PROGRAMME DE COOPÉRATION TRANSFRONTALIÈRE
GRENSOVERSCHRIJDEND SAMENWERKINGSPROGRAMMA

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@InterregFWVL

Solvent geassisteerde Recyclingtechnieken voor Plastic Afval

Prof. Steven De Meester

Myrofora Stefanidou

GHENT UNIVERSITY

AVEC LE SOUTIEN DU FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL
MET STEUN VAN HET EUROPEES FONDS VOOR REGIONALE ONTWIKKELING

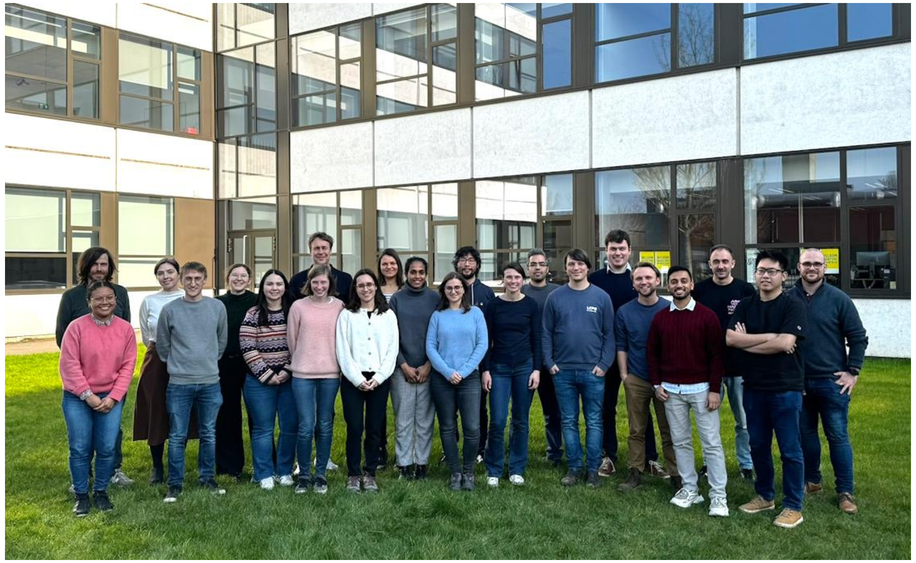
Laboratory for circular process engineering

Interreg
Cofinancé par l'Union Européenne
Medegefinancierd door de Europese Unie
France - Wallonie - Vlaanderen
CIRCOPLAST

LCPE
Laboratory for Circular Process Engineering

- Universiteit Gent Campus Kortrijk
- Opgericht in 2016, nu een 30 tal onderzoekers

Focus van de groep:
Verwijderen van polymerische vervuiling, labels, kleur, geur, additieven en andere onzuiverheden



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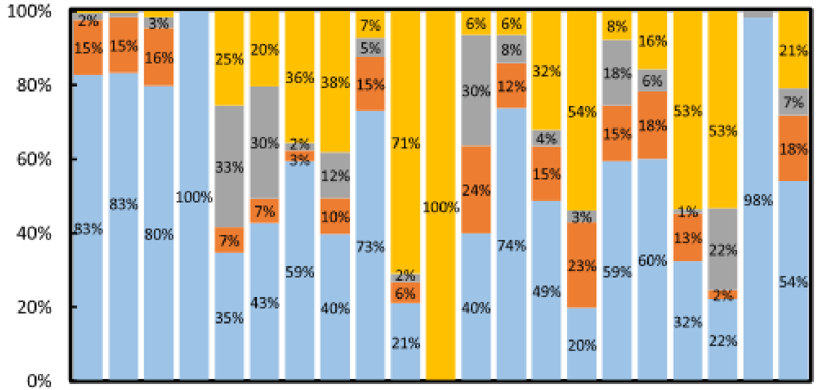
Karakterisatie van afval gecombineerd met materiaalstromen analyse

Environmental Science & Technology

Detailed Analysis of the Composition of Selected Plastic Packaging Waste Products and Its Implications for Mechanical and Thermochemical Recycling

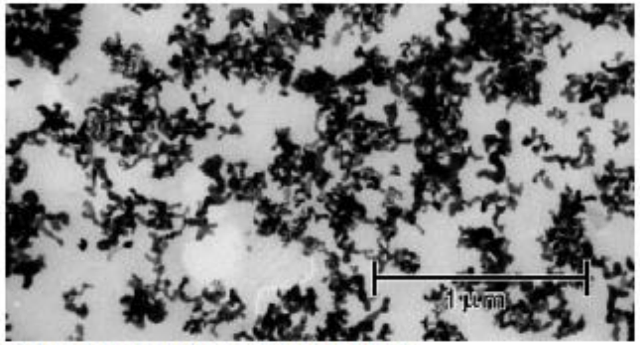
Martijn Roosen, Nicolas Mys, Marvin Kusenberg, Pieter Billen, Ann Dumoulin, Jo Dewulf, Kevin M. Van Geem, Kim Ragaert, and Steven De Meester*

(C) PE bottles



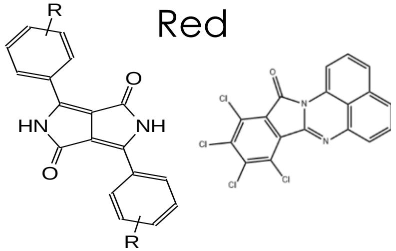
C	H	N	S	O	Co	Cr	Mn	Li	Sr	Sb	Cu	Ti	Mg	Fe	Zn	Na	Al	Ca	F	Cl
Concentration (in m%)					Concentration (in mg/kg)															
83.5	14.3	0.3	<LOD	1.4	<LOD	0.3	0.7	1.6	3.4	<LOD	8.8	8.1	31.7	13.6	7.7	145	228	1127	20.2	132

Bottle ■ Cap ■ Plastic label ■ Paper label

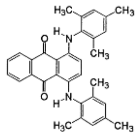


electron microscope photography

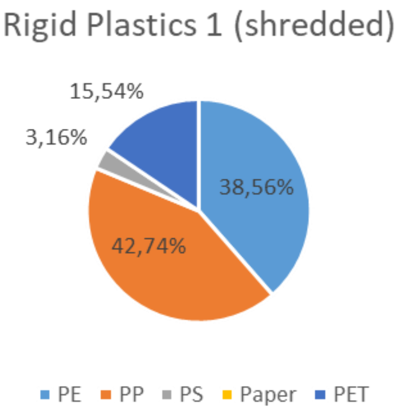
Red



Blue



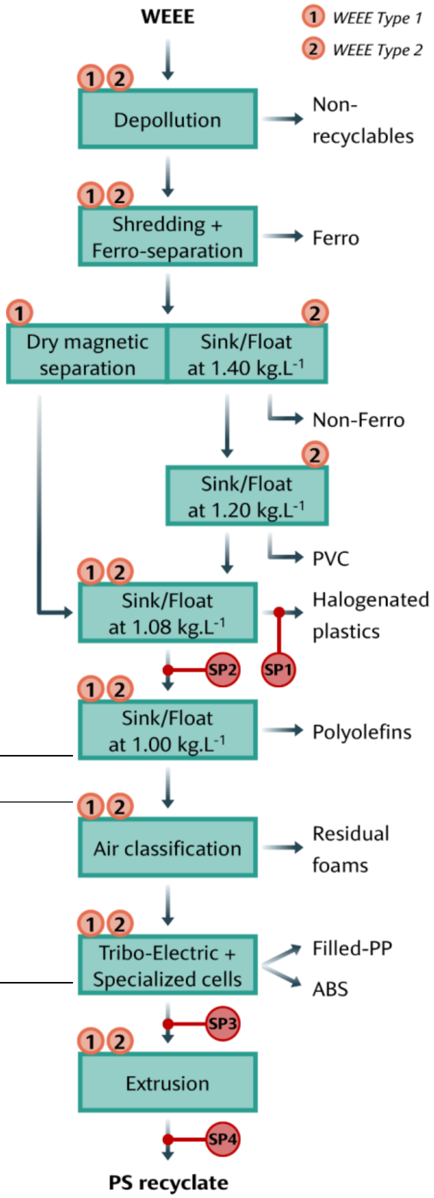
4	Rigid PP wit en transparant	52,94 %	
[illegible]	[illegible] gekleurd	[illegible]	
6	Rigid PP zwart	2,94 %	
7	Rigid PET	17,65 %	

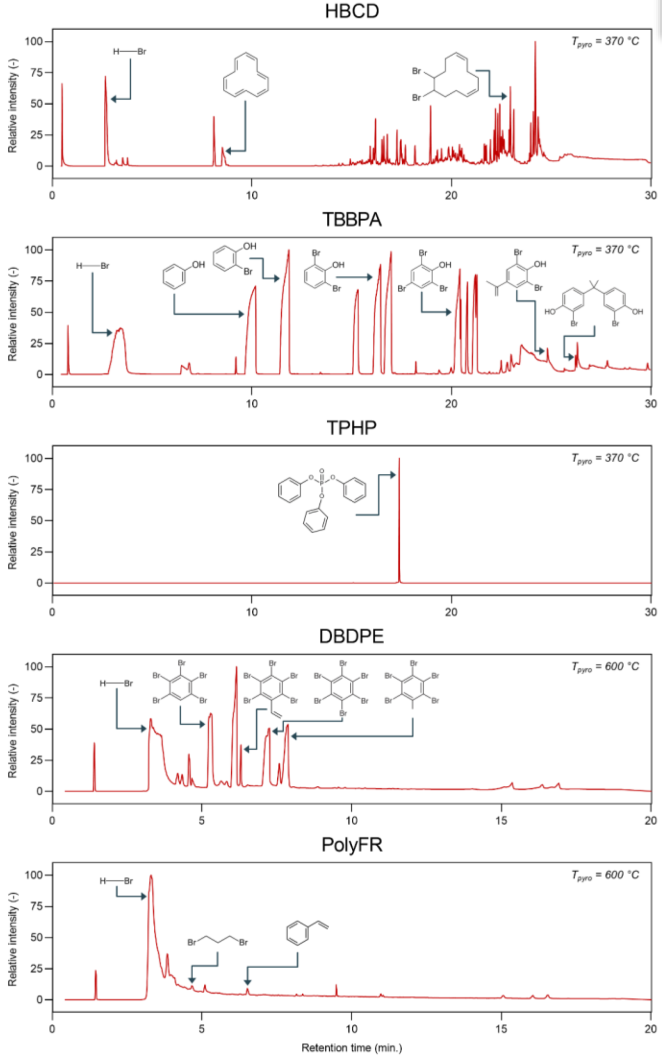


Karakterisatie Vlamvertragers

Afval	Sample punt	**Br inhoud** (mg.kg^{-1})
WEEE Type 1	SP1	641 ± 62
	SP2	278 ± 34
	SP3	91 ± 19
	SP4	54 ± 12
WEEE Type 2	SP1	2755 ± 430
	SP2	370 ± 32
	SP3	1370 ± 123
	SP4	1071 ± 5

Afval	Sample punt	**HBCD** (mg.kg^{-1})	**TBBPA** (mg.kg^{-1})
WEEE Type 2	SP1	< LOD	1534 ± 244
	SP2	< LOD	270 ± 55
	SP3	< LOD	1069 ± 202
	SP4	< LOD	984 ± 122





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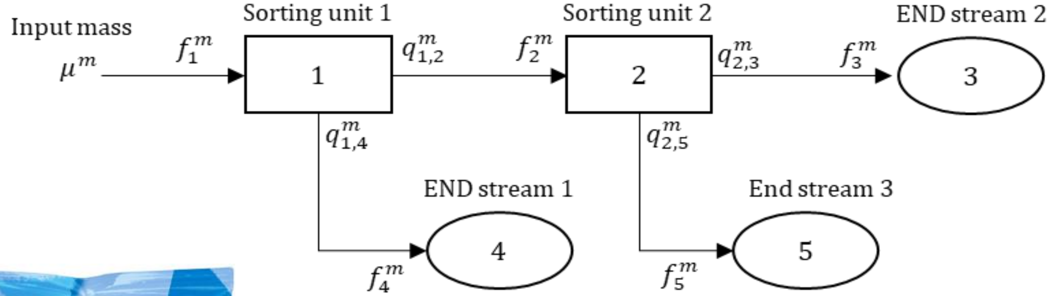
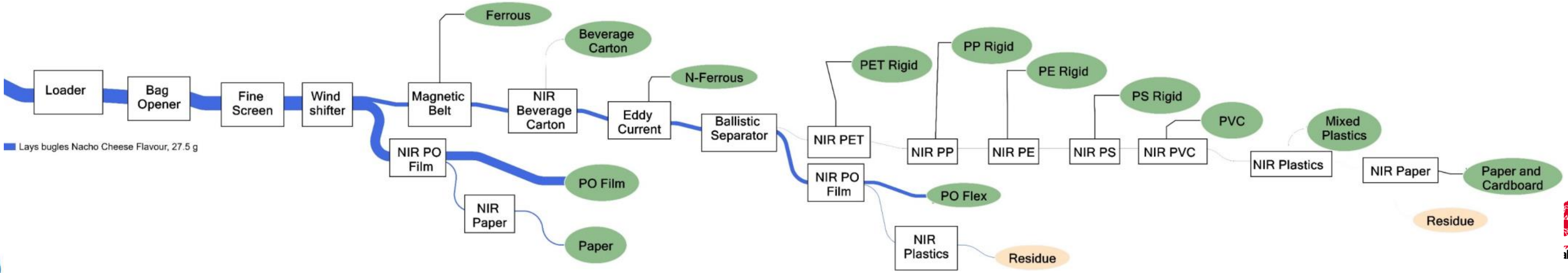
Sorteermodel

- Modelleren van sorteer en recyclage installaties
  - Databases met scheidingsefficienties
  - Design van sorteerinstallaties
  - Afhankelijk per afvaltype
  - Kan op installatie maar ook op product niveau



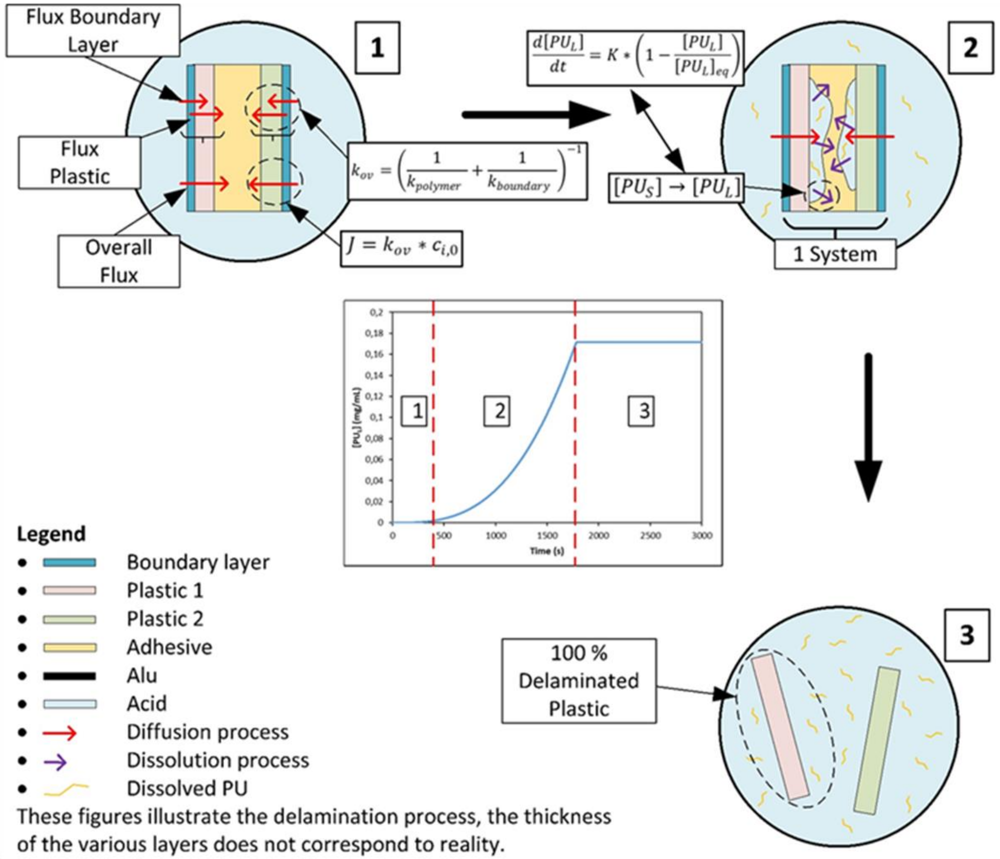
$$\begin{bmatrix} f_1^m \\ f_2^m \\ \vdots \\ f_N^m \end{bmatrix} = \begin{bmatrix} q_{1,1}^m & q_{2,1}^m & \cdots & q_{N,1}^m \\ q_{1,2}^m & q_{2,2}^m & \cdots & q_{N,2}^m \\ \vdots & \vdots & \ddots & \vdots \\ q_{1,N}^m & q_{2,N}^m & \cdots & q_{N,N}^m \end{bmatrix} \begin{bmatrix} f_1^m \\ f_2^m \\ \vdots \\ f_N^m \end{bmatrix} + \begin{bmatrix} \mu^m \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

$$f^m = (Q^m)^T f^m + \mu^m$$



Geavanceerd wassen

Delaminatie en ontinkting



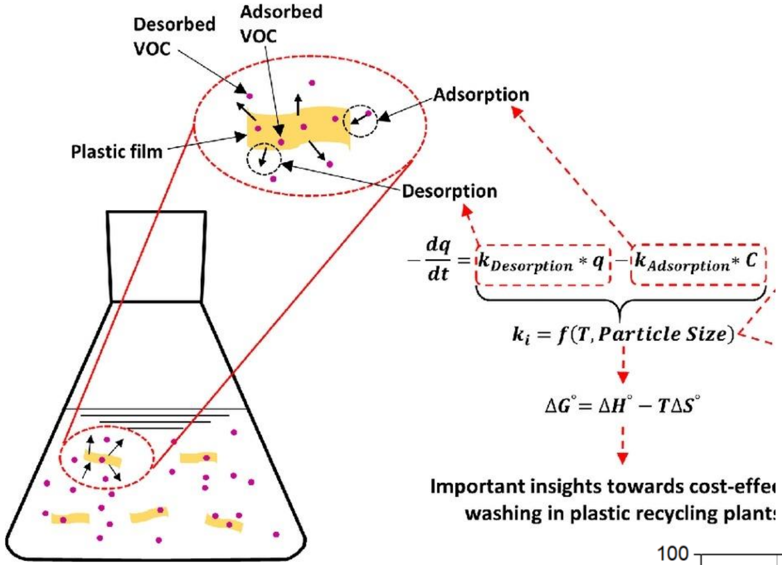
These figures illustrate the delamination process, the thickness of the various layers does not correspond to reality.

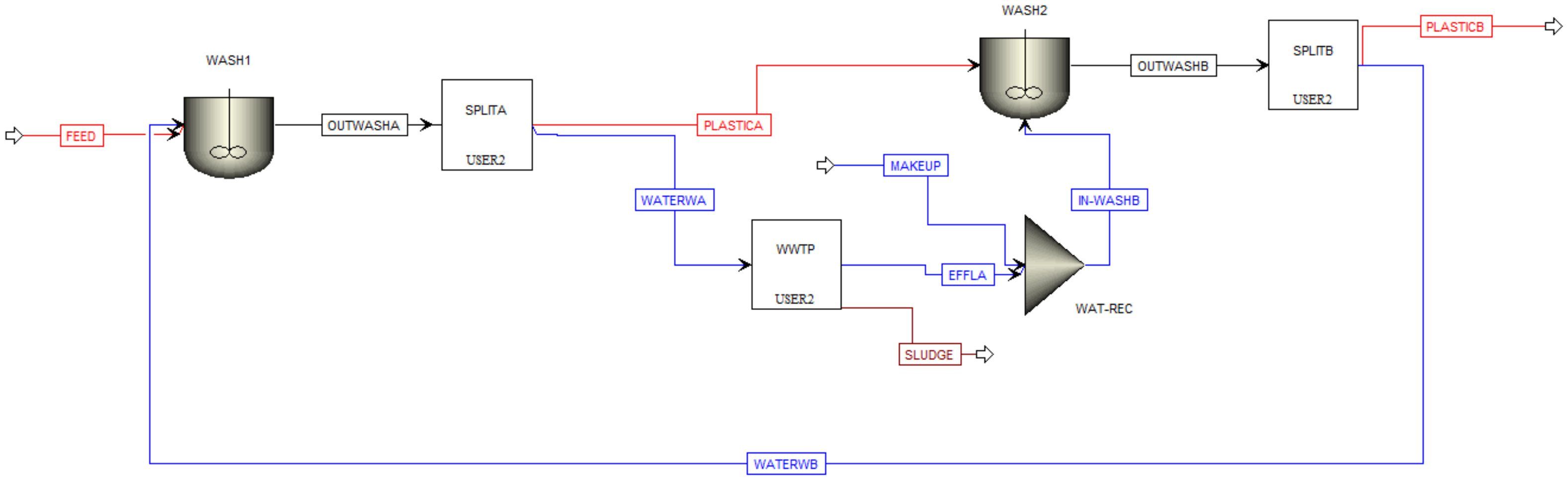
ChemSusChem
Full Papers
doi.org/10.1002/cssc.202002877
Chemistry Europe
European Chemical Societies Publishing

Towards a Better Understanding of Delamination of Multilayer Flexible Packaging Films by Carboxylic Acids

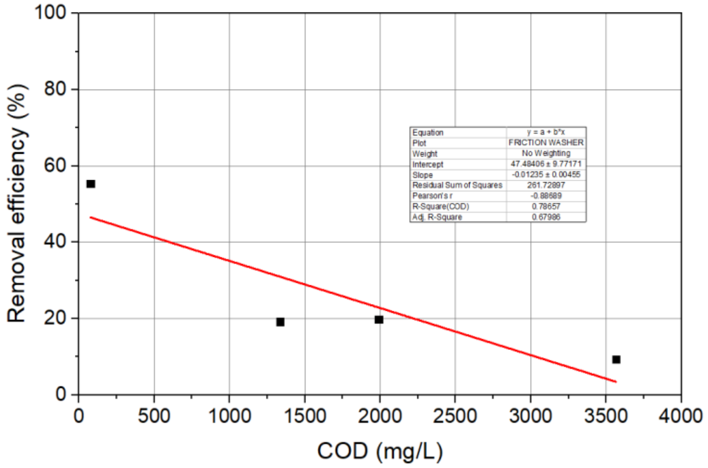
Sibel Ügdüler,[a] Tobias De Somer,[a] Kevin M. Van Geem,[b] Martijn Roosen,[a] Andreas Kulawig,[c] Ralf Leineweber,[c] and Steven De Meester*[a]

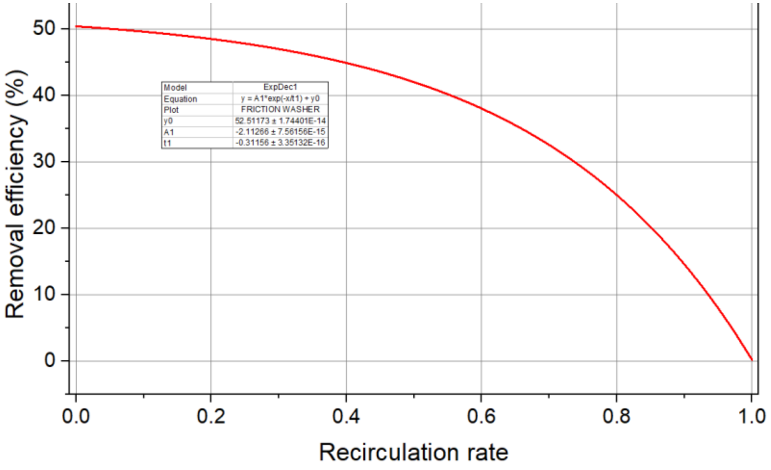
Modellen van ontgeuring





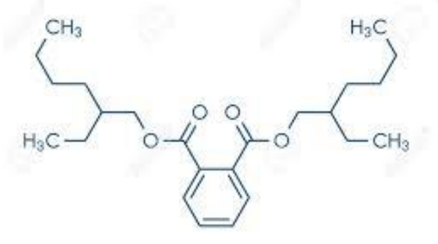
Kinetic model	Equations
Zero-order	$\frac{dq}{dt} = -k_{0,des}$
First order	$\frac{dq}{dt} = -k_{1,des} * q$
Second-order	$\frac{dq}{dt} = -k_{2,des} * q^2$
Pseudo first-order	$\frac{dq}{dt} = k_{P1,des} * (q_e - q)$
Pseudo second-order	$\frac{dq}{dt} = k_{P2,des} * (q_e - q)^2$
Reversible first-order	$\frac{dq}{dt} = -k_{RFO.1} * q + k_{RFO.2} * C$
Langmuir	$\frac{dq}{dt} = k_{LK}\left[\frac{(q_0 - q) * m}{V} * (q_{m_L} - q) - \frac{1}{b_{LK}} q\right]$



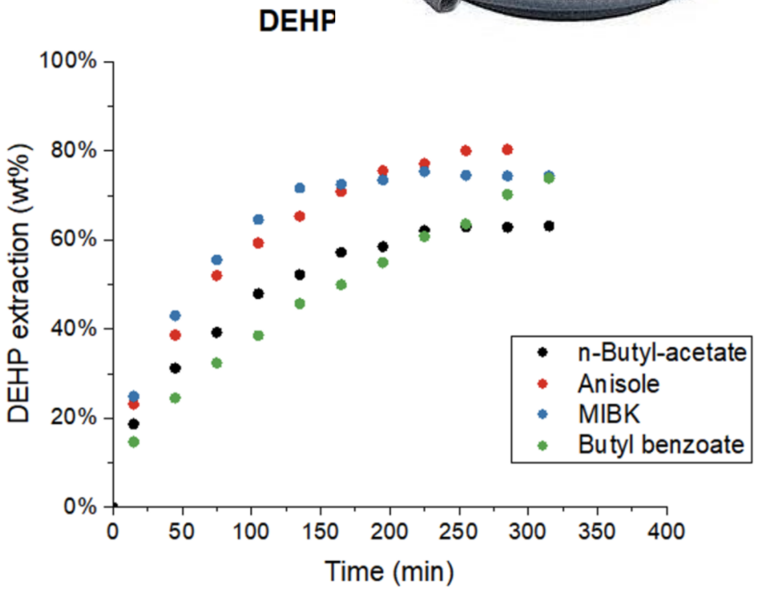


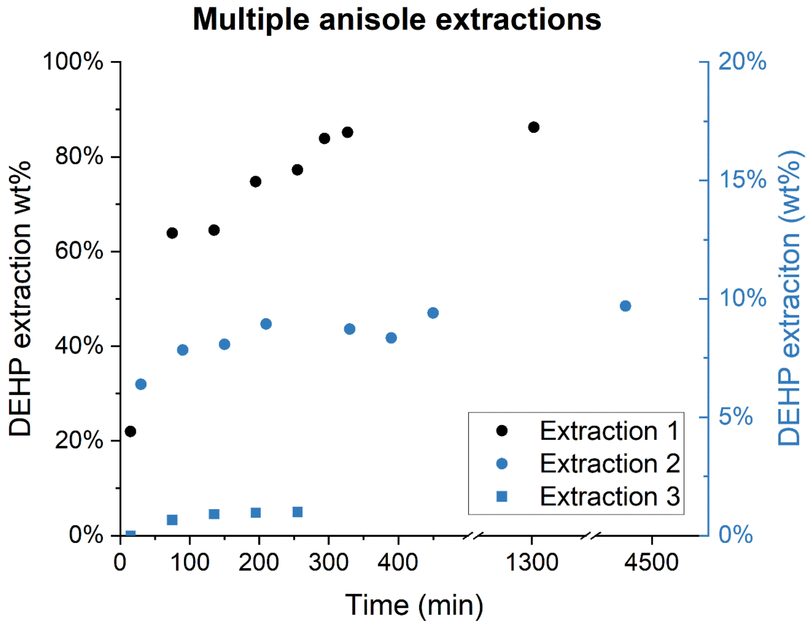
Extractie van weekmaker uit PVC

Solvent extractie



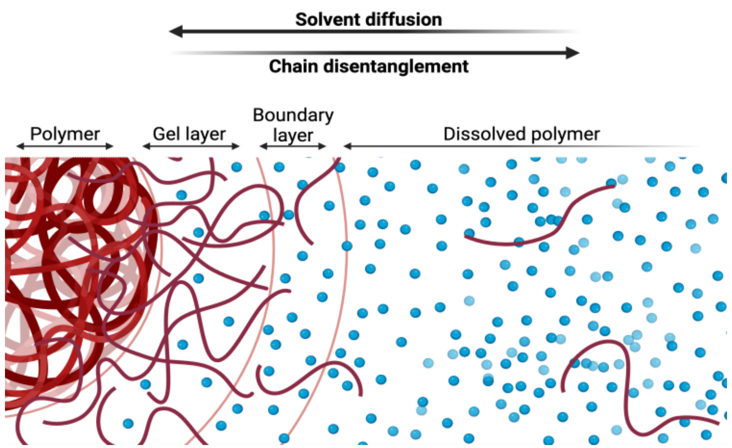
DEHP



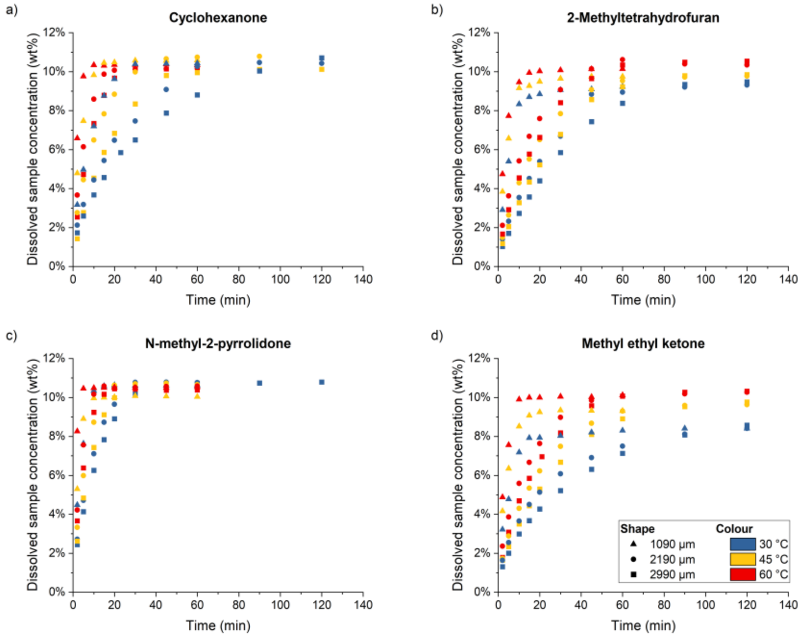


Solvent gebaseerde recyclage

Sneller oplossen



$$\omega_2 = \omega_{2,0}\left(1-\frac{(1-n)k_0T\exp(-E_a/RT)}{\eta_1 r_0^{1-n}}\,t\right)^{\frac{3}{1-n}}$$



ACS Sustainable Chemistry & Engineering
pubs.acs.org/journal/ascecg
Research Article

Increasing the Dissolution Rate of Polystyrene Waste in Solvent-Based Recycling

Rita Kol, Ruben Denolf, Gwendoline Bernaert, Dave Manhaeghe, Ezra Bar-Ziv, George W. Huber, Norbert Niessner, Michiel Verswyvel, Angeliki Lemonidou, Dimitris S. Achilias, and Steven De Meester*

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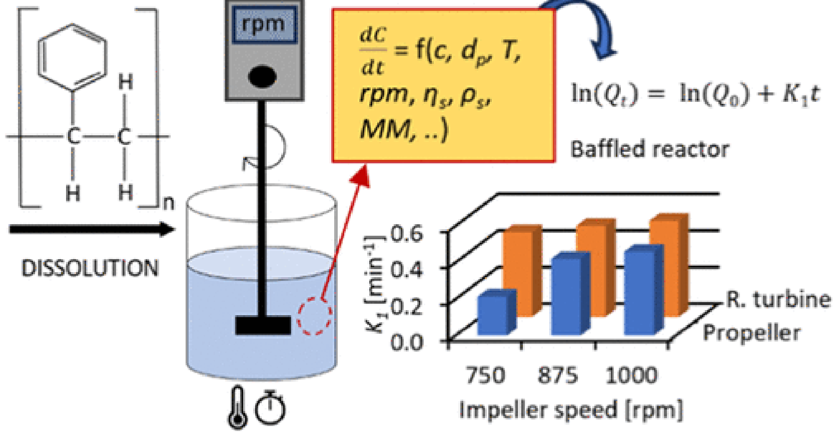

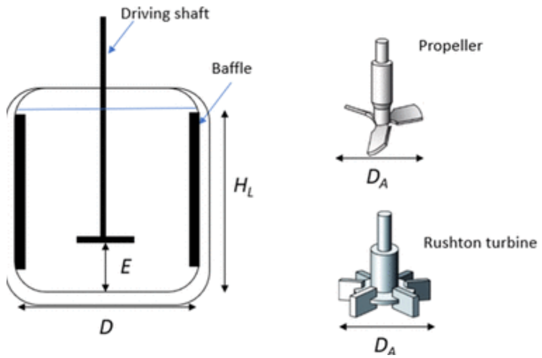

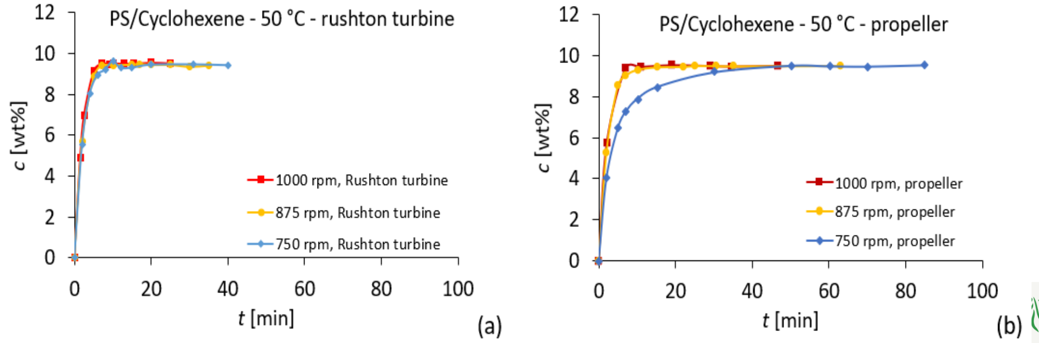

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Opzuiveren van polymeren

Contents lists available at ScienceDirect
Separation and Purification Technology
journal homepage: www.elsevier.com/locate/seppur
ELSEVIER

Removal of undissolved substances in the dissolution-based recycling of polystyrene waste by applying filtration and centrifugation

Rita Kol[a,b], Elisabetta Carrieri[a], Sergei Gusev[a], Michiel Verswyvel[c], Norbert Niessner[d], Angeliki Lemonidou[e], Dimitris S. Achilias[b], Steven De Meester[a,*]

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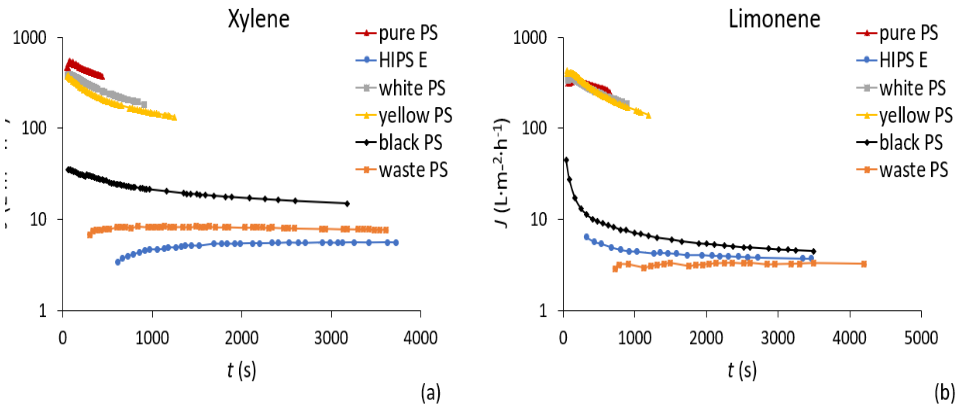

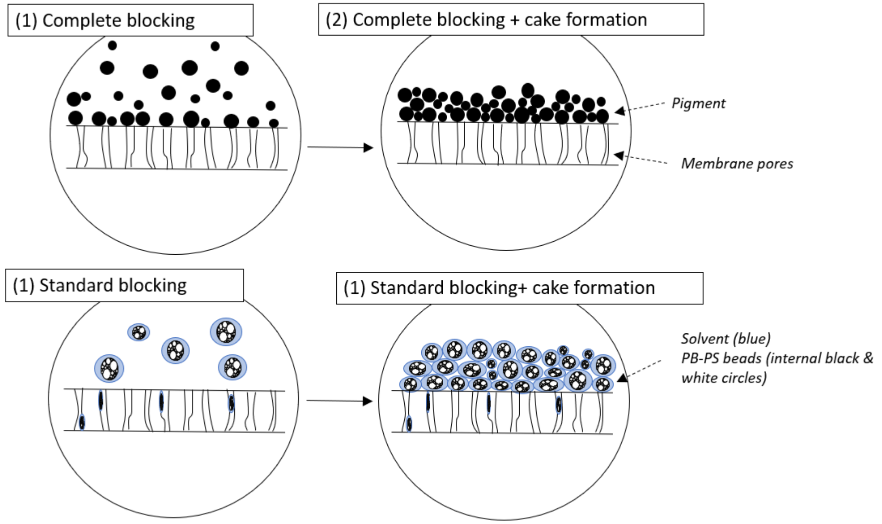

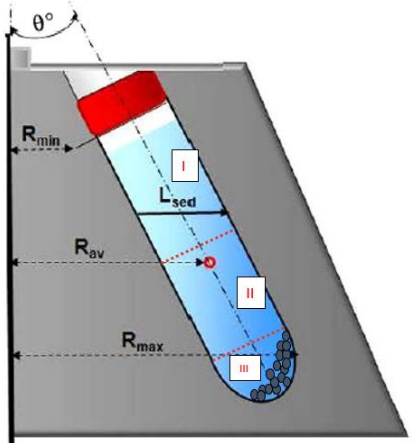

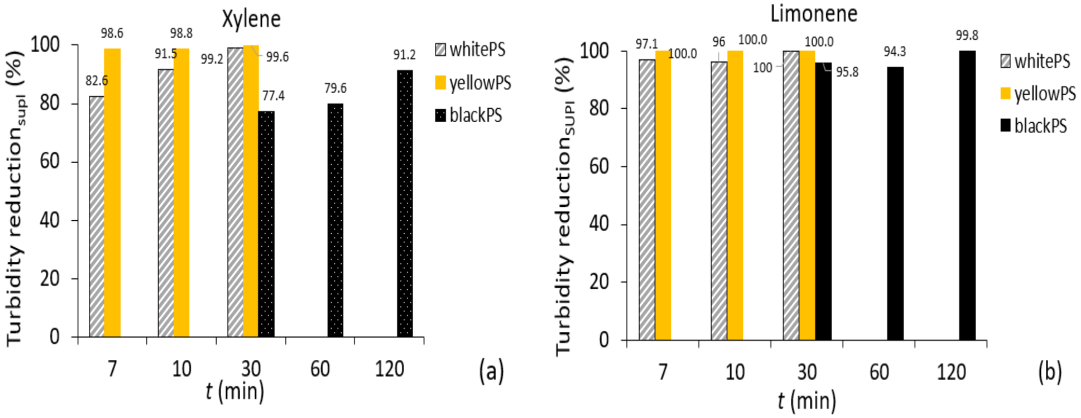

$$t^{*} = \frac{18\mu}{\omega^{2} d_p^{\,2} (\rho_p - \rho_l)} \cdot \frac{L_{sed}}{R_{av}}$$

$$d^{*} = \sqrt{\frac{18\mu}{\omega^{2} t (\rho_p - \rho_l)} \cdot \frac{L_{sed}}{R_{av}}}$$

$$Q = 2 v_g \Sigma$$

$$v_g = \frac{(\rho_p - \rho_l) d_p^{\,2} g}{18\mu}$$

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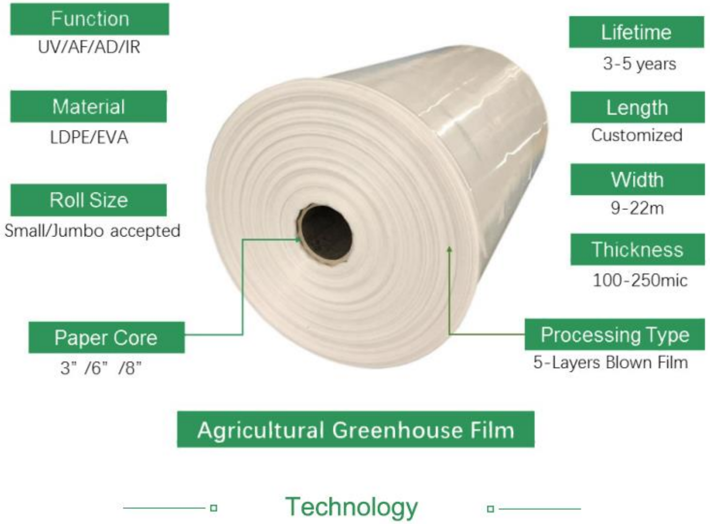
Landbouwfolie



Solvent recyclage

LDPE

EVA

TiO_2

Contents lists available at ScienceDirect
Resources, Conservation & Recycling
journal homepage: www.sciencedirect.com/journal/resources-conservation-and-recycling
ELSEVIER

Development of a solvent based recycling process for agricultural film

Elisabetta Carrieri[a], Jordy Motte[b], Pieter Nachtergaele[a,b], Ine Mertens[c], Richard Hoogenboom[c], Jo Dewulf[b], Steven De Meester[a,*]

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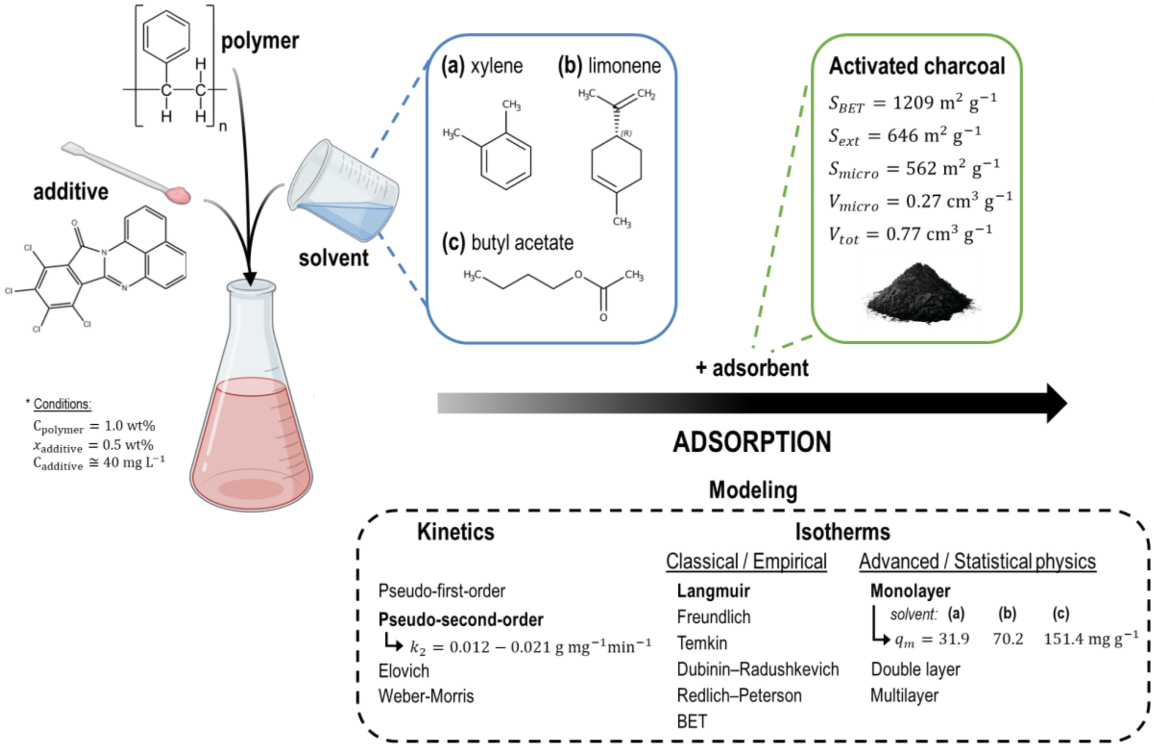
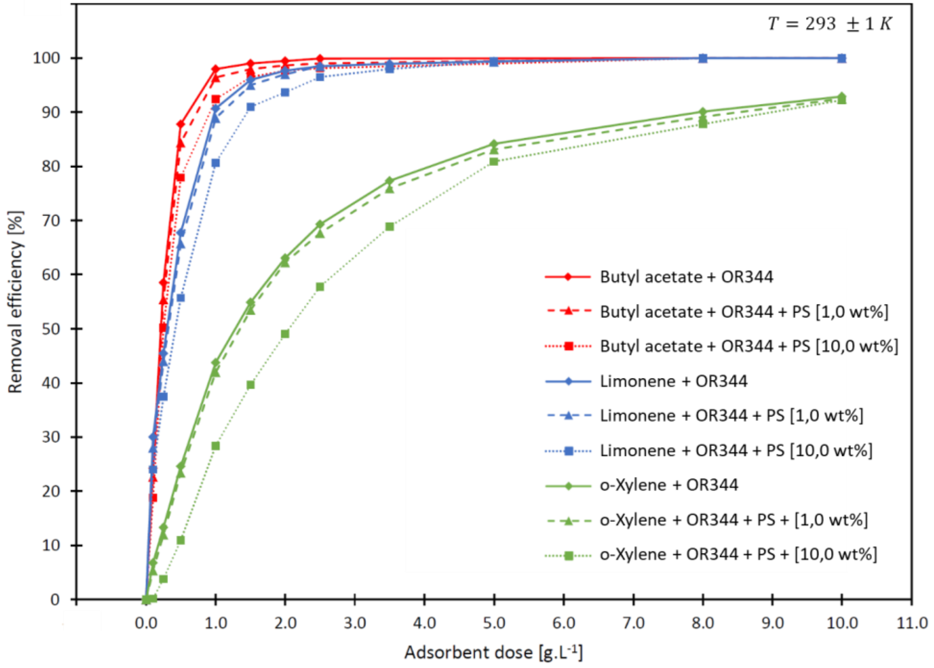
Opzuiveren van polymeren





Separation and Purification Technology 331 (2024) 125559

Contents lists available at ScienceDirect

Separation and Purification Technology

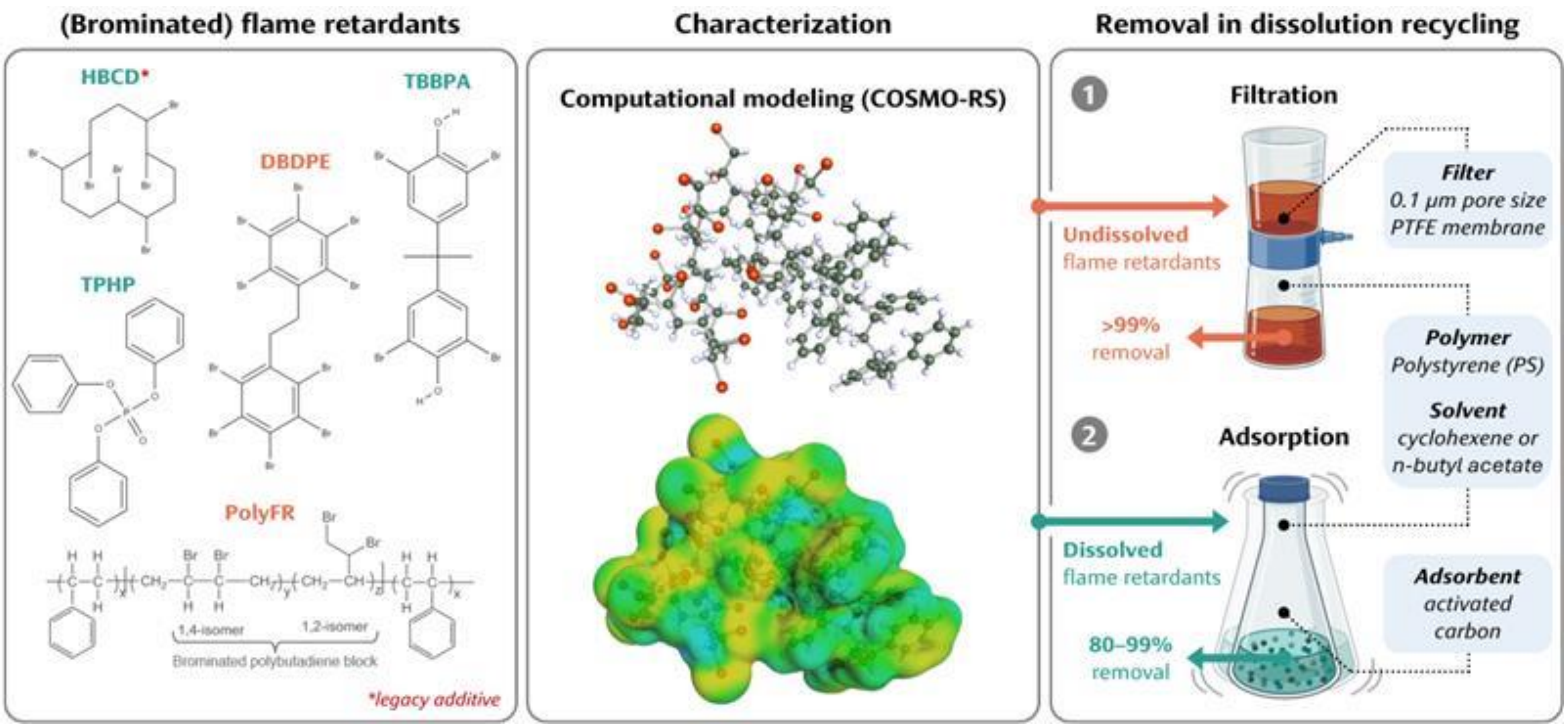
journal homepage: www.elsevier.com/locate/seppur

Adsorption modeling for contaminant removal in plastic dissolution recycling: Investigating an amino ketone-based red dye

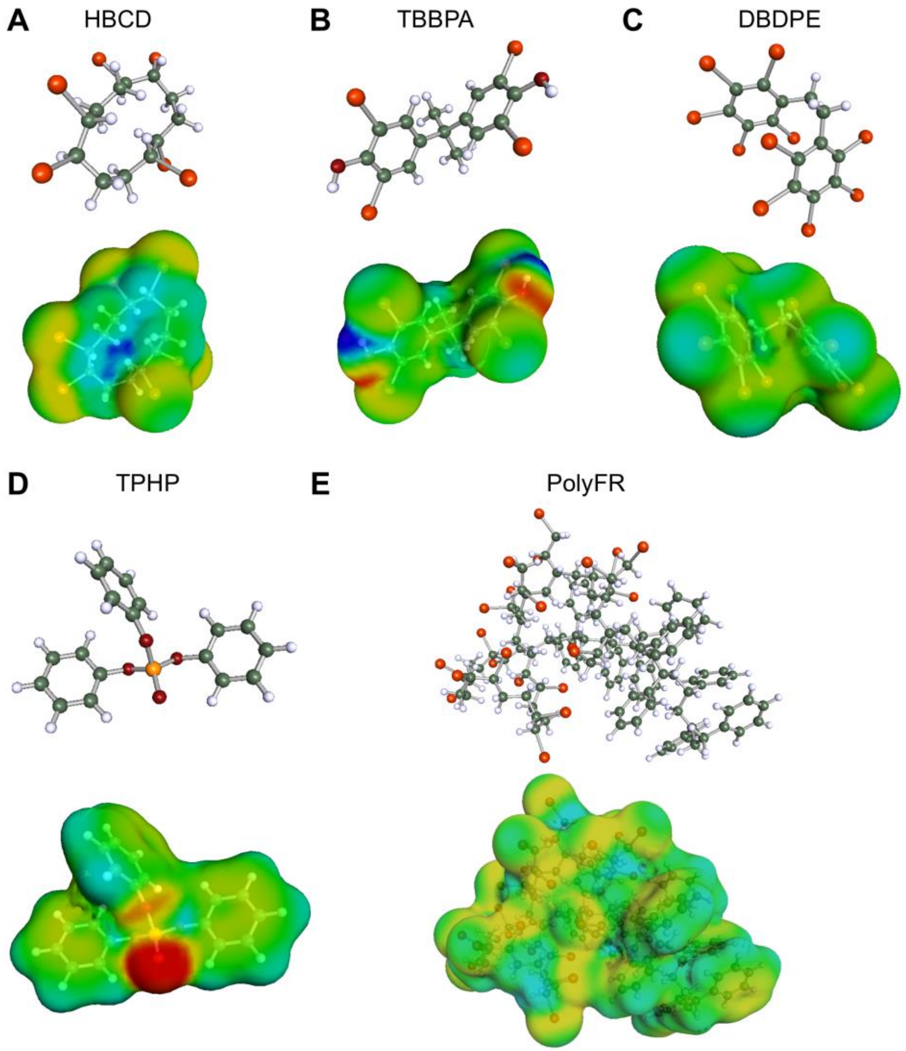
Michiel Van Melkebeke [a], Tobias De Somer [a], Tine Van Laere [a], Thien Nguyen Luu Minh [a], Hamed Mohamadzadeh Shirazi [b], Hilde Poelman [b], Kevin Van Geem [b], Steven De Meester [a,*]

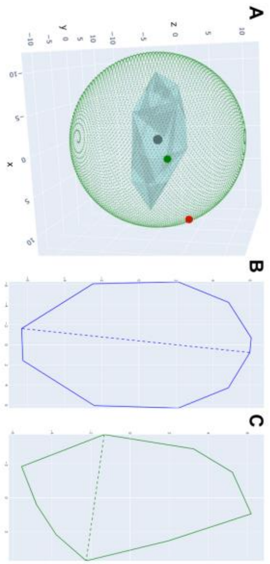
VLAIO Wallonie

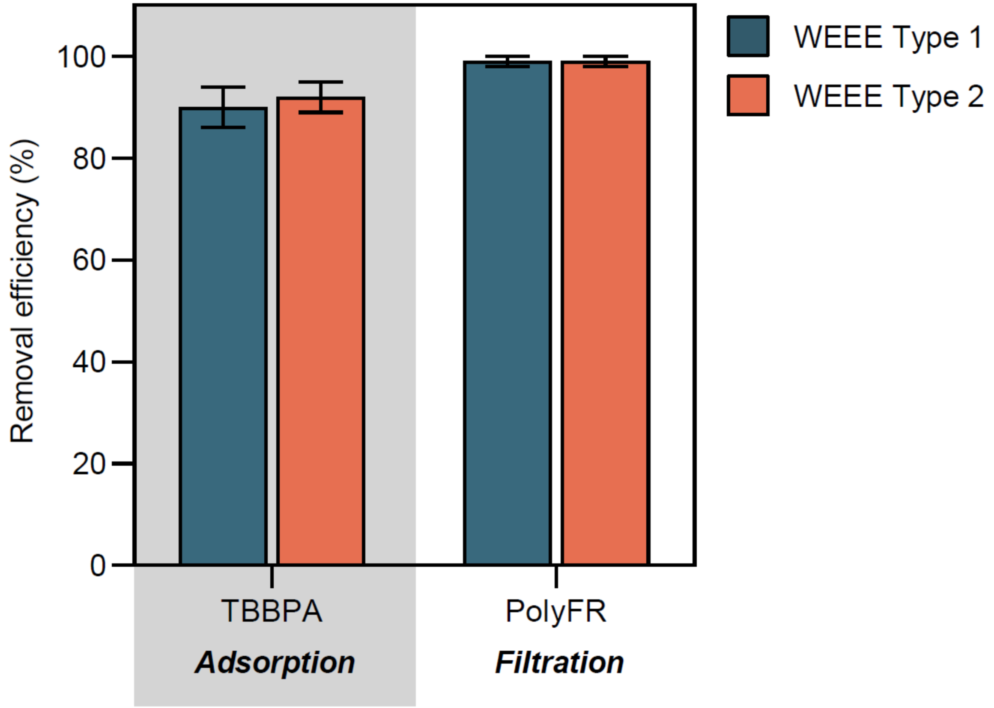
Verwijderen van vlamvertragers



Vlamvertragers







Textiel recyclage


Contents lists available at ScienceDirect
Resources, Conservation & Recycling
journal homepage: www.elsevier.com/locate/resconrec

Full length article

Analysing the potential of the selective dissolution of elastane from mixed fiber textile waste

Kim Phan [a], Sibel Ügdüler [a], Lies Harinck [a], Ruben Denolf [a], Martijn Roosen [a], Galahad O'Rourke [b], Dirk De Vos [b], Veronique Van Speybroeck [c], Karen De Clerck [d], Steven De Meester [a,*]

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[b] Centre for Membrane Separations, Adsorption, Catalysis and Spectroscopy for Sustainable Solutions (cMACS), KU Leuven, 3001 Leuven, Belgium
[c] Center for Molecular Modeling, Ghent University, Technologiepark 46, B-9052, Zwijnaarde, Belgium
[d] Department of Materials, Textiles and Chemical Engineering (MaTCh), Ghent University, Technologiepark 70A, B-9052, Zwijnaarde, Belgium

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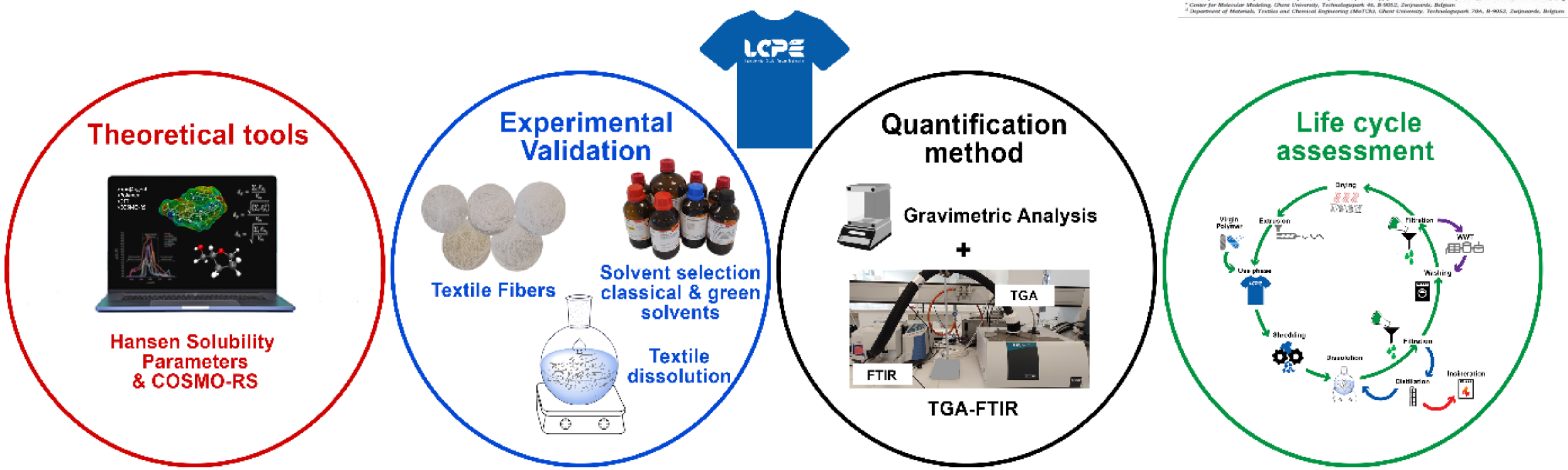
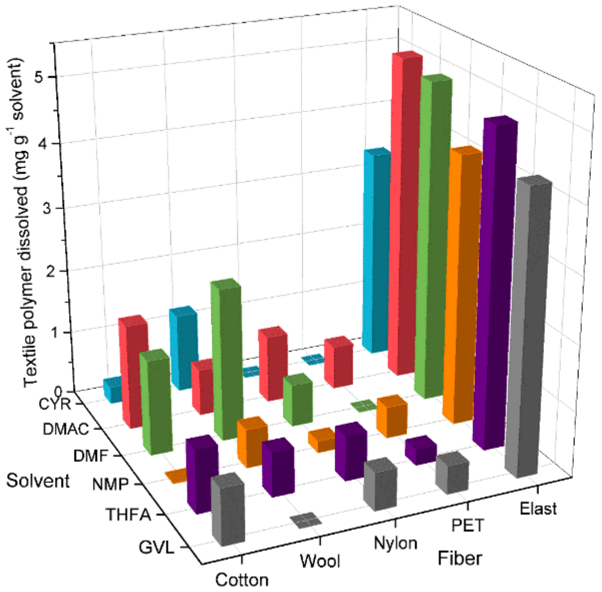
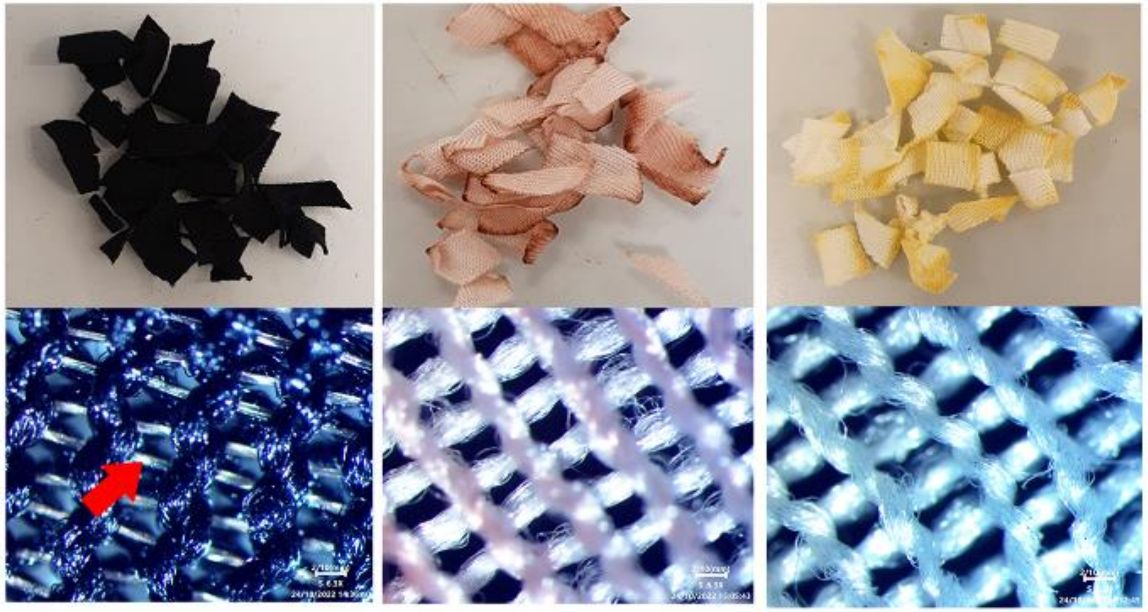
Selective solvent-based elastane dissolution from textile blends







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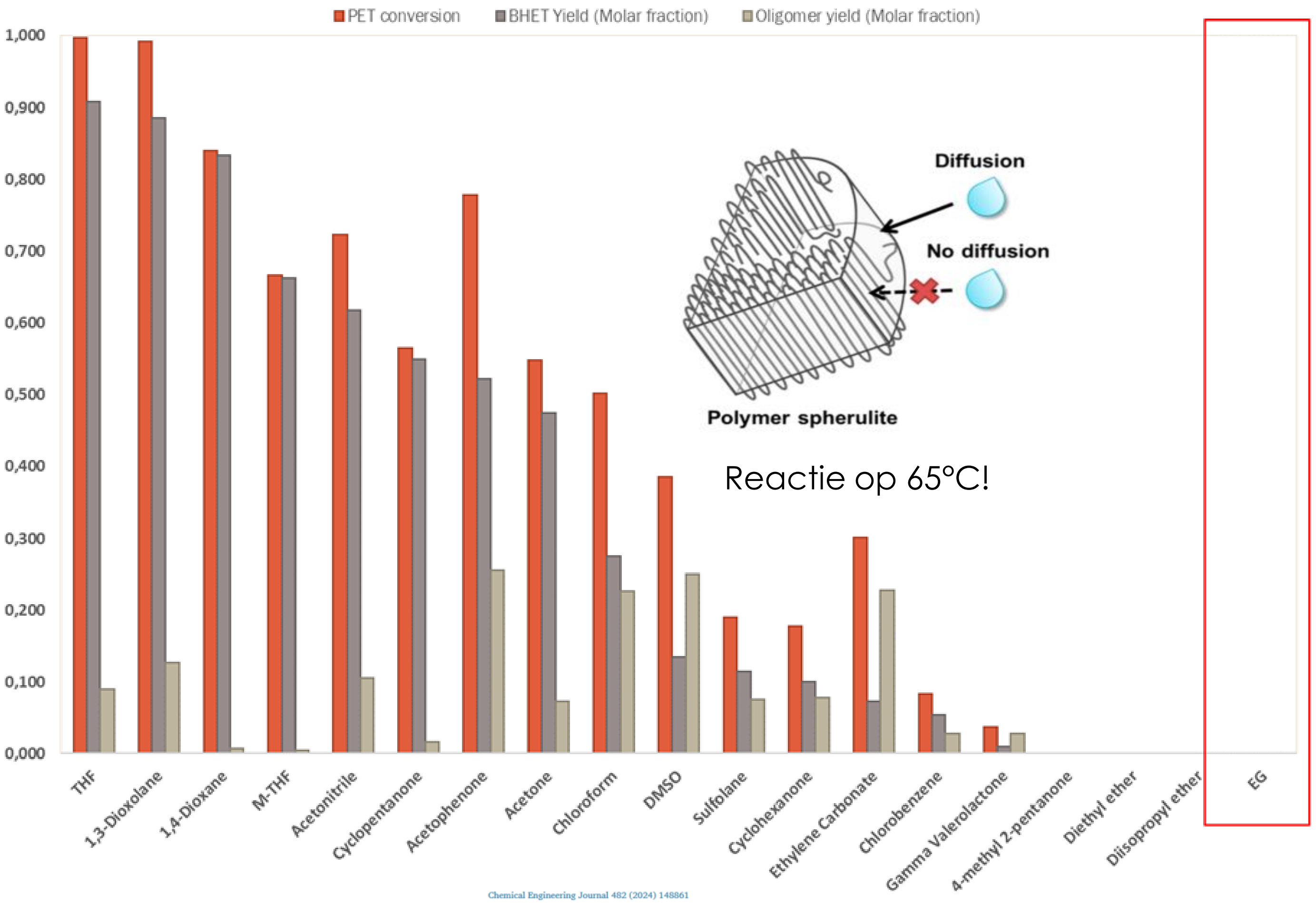
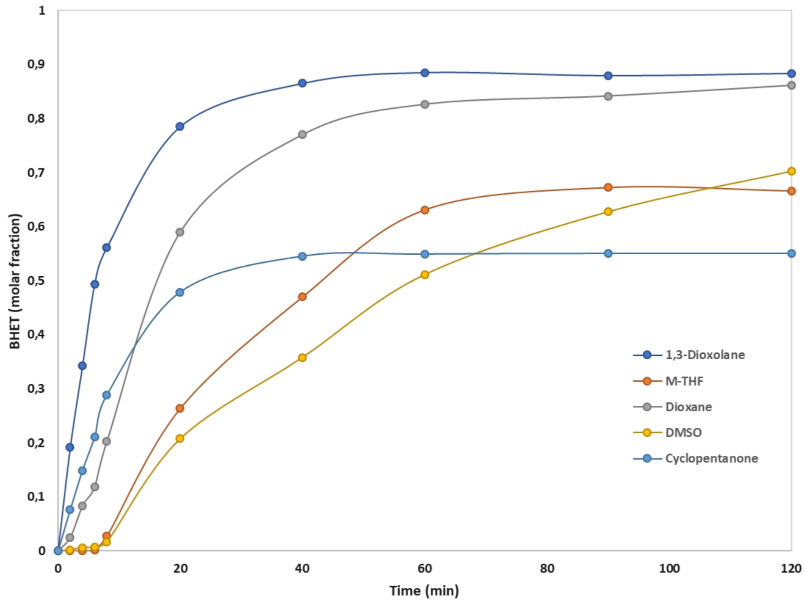
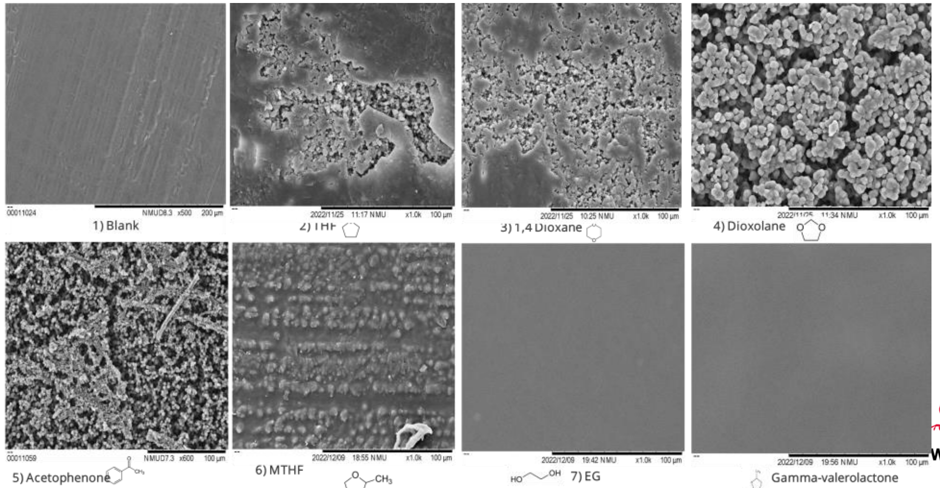
Selectieve depolymerisatie

Solvent	Best fit kinetic models
1,3-Dioxolane	Homogeneous 2nd order (**R^2= 0.97**)
Dioxane	Homogeneous 2nd order (**R^2= 0.99**)
Cyclopentanone	3D Difusion (**R^2= 0.88**)
M-THF	Contracting geometry (**R^2=0.98**)
DMSO	Contracting geometry (**R^2=0.98**)
	Homogeneous 2nd order (**R^2= 0.98**)



Reactie op 65°C!





Chemical Engineering Journal 482 (2024) 148861

Contents lists available at ScienceDirect

Chemical Engineering Journal

journal homepage: www.elsevier.com/locate/cej

ELSEVIER

Towards a better understanding of the cosolvent effect on the low-temperature glycolysis of Polyethylene Terephthalate (PET)

Emelin Luna [a,b], Ion Olazabal [a], Martijn Roosen [b], Alejandro Müller [a], Coralie Jehanno [c], Marta Ximenis [a], Steven de Meester [b,*], Haritz Sardon [a,*]

Wallonie

Vragen?

Steven.demeester@ugent.be