it is important to remember that this is not representative due to the complex nature of flexible packaging and the impact of contaminants from inks, adhesives and food residues

The conclusion

- With **further steps planned to refine the process** the conclusion is **the impact of PET** on the ARCUS pyrolysis process **at these levels is negligible**.
- **This is a fantastic result for the flexible packaging industry** as it rules out the need to design higher cost, higher carbon mono polyolefin structures, and proves the benefit of next generation recycling processes which are designed to capture and cover the value of the products which society need.