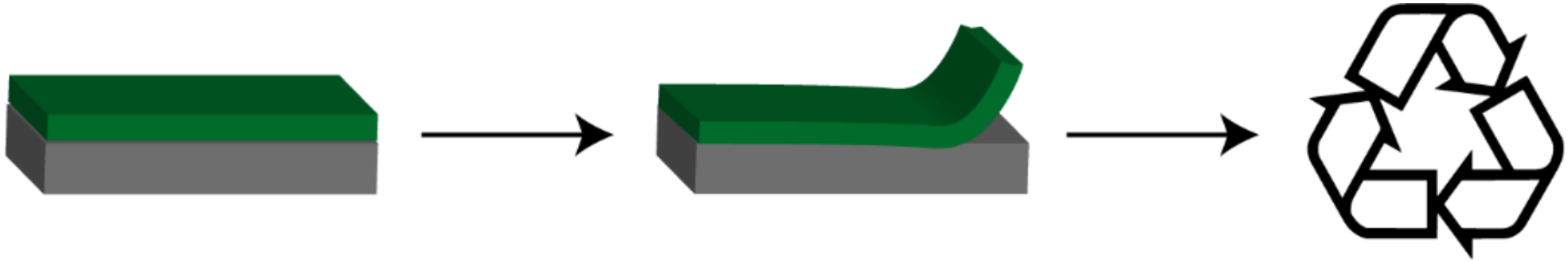
Fachhochschule Nordwestschweiz
Hochschule für Technik

Deinking and delamination of printed plastic food packaging for recycling

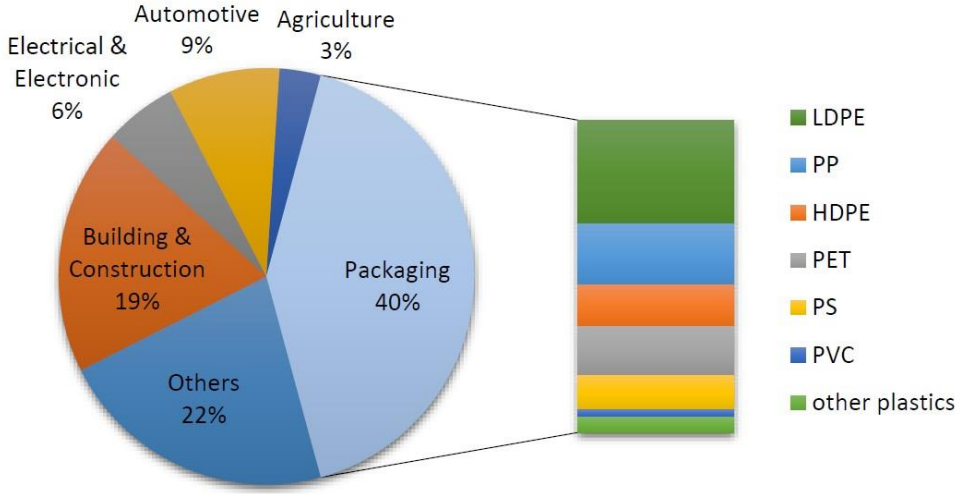


DePoly SA
Siegwerk Druckfarben AG & Co
INKA FHNW

Marianne Wink

The «plastic problem»

In Switzerland
125 kg of plastic waste per person each year
25-30 % technically recyclable

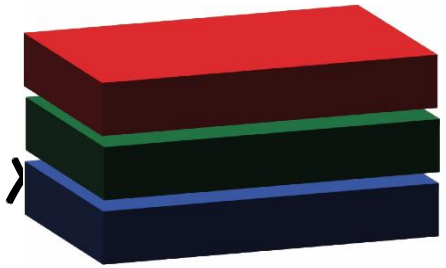


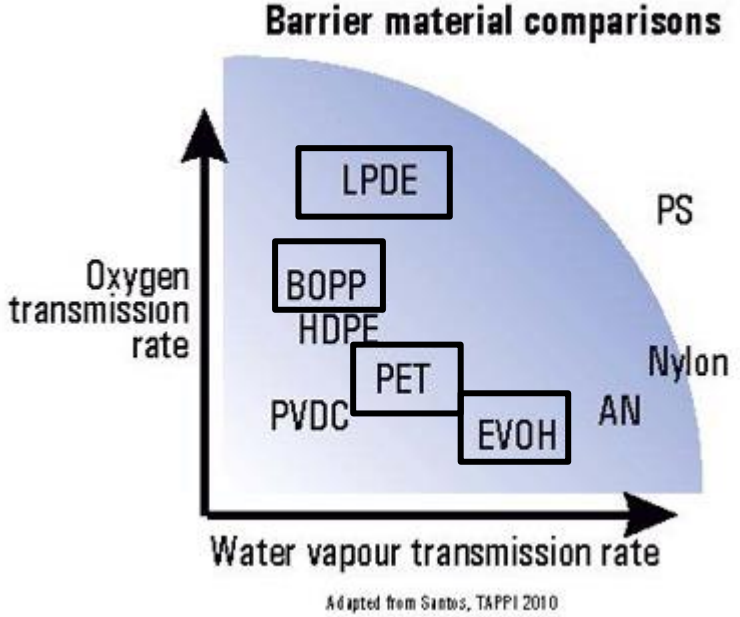
Kaiser 2017

… and yet it preserves food very well!

Why is plastic packaging not really recycled yet?

(✓)





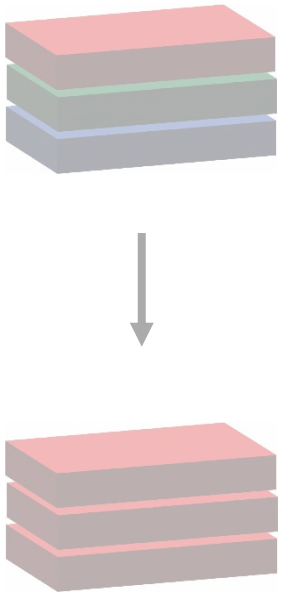
Plastic food packaging is often made from multimaterial laminates and includes inks, varnishes and adhesives that prevent its recycling!

Appearance

Mechanical stability

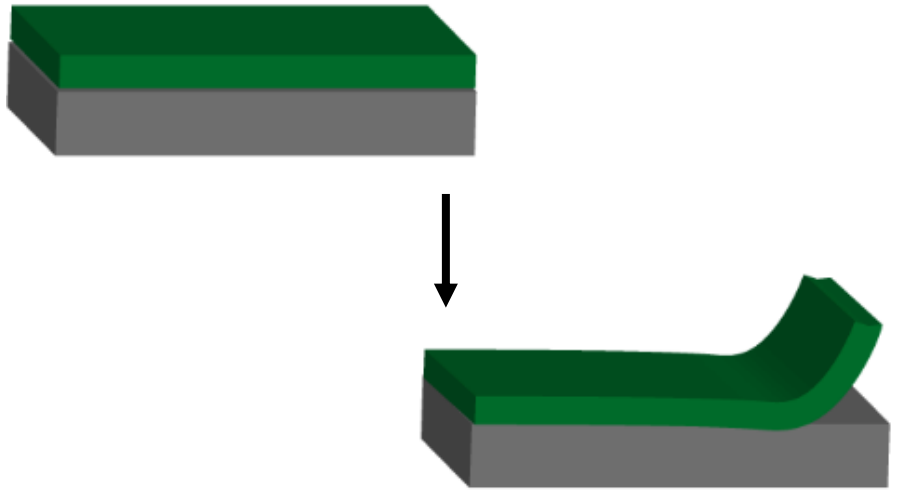
How can we make packaging circular?

monomaterial



deinking

delamination



bio-based

Bio-based is not the same as biodegradable!

What are inks made of?

Pigments

Binder

Water-based inks

dispersed in water

not very common in food packaging

very easy to deink

Solvent-based inks

dispersed in solvent

most common in food packaging

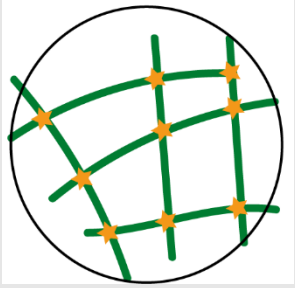
can mostly be deinked with current techniques

UV inks

without solvent, cures to 100% solid

sometimes used in food packaging

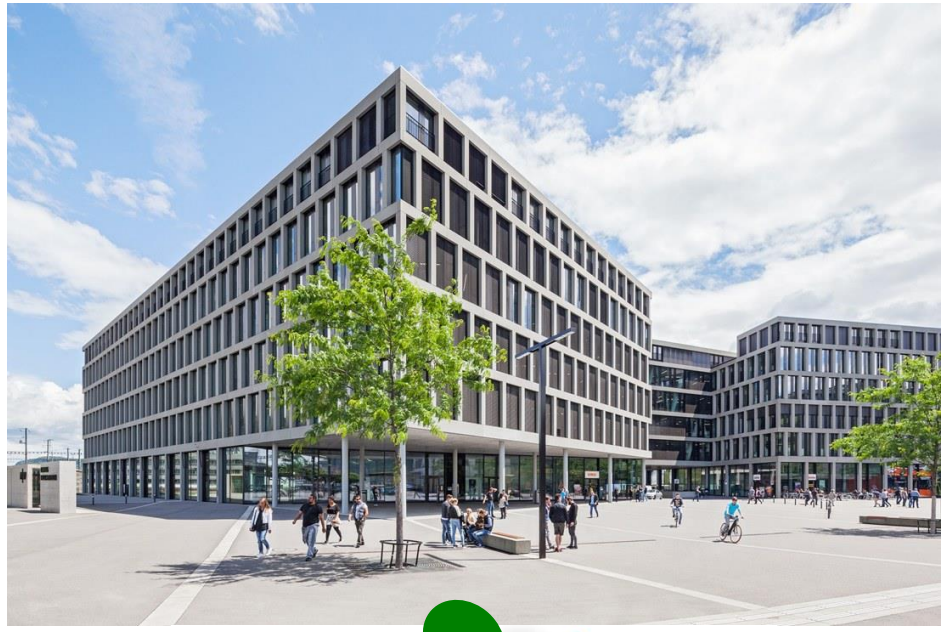
very hard to deink



What is state-of-the-art deinking?

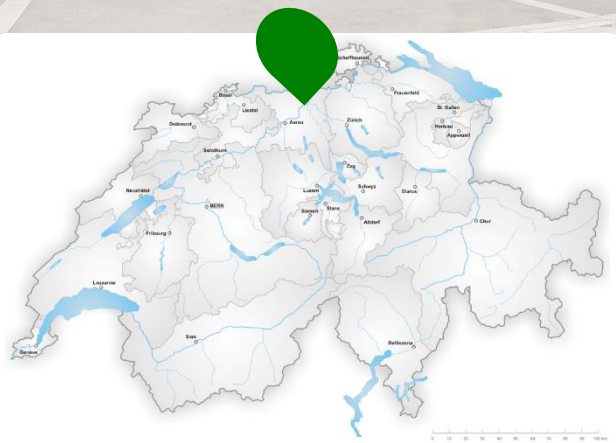
CADEL DEINKING	Solvent-based processes	Oxidizing inorganic acid
Patented technology Market entry 2020 (Erema)	On the market	Patents filed by Gent University and Borealis in 2021
Tenside & base at high T	Solvents at high T	Strong acid at high T
Fails with UV inks without dedicated primers	Fails with UV inks and overprint varnishes	Deinks all ink chemistries

The team: Institute of Polymer Nanotechnology at FHNW



Dr. Marianne Wink

Katerina Zvolska



Knowledge in polymers and their surfaces

The team: DePoly

Dr. Christopher Ireland

Dr. Pelin Uran

Enhanced recycling of PET plastic

The team: Siegwerk

Thomas Glaser

Dr. Ralf Leineweber

Dr. Andrey Charkovskiy

Pioneer in circular and deinkable inks

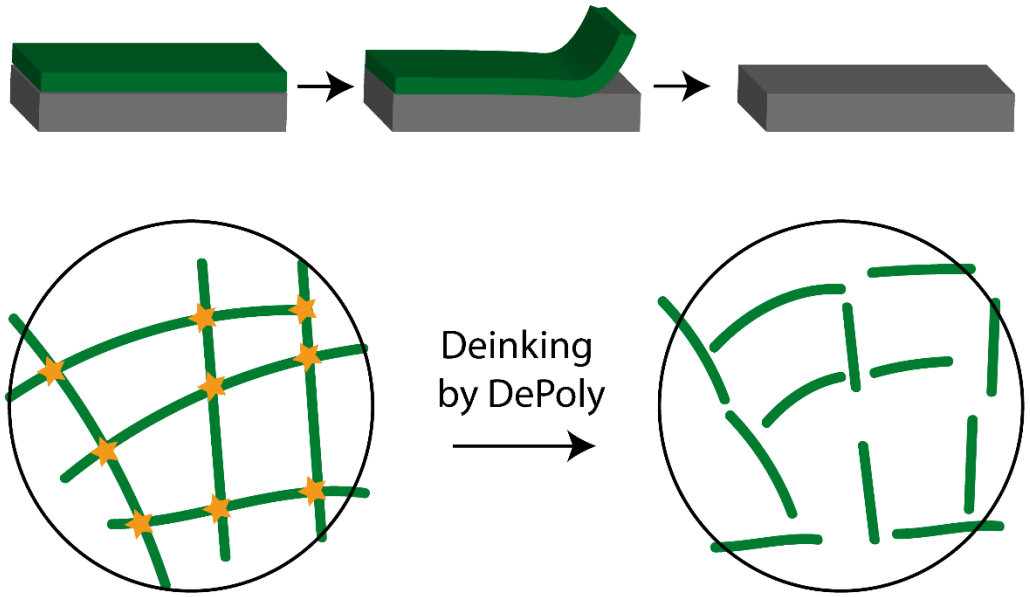
Why we joined forces

Siegwerk's inks

DePoly's process

FHNW's equipment park

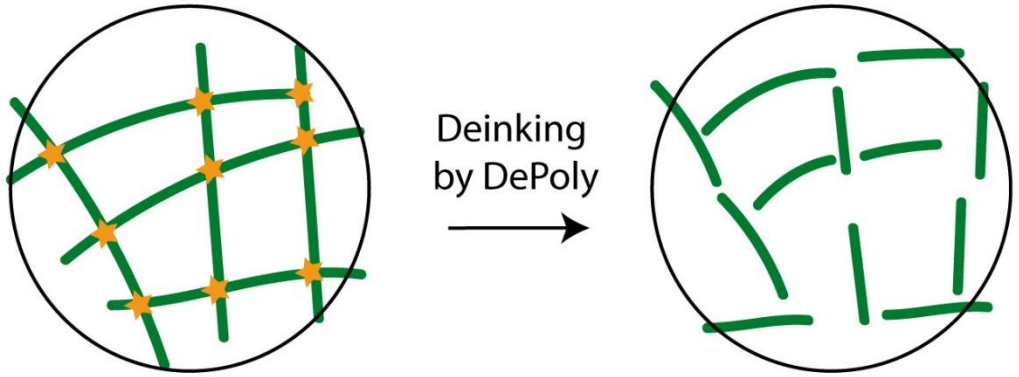
All our knowledge



What makes our process unique?

Applicable to **all types of inks** found in food packaging

Process runs **at room temperature and ambient pressure**



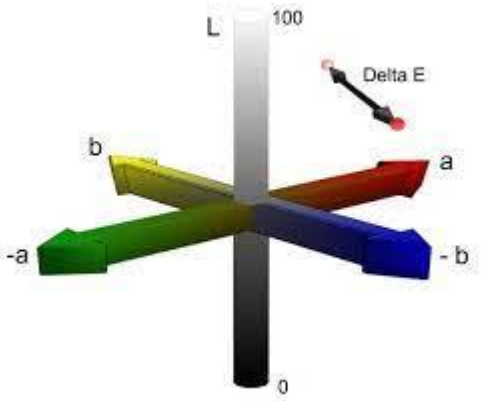
Removes **OPVs**

Can **delaminate** multimaterial packaging and remove the ink between 2 layers

No **wastewater** issues

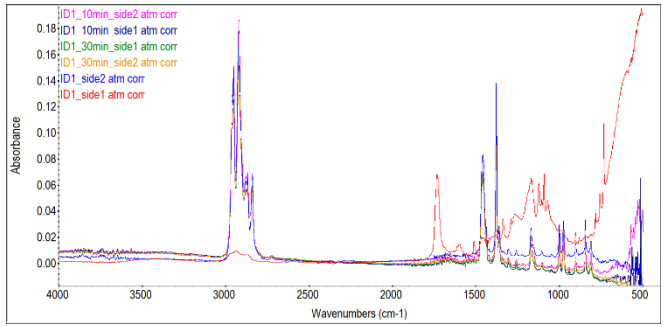
What properties matter after deinking?

Colour measurement



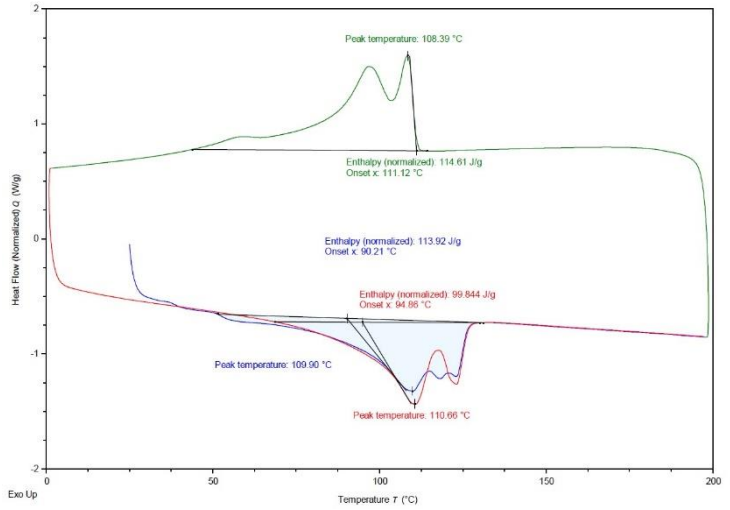
Deinking successful?

Chemical properties



Deinking and delamination successful?

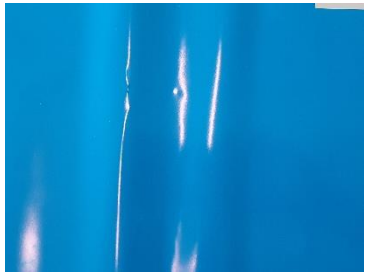
Thermal properties



Delamination successful?

Signs of degradation?

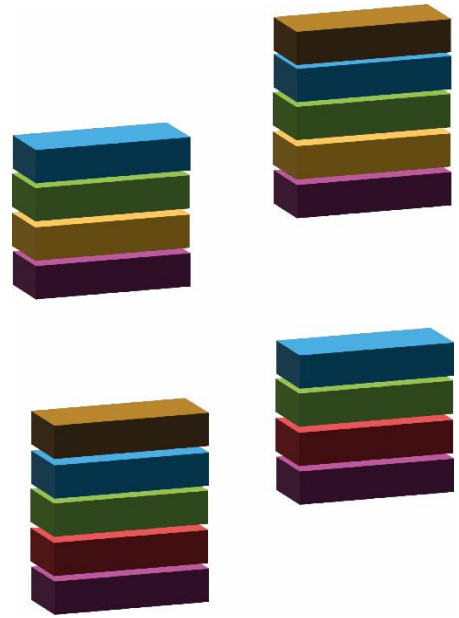
Types of samples



UV inks with
and w/o OPV

SB inks with 1K
or 2K OPV

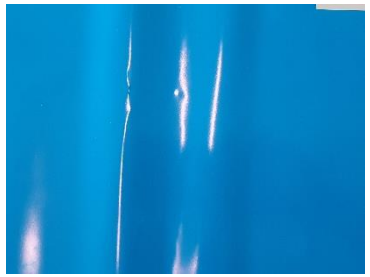
Laminates with
interlaminar ink

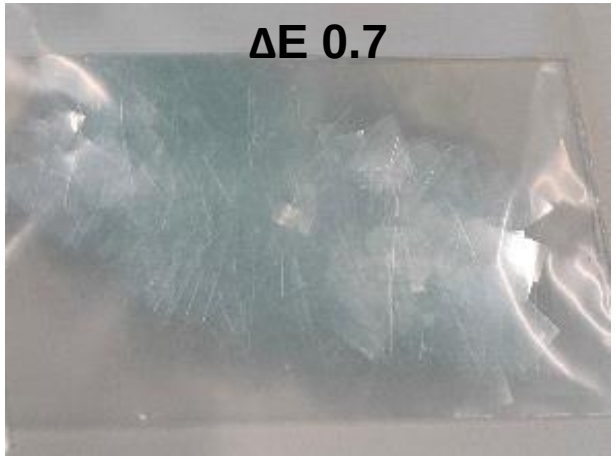


Siegwerk customer
samples

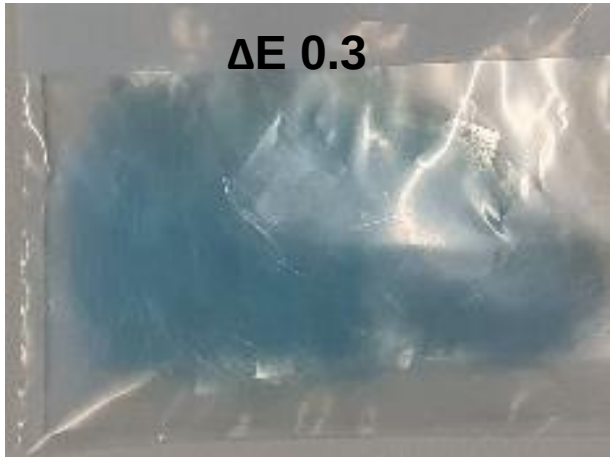
Deinking of UV inks on PP film

without overprint varnish





with overprint varnish



Conditions

DePoly's reaction run at room temperature for 1 or 2 hours.

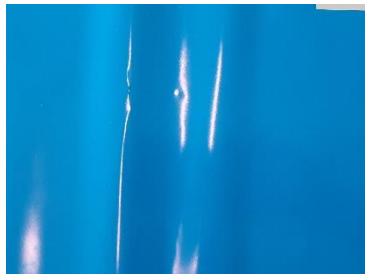
Results

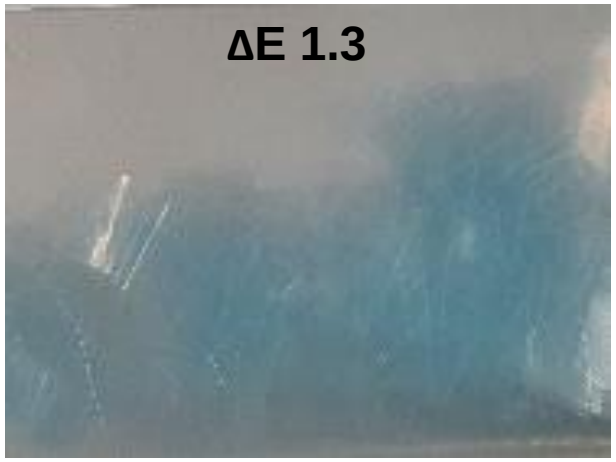
Deinking successful!

No signs of damage to the PP film resulting from the deinking process!

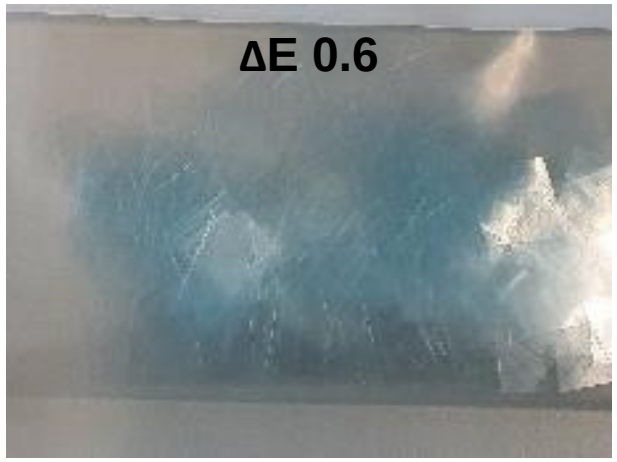
Can we be faster?

without overprint varnish





with overprint varnish



Conditions

DePoly's reaction run at room temperature for 10 or 30 minutes.

Results

Deinking successful!

No signs of damage to the PP film resulting from the deinking process!

Deinking of solvent-based inks

with overprint varnish

with 2K OPV

Conditions

DePoly's reaction run at room temperature for 1 and 2 hours.

Results

Deinking not complete!

No signs of damage to the PE film resulting from the deinking process!

Can we optimize the washing conditions?

washed with water

washed with surfactant

Conditions

Washing with water or with surfactant mixture.

Results

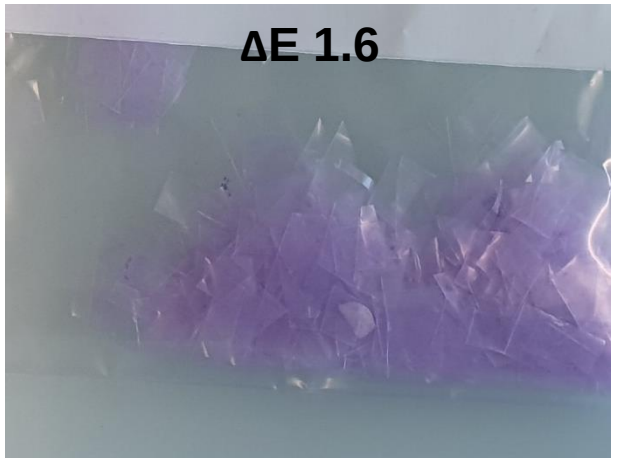
Deinking complete!

No signs of damage to the PE film resulting from the deinking process!

Deinking of model PET-PE laminate

reaction at RT

reaction at 50 °C



Conditions

DePoly's reaction run at room temperature and at 50 °C for 2 hours.

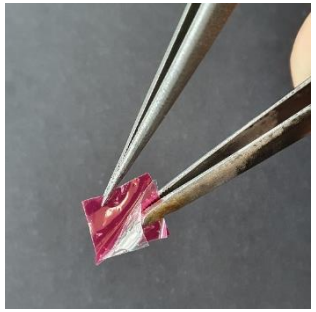
Results

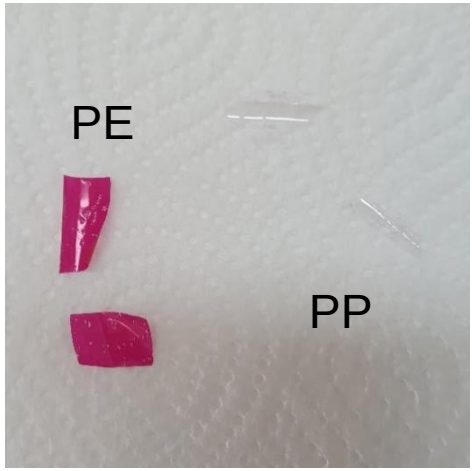
Deinking complete after 2h at 50 °C!

PET film has been delaminated and we get a PE film at the end of the reaction!

Deinking of model PE-PP laminate

delamination in solvent





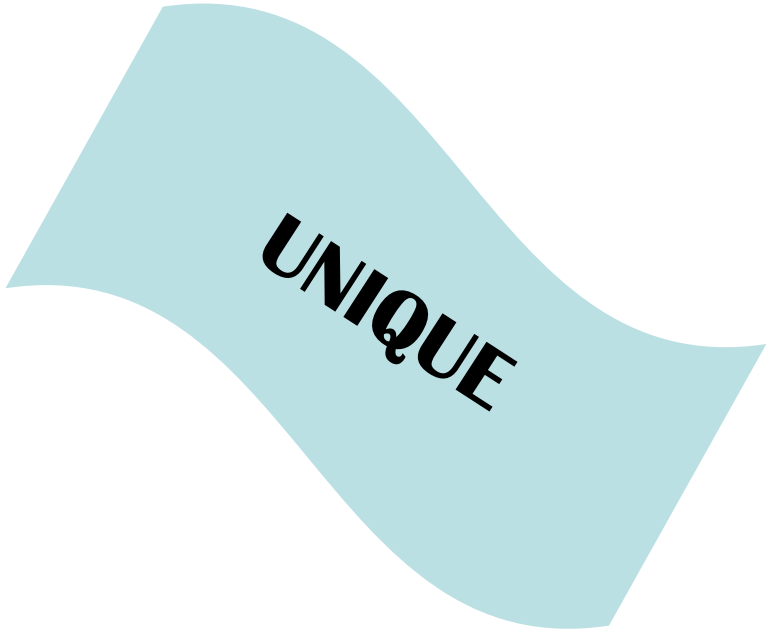
Conditions

DePoly's reaction run for 2 hours at room temperature.

Results

Deinking and delamination failed completely with DePoly's reaction!

Impact and limitations



We can deink

… any type of ink

… some require additional post-processing

… interlaminar ink in PET-PE laminates

… in 10 minutes for surface-printed films and 2 hours for laminates

… and can reuse our wastewater several times

… and can retrieve the raw materials for PET plastic production in the case of PET-PE laminates

We cannot deink PE-PP laminates without delamination!

Deinking of customer samples: coffee pouch

OPV
PET
ink
Al barrier
PE

reaction at RT

reaction at 50 °C

Conditions

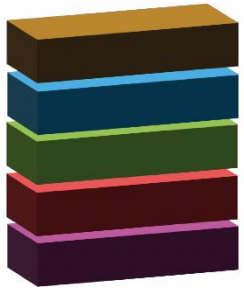
DePoly's reaction run at room temperature and at 50 °C for 2 hours.

Results

Delamination of PET and deinking complete after 2h at RT already!

Al remains on the PE and requires some post-processing.

Deinking of customer samples: meat packaging



matte lacquer
PET
ink
EVOH barrier
PE

reaction at RT

reaction at 50 °C

Conditions

DePoly's reaction run at room temperature and at 50 °C for 2 hours.

Results

Delamination complete and deinking partially complete after 2h at 50 °C!

Post-processing is under investigation.

Deinking of customer samples: pasta packaging

PET
ink
EVOH barrier
PE

reaction at RT

reaction at 50 °C

Conditions

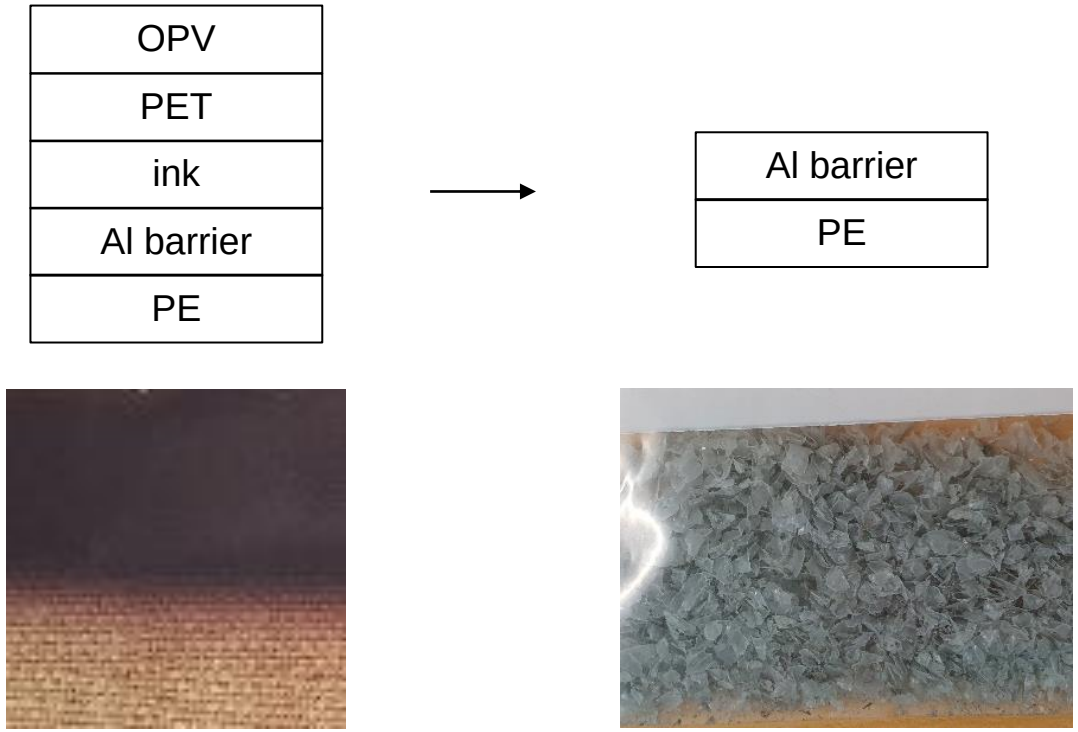
DePoly's reaction run at room temperature and at 50 °C for 2 hours.

Results

Delamination and deinking complete after 2h at 50 °C!

Post-processing is under investigation.

Take home message



We can recover both PET and PE from multilayer packaging for recycling

… using DePoly's process without toxic chemicals

… at RT or moderate temperatures

… without producing large amounts of contaminated wastewater

… without changes to packaging design

Thank you!