Sorting of bioplastics

Natalia Nowak
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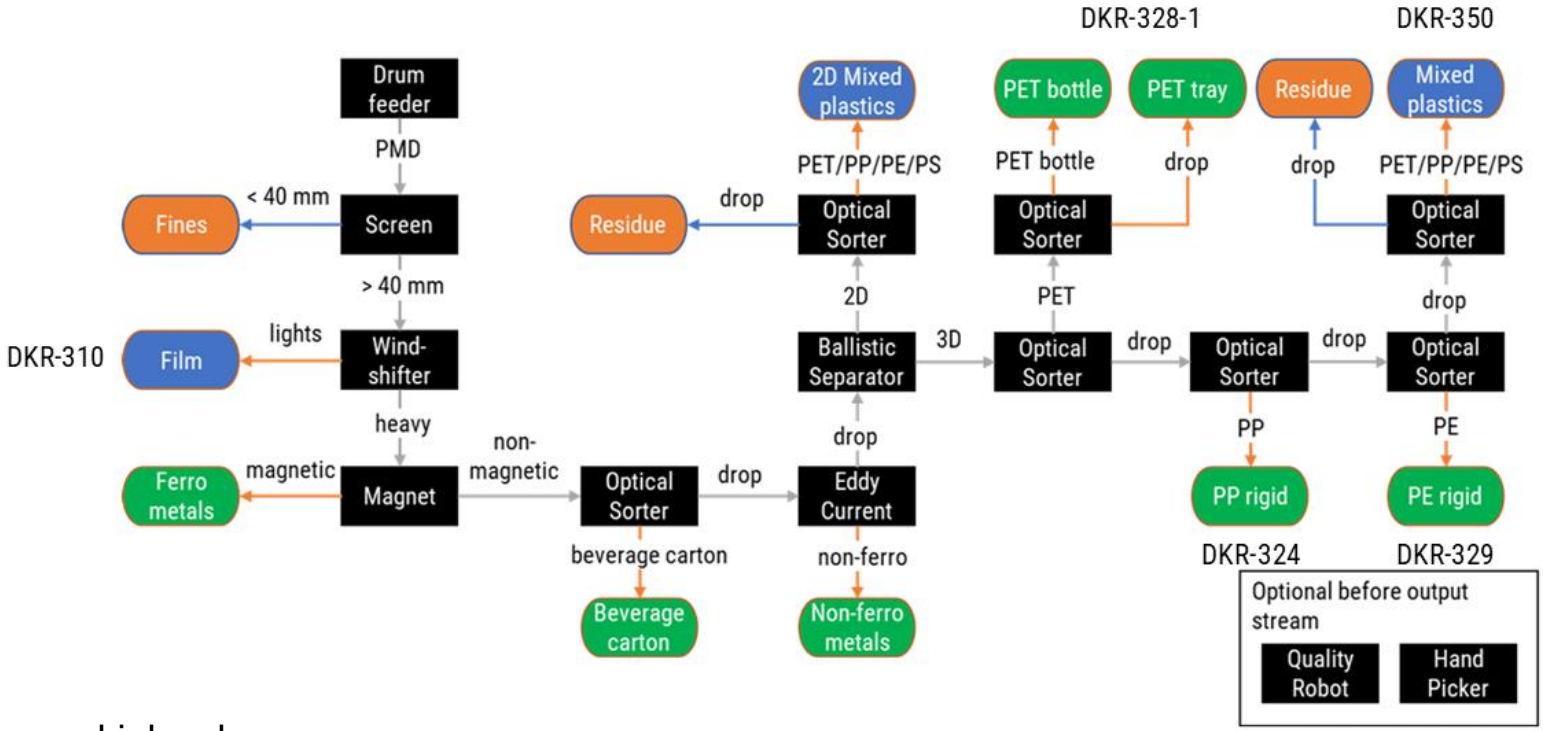
The project is supported by the Circular Bio-based Europe Joint Undertaking and its members under grant agreement Nº 101157907. Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CBE JU. Neither the European Union nor the CBE JU can be held responsible for them.

Circular Bio-based Europe Joint Undertaking

Bio-based Industries Consortium

Co-funded by the European Union

Why sort bioplastics?



Green = high value
Blue = needs further sorting
Orange = incinerated

Not identified → not sorted → residue → incineration

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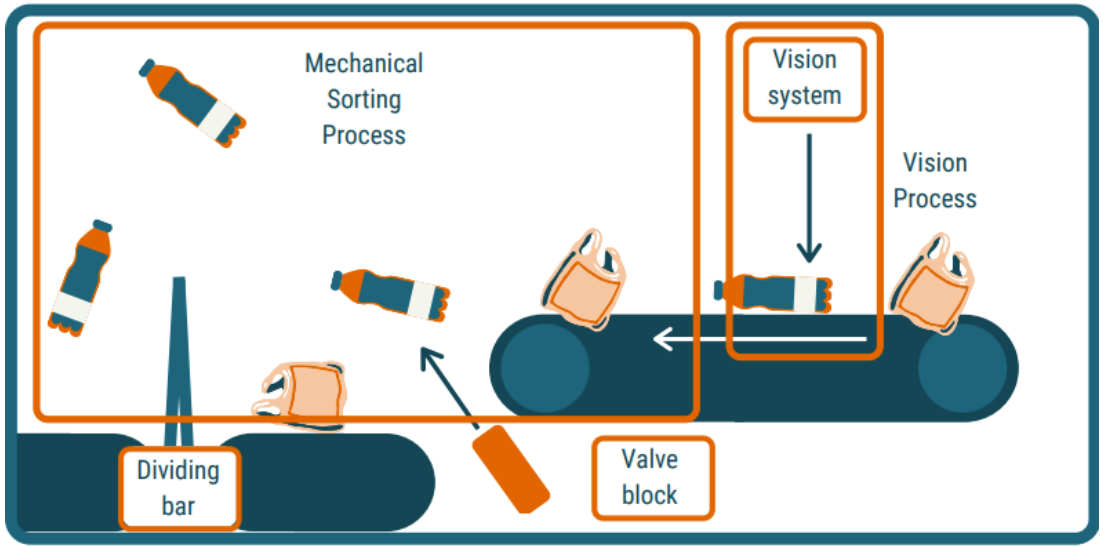
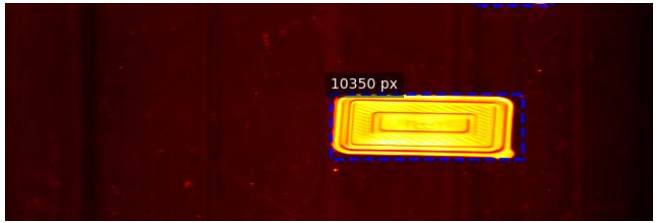
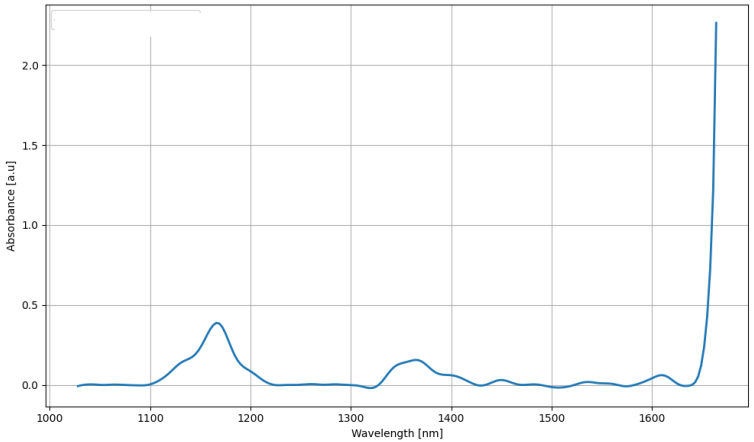
Heart of the sorting line



How does the NIR sorter work?

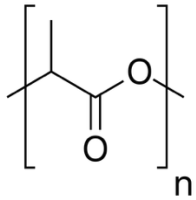




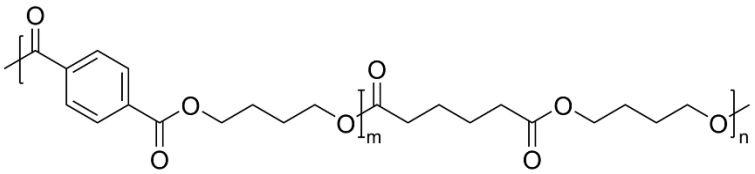
Material	Fit
PE	0.12
PP	0.36
PET	0.43
PVC	0.21
PLA	0.98

Sorting decision

What is fit based on?

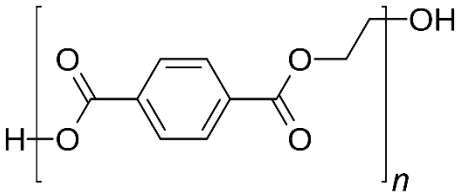


Poly(lactic acid)
PLA

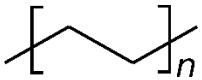


Poly(butylene adipate-*co*-terephthalate)
PBAT

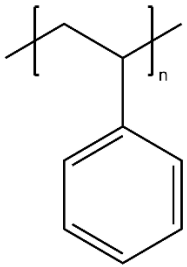
VS.



Poly(ethylene terephthalate)
PET

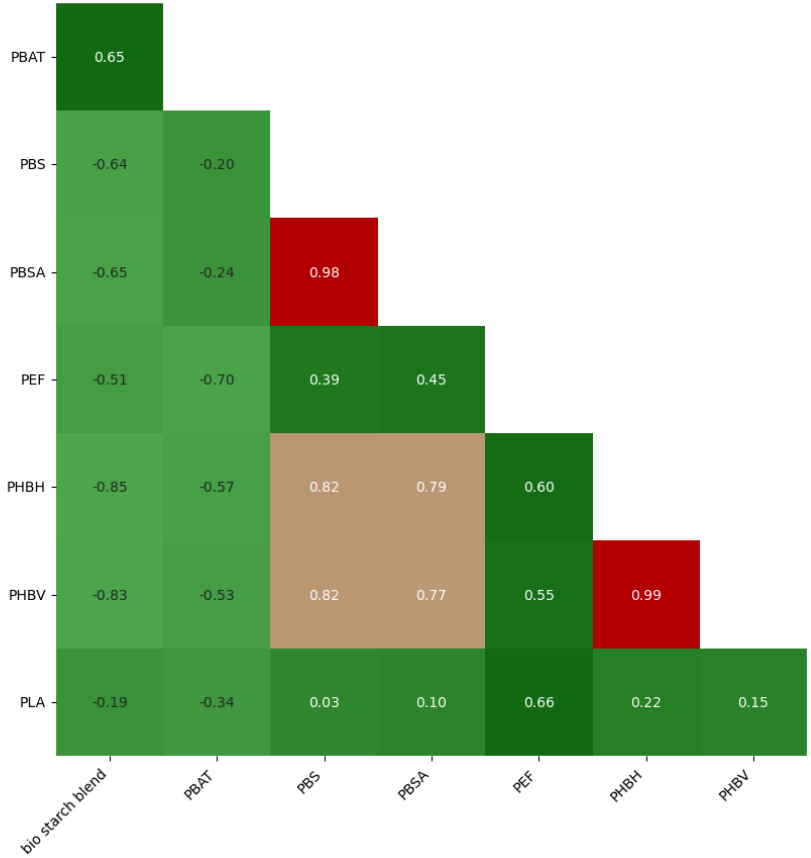


Polyethylene
PE



Polystyrene
PS

Spectral similarity of bioplastics



1. PBS and PBSA are too similar
2. Different PHA types are too similar

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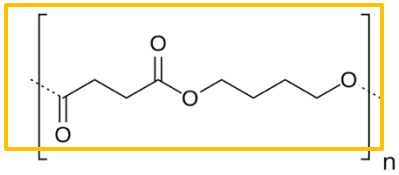
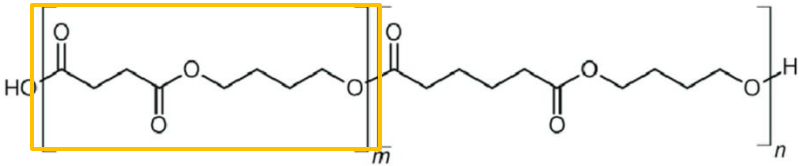
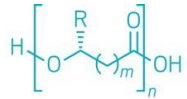


Poly(butylene succinate)
PBS

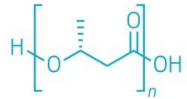


Poly(butylene succinate-*co*-adipate)
PBSA

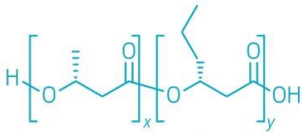


Polyhydroxyalkanoate

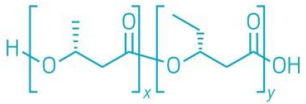
R = alkyl



Poly-(*R*)-3-hydroxybutyrate (PHB)

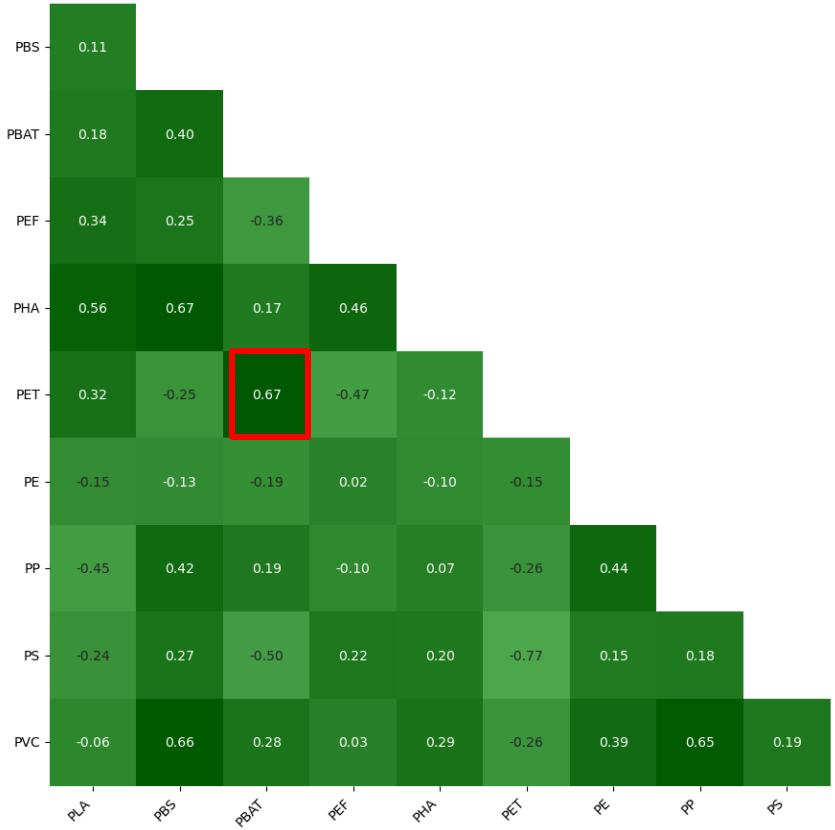


Poly(3-hydroxybutyrate-*co*-3-hydroxyhexanoate) (PHBH)



Poly(3-hydroxybutyrate-*co*-3-hydroxyvalerate) (PHBV)

Are bioplastics different enough?

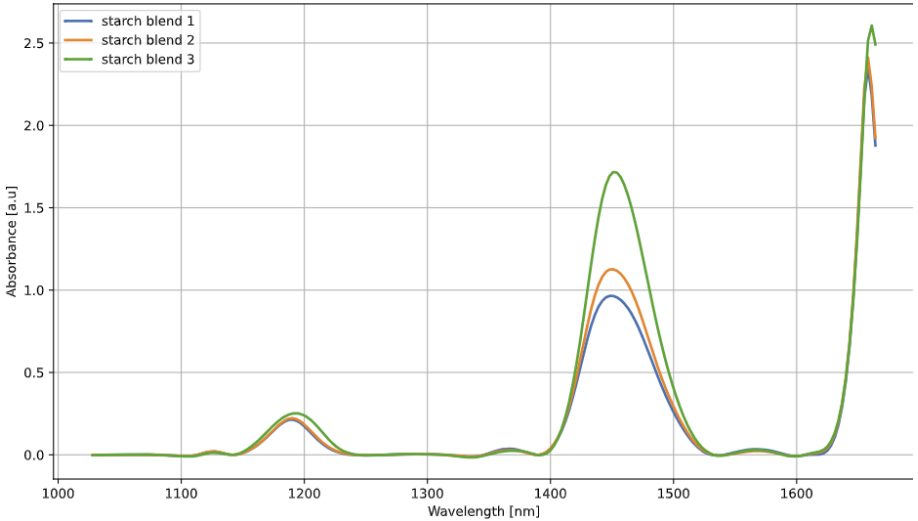


Bioplastics are spectrally different from conventional plastic

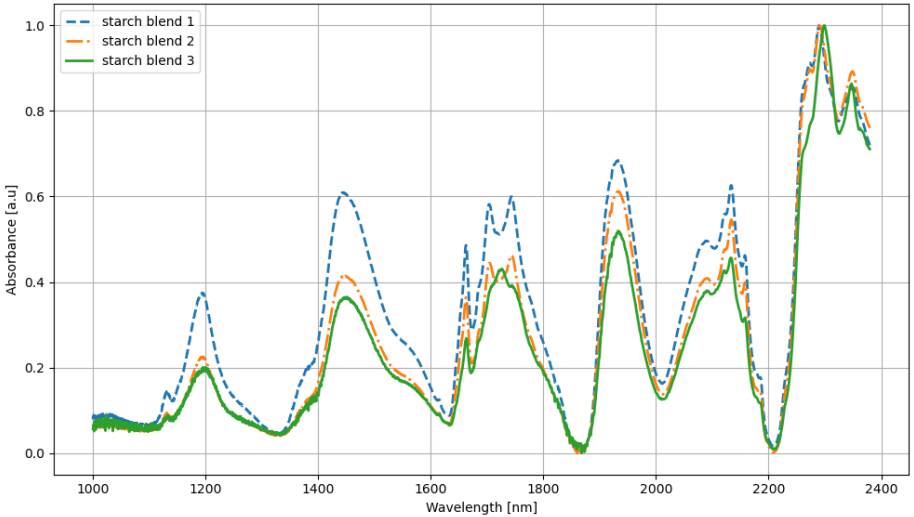
There is a similarity between PBA**T** and PE**T** (terephthalate)

And blends?

Starch blend = PBAT + starch



NIR (optical sorter)



FT-NIR

Identification of bioplastics

Conclusions

- Conventional plastics do not interfere with the detection of bioplastics
- Most bioplastics can be discriminated from each other
- PBS and PBSA are spectrally too similar
- Different types of PHA (e.g. PHBH, PHBV) cannot be distinguished
- Bioplastic blends with different compositions → different spectra → hard to sort

NIR scanning of Dutch waste

- Around 600 kg of mixed film and 800 kg of sorting residue stream processed
- **0.44%** (area) bioplastics in sorting residue

  0.12% (area) bioplastics in mixed film

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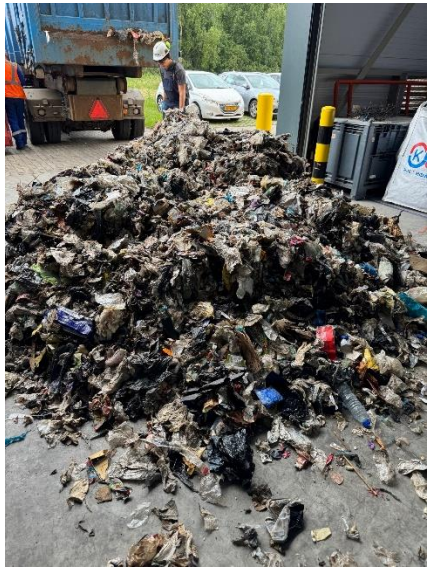

Sorting trial with bioplastic spiked streams

Input

1. PLA cups, trays + lids = 200 kg
2. 2. Biopolyester seedling pods = 130 kg
3. 3. Biopolyester film = 100 kg

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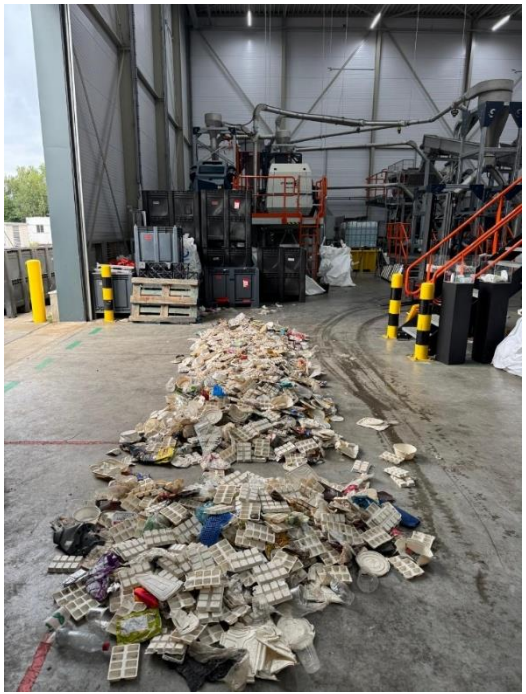
Sorting trial with bioplastic spiked streams

Mixing and compression of bioplastics with 3.4 ton of LWP

Sorting trial with bioplastic spiked streams

Output

PLA rigid
Purity: 95%



Biopolyester rigid
Purity: 83%

Biopolyester film
Purity: 70%

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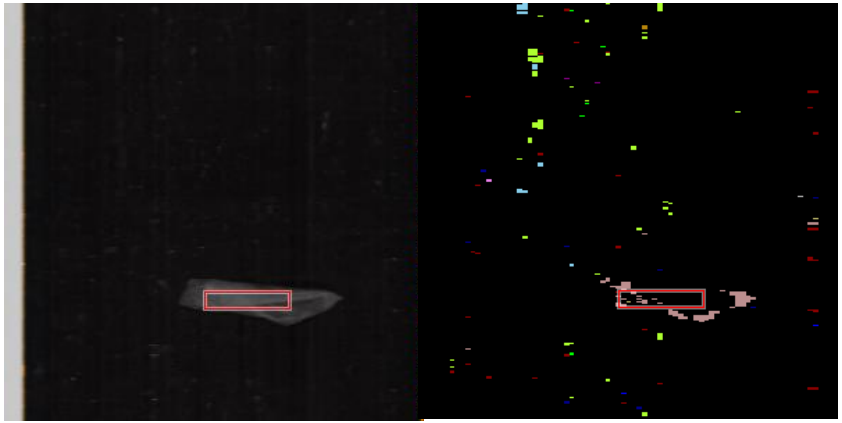
Sorting trial with bioplastic spiked streams

Low film yield

- Detection issues
- Bioplastic films are adhering to other objects



Anzahl aller Detektionen	520 px	
Unbekannt-Detektionen		
Klassifizierung	0 px	0,0 %
Materialverteilung		
PP_3D	0 px	0,0 %
PLA+Talcum	0 px	0,0 %
PBSA	0 px	0,0 %
STARCH-BLEND	251 px	48,3 %
PHA	2 px	0,4 %
PEF	1 px	0,2 %
PBS_A-Talcum	0 px	0,0 %
PBS	0 px	0,0 %

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Thank you.

www.prosperbioplastics.eu
info@prosperbioplastics.eu

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