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Kvalitet af genvunden plast – kan den nærme sig jomfrueligt materiale?

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A European Strategy for Plastics in a Circular Economy

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- **Background**
- European Commission, Communication on Closing the loop - An EU action plan for the Circular Economy, COM(2015) 614
- European Parliament, Resolution of 14 January 2014 on a European strategy on plastic waste in the environment, 2013/2113(INI)
- European Commission, Roadmap for the strategy on plastics in a circular economy, January 2017

- We wait for *A European Strategy for Plastics in a Circular Economy*
- *A draft was leaked…..*

A European Strategy for Plastics in a Circular Economy

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- We wait for *A European Strategy for Plastics in a Circular Economy*
- We may anticipate actions on improving the quality and economy of plastics recycling
  - Harmonised rules to ensure that by 2030 all plastics packaging placed on the EU marked can be reused or easily recycled.
  - New standards for sorted plastics waste and recycled standards
  - Incentives to reward first-movers boosting uptake of recycled content, e.g. through the packaging and packaging waste directive
  - Strengthen system for authorisation of recycled plastics for food-contact uses (EFSA)
  - Favour recyclable and recycled plastics in public procurement, taxation and other economic incentives
  - Step-up separate collection schemes for plastic waste

A European Strategy for Plastics in a Circular Economy

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- We wait for *A European Strategy for Plastics in a Circular Economy*
- We may anticipate actions on plastic waste and littering
  - Possibly initiative on single use plastic products
  - Marine litter and micro plastics
  - Harmonised rules for definition and marking of biodegradable and compostable plastics
  - Restrict use of oxo-biodegradable plastics (degradable polyolefins)

Fødevarekontakmaterialer

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- Regulation No (EC) 282/20084 on recycled plastic materials intended to come into contact with foods
- Recycling processes must be authorised. Before a recycling process is authorized, EFSA opinion on its safety is required.
- EFSA will evaluate whether it has been demonstrated in a challenge test, or by other appropriate scientific evidence, that the recycling processes are able to reduce any contamination of the plastic input to a concentration that does not pose a risk to human health.
- Plastic input for recycling must originate from plastic food contact materials and articles (i.e. to avoid the use of non-authorised substances).

European Food Safety Authority

EFSA Journal 2015;13(2):4016

SCIENTIFIC OPINION

Scientific Opinion on the safety assessment of the processes 'Biffa Polymers' and 'CLRrHDPE' used to recycle high-density polyethylene bottles for use as food contact material[1]

EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids (CEF)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

Processer

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- Sortering – Vask - EREMA super-clean recycling proces:
- pre-decontamination, where washed flakes are subjected to temperatures of about 90 °C and a vacuum of about 3-5 mbar (residence time about 30 min)
- decontamination, where the flakes are heated to about 120 °C with a vacuum of about 1-2 mbar (residence time about 45 min)
- The decontamination step is followed immediately in the same unit by extrusion and melt filtration, where the material is re-extruded with degassing at 220-230 °C followed by melt filtration.

Challenge test

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Table 1: Decontamination efficiency of the two consecutive reactors (steps 2 and 3) and extrusion (step 4) of the recycling process Biffa Polymers

Surrogates	Total mass of surrogates introduced in the first reactor (step 2) (grams of surrogate)	Total mass of surrogates in the pellets after extrusion (step 4) (grams of surrogate)	Decontamination efficiency (%)
Toluene	23.2	< 0.009	> 99.96
Chlorobenzene	35.4	< 0.004	> 99.99
Butyl salicylate	36.7	20.08	45.28
Benzophenone	36.1	11.22	68.95
Phenylcyclohexane	34.1	9.78	71.34
Methyl palmitate	39.3	26.68	32.23

Table 2: Decontamination efficiency of the two consecutive reactors (steps 2 and 3) and extrusion (step 4) of the recycling process CLRrHDPE

Surrogates	Total mass of surrogates introduced in first reactor (step 2) (grams of surrogate)	Total mass of surrogates in the pellets after extruder (step 4) (grams of surrogate)	Decontamination efficiency (%)
Phenylcyclohexane	8.5	3	64.7
Benzophenone	9.8	7.4	24.5
Methyl stearate	24.2	24.7	0

Proceskemiske metoder til optimering af kvalitet

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- EPS – solventbaseret rensning CreaSolv® (Fraunhofer IVV)
- Polystyrene Loop: Demonstrating the economic and technical viability of closed-loop recycling of polystyrene foam construction waste
- Konference 13 November 2017 om ”Cirkulært kvalitetsbyggeri”:
  - Bewi Flamingo recycling af eget materiale (food kontakt) ved granulering til eps perler, der bruges i koncentrationer på 20-40% med jomfruelige eps perler i støbeprocessen
  - Bewi Styrochem (FI) tager fiskekasser retur fra Polen og ektruderer nyt PS granulat, der kvældes med pentan til ny (grå) EPS råmateriale

Proceskemiske metoder til optimering af kvalitet

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- MUDP projekt: ”Nyt liv til post-consumerisolering og emballager i EPS”
  - Deltagere: Amager Ressourcecenter, Aage Vestergaard Larsen og SharkContainers
  - Regranulering ved AVL – Farve og MFI udfordring
  - Oprenset ved CreaSolv proces hos Fraunhofer IVV – Gennemsigtigt med egenskaber som jomfruelig EPS – rest farve.

Materialeegenskaber PS regranulat (EPS-affald fra genbrugsplads)

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					Standard-referencer	
				PS regranulat	GPPS	HIPS
Rheologiske egenskaber:	Condition	Unit	Standard	Value	General Purpose PS	High Impact PS
Melt flow rate, MFR	(200 °C, 5 kg)	g/10 min	ISO 1133	19	0,1-11	3-12
Mekaniske egenskaber:						
E-modulus	(1 mm/min; 23 °C)	MPa	ISO 527-2	2853	1980-3400	1400-2230
Tensile strength at break	(50 mm/min; 23 °C)	MPa	ISO 527-2	31	15-55	19,7-30,8
Tensile strength at yield	(50 mm/min; 23 °C)	MPa	ISO 527-2	-		
Elongation at break	(50 mm/min; 23 °C)	%	ISO 527-2	1,1	1,0-5,0	28-61
Elongation at yield	(50 mm/min; 23 °C)	%	ISO 527-2	-		
Charpy notched impact strength	(23 °C)	Kj/m2	ISO 179/1eA	1,1	1,9-10	4,8-11
Termiske egenskaber:						
Vicat softening temperature	(50 N; 50 °C/h)	°C	ISO 306/B50	98	82-107	81,4-100
Andre egenskaber:						
Density	(23 °)	g/cm3	ISO 1183	1,05	1,04-1,05	1,05-1,05

GPPS, eksempler på anvendelser: Stive emballager, bakker og kasser (bl.a. til køleskabe), kassetter (bla. til CD´er), legetøj etc.

HIPS, eksempler på anvendelser: Plastbægre/kopper, toiletsæder, køleskabsbeklædninger, instrument/betjeningsknapper og paneler, plastlåg etc.

Indsamlingsforsøg på genbrugsplads viser, at der ud fra EPS-affald kan produceres et PS regranulat med en kvalitet til anvendelse i nye produkter

Proceskemiske metoder til optimering af kvalitet

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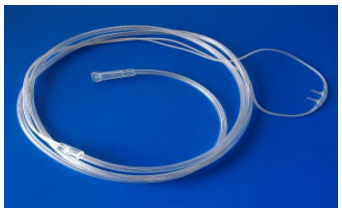
- MUDP projekt "Sikker og effektiv genanvendelse af blød PVC fra medicinsk udstyr ved miljøvenlig superkritisk (scCO2) teknologi"
  - Region Hovedstaden, AMBU A/S, SP Extrusion, PVC Informationsrådet, PVC MedAlliance, Teknologsdik Institut
- 40 % af medicinsk engangsudstyr på hospitaler er lavet af blød PVC
- En blødgører gør et materiale flexibelt , elastisk og lettere håndterbart– den øger plasticiteten.

		
Anæstesimaske	Ilt brille	Larynx Mask

Tilladte og forbudte blødgører

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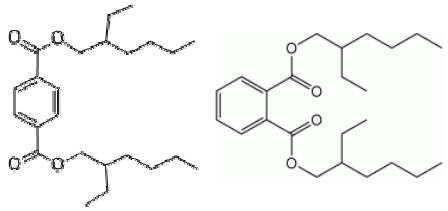
- EU's REACH komite har klassificeret de fire ftalater DEPH, DBP, DIBP og BBP som hormonforstyrrende (reproductive toxicity category 1B in accordance with Article 57 (c) of REACH). Disse plastblødgørere findes i fx badeforhæng, plastfodbolde, vinylgulve, presenninger og andre forbrugerprodukter og især i produkter importeret fra ikke-EU lande. *Næste trin er forbud < 0,1 % tilladt*
- European Directorate for the Quality of Medicines (EDQM) has in 2017 announced that **four** alternatives to DEHP will now be listed with all their properties as suitable alternatives to DEHP in the revised European Pharmacopeia (2018).
  - cyclohexane1,2-dicarboxylic acid, diisononylester – plastic additive 24
  - butyryltri-n-hexylcitrate - plastic additive 25
  - tris(2-ethylhexyl) trimellitate – plastic additive 26
  - bis(2-ethylhexyl) terephthalate - plastic additive 27



Superkritisk ekstraktion

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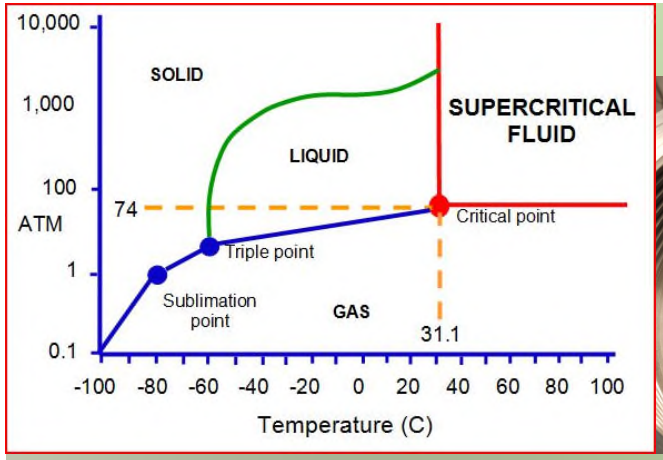
- Teknologisk Institut ekstrahere blødgører med superkritisk CO2 (ScCO2)
- Målet er bedre end 99.9 % ekstraktion
- Målet er genbrug som
- Vi måler os mod projekter i UK og australien
- Vi får slanger m.m. fra Gentofte og Bispebjerg hospital



Ekstraktion fra en Larynxmaske

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Tak til

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- Mine kollegaer Michael Lei og Mark Holm Olsen
- Vores partnere i projekterne ”Sikker og effektiv genanvendelse af blød PVC fra medicinsk udstyr ved miljøvenlig superkritisk (scCO2) teknologi” og ” Nyt liv til post-consumerisolering og emballager i EPS”
- Miljøstyrelsen bevillinger MST-141-01413 og MST-141-01426
- Styrelsen for Forskning og Uddannelse resultatkontrak ”Cirkulær ressourceøkonomi indenfor byggeri”

Kvalitet af genvunden plast – kan den nærme sig jomfrueligt materiale?

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- Ja!
- Nye processer
- Harmoniserede regler og standarder
- Nye metoder for mærkning / materialepas (byggeri)
- Simplificere materialekompleksitet
- Det bliver dyrere – krav til importerede produkter