

Working for a better future

PETplanet

Challenges in PET food grade Recycling PETinar 06.06.2023

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LSP: Liquid State Polycondensation



PET



The Material for the now and the future

Broad range of application (food- and technical applications)



Easy for collecting washing and sorting (packaging PET)



Mechanical recycling technology's are state of the art, the properties of PET like iV can be adjust by application.



efsan Approval by FDA, EFSA and Brand Owners for 100 % food safety



NGR

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We are working for a better **future**



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> 200 Highly Qualified Employees

~ 96 Mio. EUR Annual Sales

> 1,450 Installed Base

> 90 Installed in Number of Countries





Next Generation Holding GmbH:

- Josef Hochreiter
- Gerold Barth
- **INGKA Group**







Post Industry Recycling

Plastics Recycling Reimagined



Post Consumer Recycling



PET Improvement

textile, sheet and bottle application











PET Improvement



Material in-feed

Bottle flakes, PET fiber, PET sheet,... recycled to

100% food grade quality with FDA and EFSA approval and brand owner confirmation

Coming soon

LSP – Technology for HIPS, PP and materials what need to be decontaminated for food application.





P:REACT System Configuration examples







PET materials such as empty bottles, films or textile fibers represent a valuable raw material.

Thanks to NGR technology PET is recycled and can be further processed to the highest standards. Food-grade and material friendly!



PET Recycling challenges for food grad application

- 1) Impurities of bottle flakes (PA, PVC, PO, PC, Glue Metal, ...)
- 2) Quality instability (import/export, different sources, performance of washing lines...)
- 3) Variation of humidity (storage and transport)
- 4) Bulk Density (mainly depending on country)
- 5) Price difference of virgin an rPET pellets
- 6) Bottle Flakes collection rate and availability







impurities effects the rPET quality

Contaminant	Main impact	
PS	Yellowing , Haze, lower iV,	н
PP	Haze, particle contamination, lower iV	н. , С. , н
PLA	Faster crystallization, lower iV,	`C´`` <c` "</c`
EVOH	Cross-linking with PET, faster crystallisation, lower iV,	
PE, LDPE	Haze, particle contamination, faster crystallisation	Benzene does have a negative impact on
Nylon	Yellowing, lower iV,	health. The formation of benzene in the
glue	(water based or epoxy haze based) Yellowing, lower iV, Bisphenol A (BPA)?	extrusion process is directly related to the PVC content
PVC	Yellowing and Redding, <i>Benzene</i> formation, reduction of iV and molecular weights prior polycondensation, lower iV building in polycondensation,	the rve content.
PC	Bisphenol A (BPA), Yellowing	





Quality instability: Bottle Flakes to Pellets – South America

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Contaminants after roasting (based on EN ISO 15348 Anh. D; 1 h at 220 °C):

PVC
Polyolefins
Yellow
PA und glue
Metals
Wood
Other

9,0	mg 🤇	72	ppm
0,0	mg	0	ppm
75,3	mg	3799	ppm
19,1	mg	28930	ppm
1,4	mg	11	ppm
0,0	mg	0	ppm
0,0	mg	0	ppm





Sample Nr.	NGR ID	L	а	b	AA (ppm)	Benzene (ppb)	IV (dl/g) (+/- 0,02)	Size of pellets (weight per 100 pcs)
13	10490	67,34	-2,80	2,01	0,45	8	0,84	1,81
19	10494	66,09	-2,78	1,86	0,54	8	0,85	1,77
25	10498	67,19	-2,81	2,13	0,6	8	0,86	1,78
29	10501	66,15	-2,95	1,76	0,65	1	0,85	1,81



LSP out

Quality instability: Bottle Flakes to Pellets- Europe



Contaminants after roasting (based on EN ISO 15348 Anh. D; 1 h at 220 °	C)
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PVC
Polyolefins
Yellow
PA und glue
Metals
Wood
Other

mg	27	ppm
mg	440	ppm
mg	14961	ppm
mg	7293	ppm
mg	0	ppm
mg	0	ppm
mg	0	ppm
	mg mg mg mg mg mg mg	mg 27 mg 440 mg 14961 mg 7293 mg 0 mg 0 mg 0

	contents	LSP - RPET
	benzene [ppm]	0,0024
	1,3, diox	0,0011
analyses results	lemonen	0,0004
	other extractibles	0,007
	iV	0,826



Benzene performance based on PVC content in P:React





BPA behaviour in P:React

On April 20th, the EFSA has published its final assessment on BPA :

Based on all the new scientific evidence assessed, EFSA's experts established a TDI of 0.2 nanograms (0.2 billionths of a gram) per kilogram of body weight per day, replacing the previous temporary level of 4 micrograms (4 millionths of a gram) per kilogram of body weight per day. \rightarrow approx. 20.000 times lower

Source: <u>https://www.efsa.europa.eu/en/topics/topic/bisphenol</u>

BPA, the example of the French legislation on risk management In France, BPA is subject to a ban which forbids the intentional use of BPA in direct contact with foods. The interdiction of BPA use in France introduces specificities for recycled materials. The processes must ensure that the BPA concentration is as low as possible and that the risks are managed throughout the processes and in the output. As an example, some French recyclers have reported the following measures:

- Regular control of the BPA concentration at the recycling facilities.
- Additional sorting to further reduce the amount of contaminants. Source: plastic recyclers Europe & PETCore Europe

	contents	LSP - RPET	conventional SSP
	benzene [ppm]	0,0024	
	1,3, diox	0,0011	
	lemonen	0,0004	
analyses results	other extractibles	0,007	
	PBA [ppm]	0,09	0,75
	IV	0,826	

BPA in LSP-technology:

→ it is not yet 100% clear which contaminants all have an influence on the formation of BPA in the melt process: PC, glue, ...?

Next steps:

- → Further dependency trails with LSP-technology are in planning (close relationship to brand owners)
- \rightarrow Migration tests on water bottles





variation in bulk density and humidity



- ightarrow Variation in humidity are minimized and homogenised by the crystallizer/dryer
- ightarrow Variation in bulk density can be handled by using twin screw





price comparison virgin PET vs. rPET pellets

KI Polymerpreise



June 2021:	Virgin PET rPET pellets	~ 1350€/t ~ 1450€/t	}	~ 100€/t
June 2022:	Virgin PET rPET pellets	~ 1800€/t ~ 2450€/t	}	~ 650€/t
June 2023:	Virgin PET rPET pellets	~ 1300€/t ~ 1850€/t	}	~ 550€/t

- The key drivers to the R-PET market are brand pledges and legislation
- EU recycled content: The bottle industry must achieve 25% recycled content in PET bottles by 2025
- EU Packaging: 65% recycling by 2025 and 70% recycling by 2030





PET bottle collection rate in Europe and USA

Lack of harmonisation in collection systems produces varied rates across Europe



90% collection rate in 2029 77% collection rate in 2025

28,6% collection rate in 2021 means 1.9 billion pounds Source: Report Archives - NAPCOR

PET bottle collection rates 2019

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Published December 2020

Europe has a target of 77% collection of plastic bottles by 2025, under the Single Use Plastic (SUP) Directive.

Collection rat

Source: INSIGHT: European plastic bottle recycling held back by structural shortage of feedstocks | ICIS



"Bottle flakes to preform technology" (with Husky)



most energy-efficient process: LSP to direct preform process

Total saving potential (recycling and IMM process)	> 1.200.000 € investment	~ 0,3 kWh/kg saving
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LSP: Liquid State Polycondensation



Why P:REACT ?

The future of PET recycling

 Best in Class cleaning efficiency specially of the human health harmful substances

PET Improvement

- > Extremely low energy consumption
- > Unique: iV controllable system
- > Approval by FDA and EFSA for 100 % food safety



PET Recycling World is going liquid

Realised Plants: > P:Reacts in several applications like Bottle to Bottle, Sheet, Fiber and virgin application

All action alters the future. It's on us to change it for the better.

David Hehenberger Product Manager & Business Development PET

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