Circular and Biobased Performance Materials Symposium
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Session: Applying biobased polymers for new products
Presentation by: Vladislav Jašo, *Total Corbion PLA*

Title: **PLA in mechanical and chemical recycling**

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Curriculum:
Vladislav Jašo, currently works as application specialist at Total Corbion PLA, based in Gorinchem, the Netherlands. He has a PhD in Technology Engineering from the University of Novi Sad, Republic of Serbia. From 2009 to 2012, he worked as research associate and teaching assistant at the Department of Polymer Materials Engineering, at the same university. After that, 2013-2015 he worked as research associate at the Kansas Polymer Research Center in Pittsburg, Kansas, on various projects related to industrial application of bio-based polymers. In 2016 he joined first Corbion, and then in 2017 Total Corbion PLA, where he is leading various research and development projects, including those related to PLA compounding and end-of-life solutions for PLA.

Abstract:
Total Corbion PLA is a global technology leader in Poly Lactic Acid (PLA) and lactide monomers. The Luminy® PLA portfolio, which includes both high heat and standard PLA grades, is an innovative material that is used in a wide range of markets from packaging to consumer goods, fibers and automotive. Total Corbion PLA, headquartered in the Netherlands, operates a 75,000 tons per year PLA production facility in Rayong, Thailand. The company is a 50/50 joint venture between Total and Corbion.
PLA is a versatile biobased and biodegradable polymer made from annually renewable resources, offering a reduced carbon footprint versus many traditional plastics. It provides a valuable contribution towards the circular economy being biobased and biodegradable and offering multiple environmentally-friendly waste solutions. At the end of their useful life, PLA products can be mechanically or chemically recycled, or in some cases composted and returned to the soil as fertilizer.
Presentation will examine when PLA should be composted and when mechanically recycled. It will go through the available data about behaviour of PLA inside the waste sorting facilities. Possible products made from mechanically recycled PLA will be mentioned. In addition, basics of chemical recycling of PLA will be explained as well as the various applications of the recovered "building blocks". Finally, presentation will explain why chemical recycling of PLA is an attractive option.

PLA in mechanical and chemical recycling

Vladislav Jaso

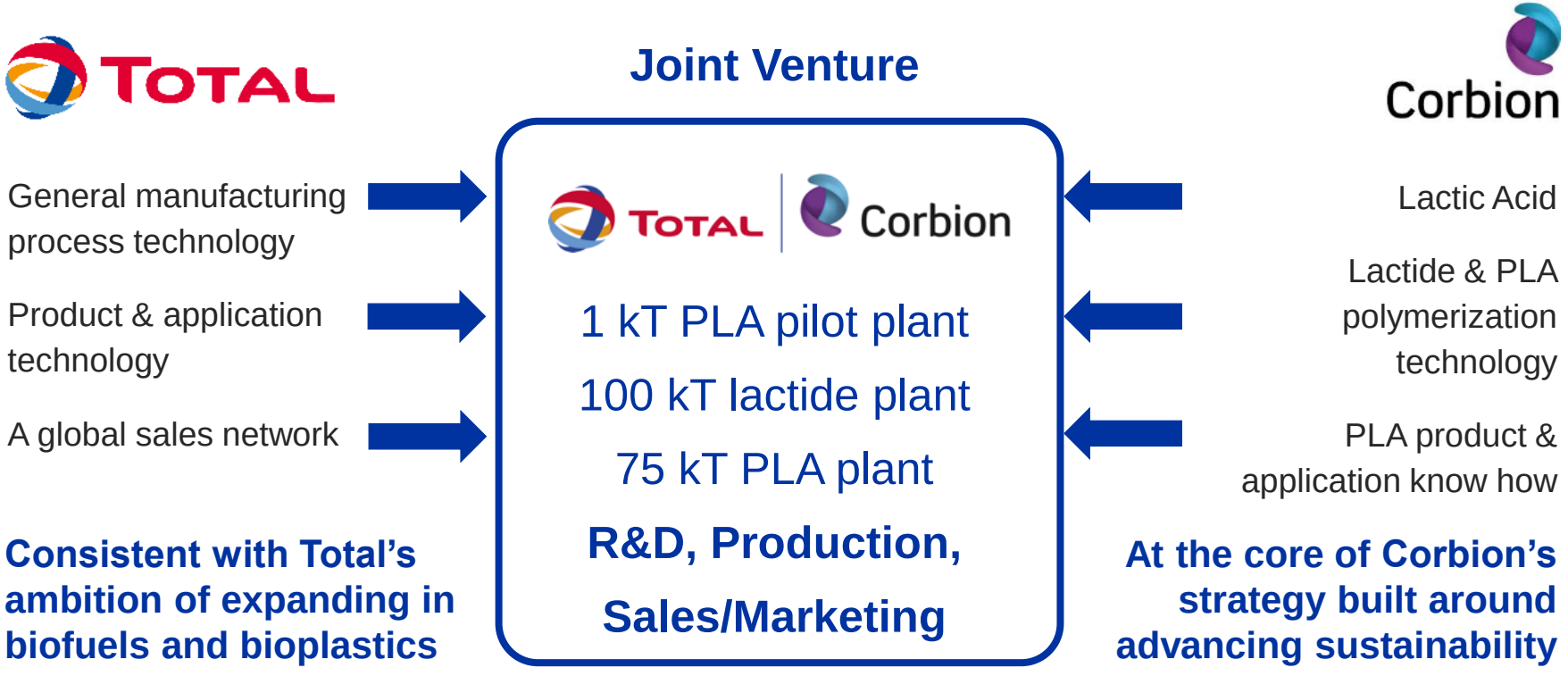
CBPM Conference,

Wageningen,

19th June 2019

Total Corbion PLA:
a 50/50 joint venture to become a major player in PLA

- Launched on 2 March 2017
- Strategic partnership to become a major player in PLA, both biobased and biodegradable, with low carbon footprint & high feedstock efficiency



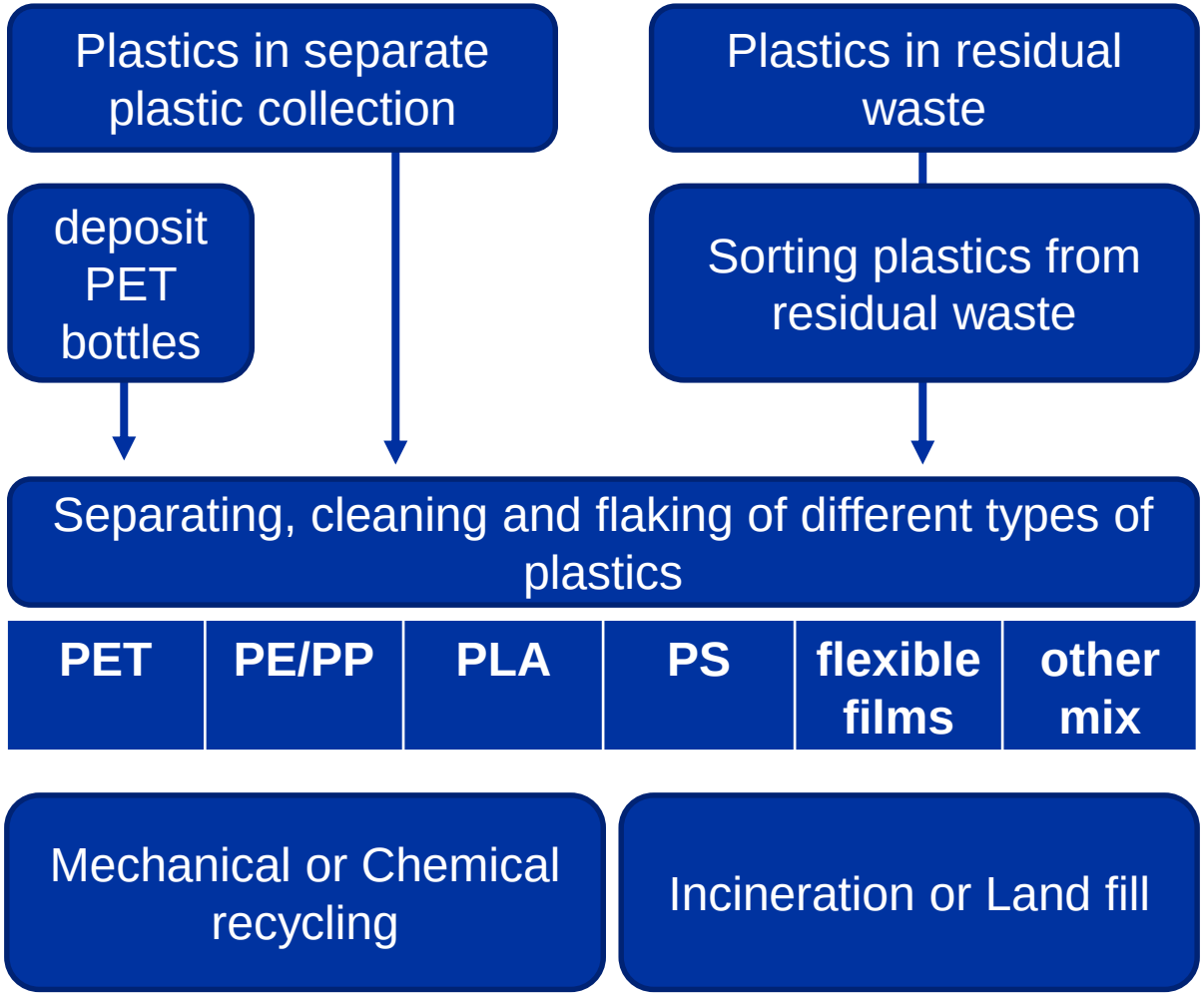
How much PLA is entering the market ?

- The global PLA market in 2017 → 140 kT PLA globally
- 33% Americas – 33% Europe – 33% Pacific → 47 kT of PLA in Europe
- 70% of bioplastics are used in packaging → 33 kT of PLA in packaging in Europe

PLA is in “shopping bag compounds” → 7-9 kT
PLA used in “flexible films– thin films” → 2-4 kT
PLA is “rigid packaging” → 21-23 kt

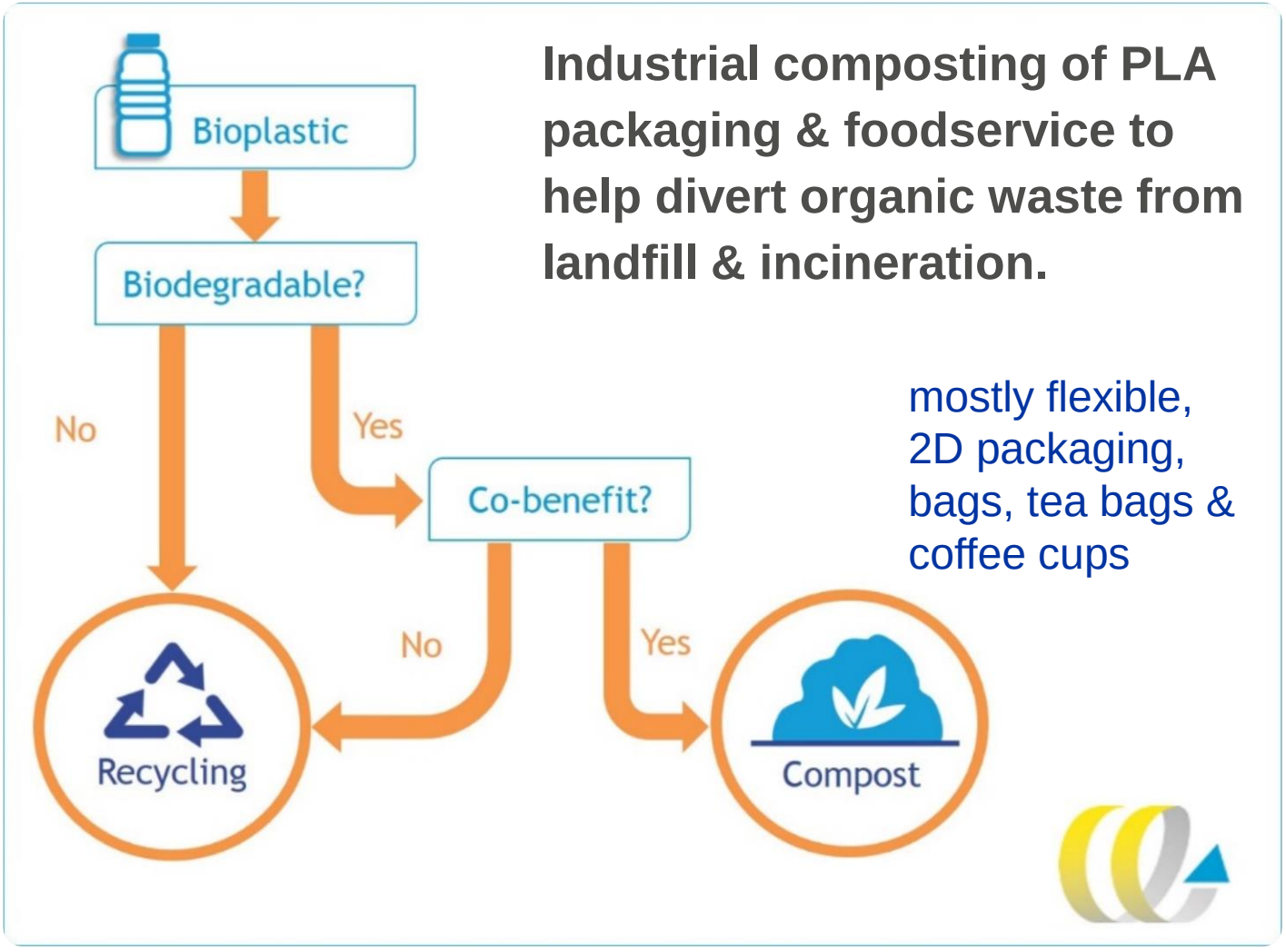
Sources: Nova, European Bioplastics, Export statistics, public documents NatureWorks and Total Corbion PLA

Simplified plastic packaging waste streams in Europe



Sources: WUR, Dutch waste collectors association, Suez, Knoten Weimar/Fraunhofer

When should PLA be recycled and when composted ?



Industrial composting of PLA packaging & foodservice to help divert organic waste from landfill & incineration.

mostly flexible, 2D packaging, bags, tea bags & coffee cups

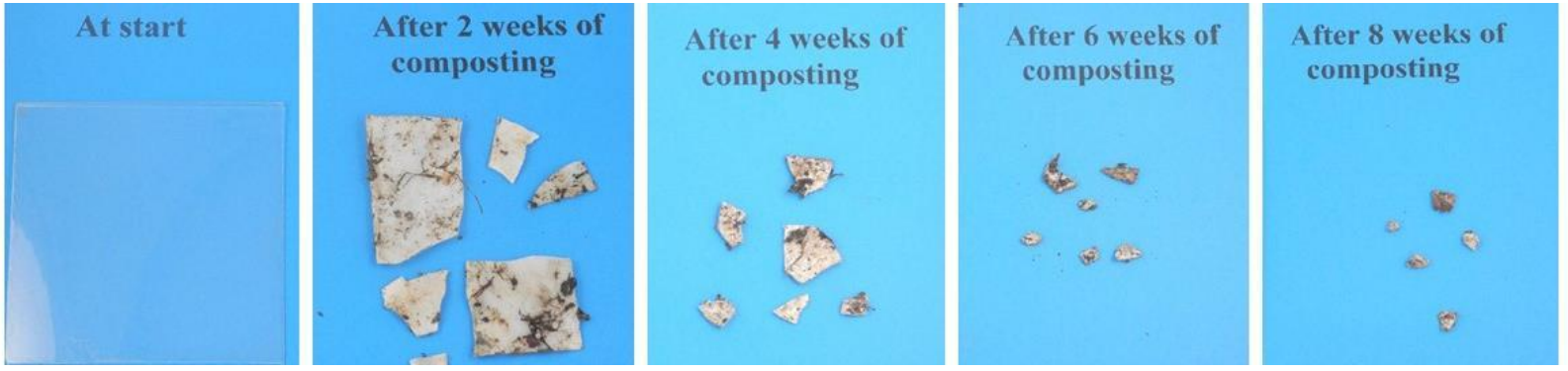
mostly rigid, 3D packaging clam shells & containers

Sources: CE Delft

PLA in composting – how does it look ?

- Luminy PLA portfolio passes EN13432
- Certified compostable by Vincotte OK Compost, EUBP Seedling and USA BPI

Industrial Composting test on Luminy PLA
Starting size PLA sheet of 10cm x 10cm:



Everything gone !

Start | 2 weeks | 4 weeks | 6 weeks | 8 weeks | 12 weeks

Sources: Organic Waste Systems

PLA in mechanical and chemical recycling

Post consumer PLA

- Near-infra red sorting technology for PLA already available and very effective

Sorting & Cleaning

- PLA recycle can tolerate up to 5% impurities

- Products from recycled PLA meet market demands
- gardening, agriculture, 3D printing, deskware

Mechanical Recycling

Chemical Recycling

- Recycle back to PLA, Lactide or Lactic Acid

How well can PLA be sorted out from other plastic waste ?

- **Near-Infrared (NIR)** sorting is the industry's preferred plastics sorting technology because it can accurately identity many different polymers.
- With NIR PLA can be identified in the mixed waste plastics stream with very high accuracy.

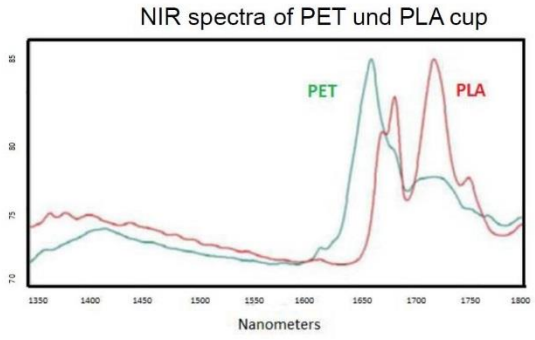


Table 2 Output purity for whole item Near Infra Red (NIR) sorting — WRAP

Polymer	PP	PE	PET	PS	PVC	PLA	Throughput
Purity Achieved*	96%	94%	94%	87%	93%	97%	3 tph

*Representative output purity for NIR Sorting

Titech/Primo Water Cooperation: "On a sorting line, running at industrial speeds, NIR can be used to sort out PLA- and PET-bottles. The resulting r-PET can be further processed without any negative impacts when compared to a reference stream of r-PET."

Knoten Weimar/Fraunhofer: "When PLA is present in the plastic waste, and less than 3.5% of the PLA will end up in the PE/PP/PET fractions when NIR is used to sort out PE/PP/PET.
The vast majority of PLA will end up in the mix waste fractions"

Sources: WRAP, Titech/Primo Water Cooperation, Knoten Weimar/Fraunhofer

Mechanical recycling of PLA

PLA mainly reused in non-food applications:

- Agriculture and gardening
- 3D printing applications
- Office utilities (pens, etc..)
- …

Abbildung 15: (Links) PLA Rezyklat aus dem Industrieabfall (Stanzgitter, Input Bösel Management GmbH), (Rechts) PLA Rezyklat des post-consumer PLA Abfall S.

Looplife:
Datasheet for commercially available r-PLA

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TECHNICAL DATA SHEET

LOOPLIFE r-PLA

Biopolymer

R-PLA20A-30-MK / GRADE

REPROCESSED POLYLACTIDE / PRODUCT NAME

Description

r-PLA grades from LOOPLIFE POLYMERS are reprocessed material obtained from sources of polylactide (PLA) which is a biodegradable, thermoplastic polyester derived from renewable resources through fermentation of agricultural by-products such as corn starch or other carbohydrate-rich substances like maize, sugar or wheat.
R-PLA grades are a sustainable alternative to petrochemical-derived products and have a wide range of applications.
They are not suitable for food-contact applications.

PHYSICO-CHEMICAL PROPERTIES

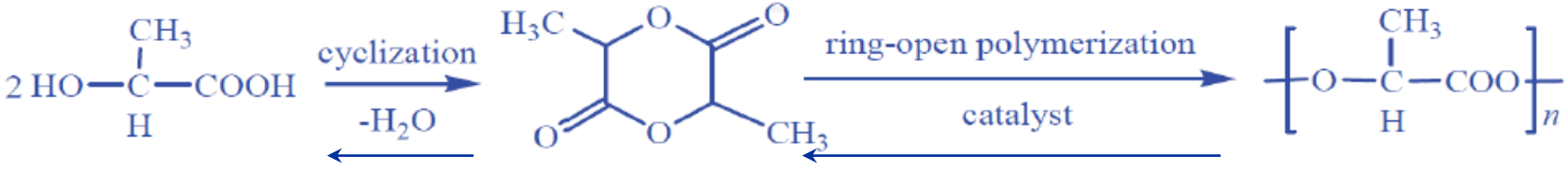
Chemical name	Polylactide resin							
Granulometry	*pellets/g*	30	-	95	Residual moisture	*ppm*	Max	3000
Density	*g/cm³*	1,26			Ash content @450°C	%	1,7	
Melt index @190°C, 2,16kg	*g/10 min*	15	-	30	Melt index @230°C, 2,16kg	*g/10 min*		-
Melt index @190°C, 5kg	*g/10 min*		-		Melt index @230°C, 5kg	*g/10 min*		-

Sources: Looplife, WUR, IfBB, Total Corbion PLA, Bösel

TOTAL | Corbion

What is Chemical recycling of PLA ?

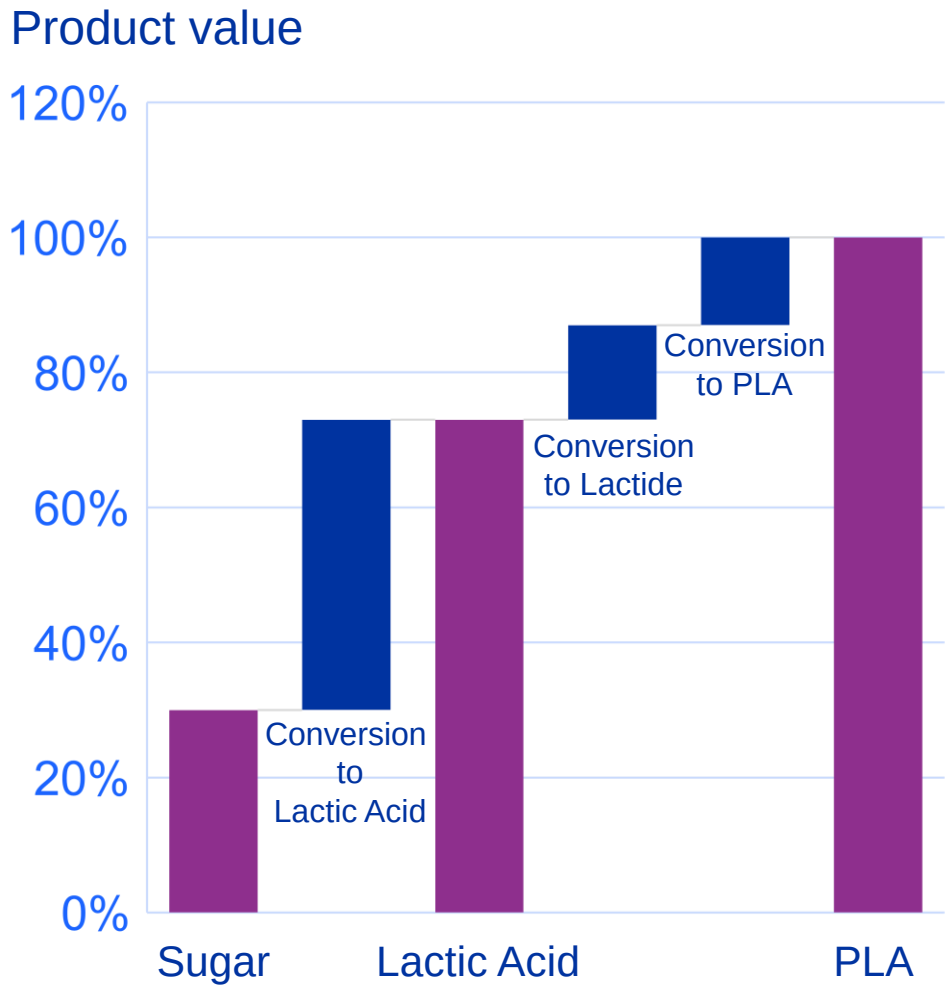
Chemical recycling:
breaking PLA back into its “building blocks” + re-using those “building blocks”.



Lactic Acid	Lactide	PLA
Applications: - Lactide - Textile industry - Leather industry - Cleaning products	Applications: - PLA - Sealants & adhesives - Coatings	Applications: - Same as virgin PLA

Why is chemical recycling of PLA attractive?

- Lactic Acid contains over 70% of the “value” of PLA - conversion of LA to PLA is “only” a small step.
- PLA can be reworked into Lactic Acid or Lactide – for both materials an extensive end-use market exists.
- The hardware to convert PLA to lactide or lactic acid is already in place in our 75kT PLA plant.
- Industrial PLA recycle is already being chemically recycled in our new 75kT PLA plant.



Main conclusions

- In 2017 ~ 0.2% of plastics packaging contains PLA
- In 2025 8% to 14% of plastics packaging ending up at plastics waste sorting facility could be made from PLA.
- PLA is easy to separate using NIR and when using NIR PLA does not end up in PE/PP/PET fractions
- A market for r-PLA already exists and r-PLA is used in a range of applications
- Chemical recycling of PLA is attractive and the high value of lactic acid is in that case fully preserved.

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