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Valorization of Plastic Waste by Colour Removal

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Outi Härkki,
Tommi Vuorinen,
Harri Joki,

Technical Research Centre of Finland, VTT



Picture: <http://www.premiertechanicalplastics.com/>



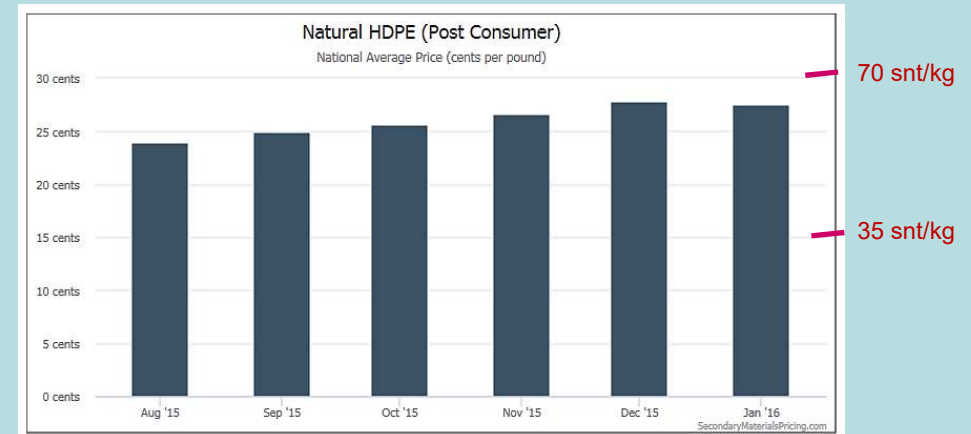
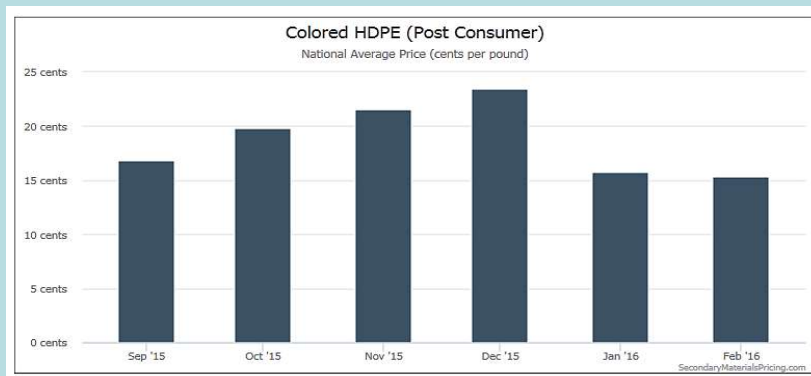
Motivation

Table 26: Average recycling costs and employment by resin

	PET	PE-HD	PE-LD	PP	PS	PVC	Other plastic resins
Recycling costs (EUR per tonne)	400	450	500	450	500	400	450

The capacity of plastic recycling facilities in EU-28 is 3.7 million tonnes according to the latest available data from Plastics Recyclers Europe.

Source: <http://www.plasticsrecyclers.eu/>



Price for natural HDPE (post consumer) has been 15 - 40 % higher compared to colored HDPE (post consumer)
→ removal of colorants will add the value of recycled plastic resins



Color Removal from Recycled Plastics

The colorants have usually

- Strong covering power
- Thermal stability
- Chemical resistance
- Resistance to migration



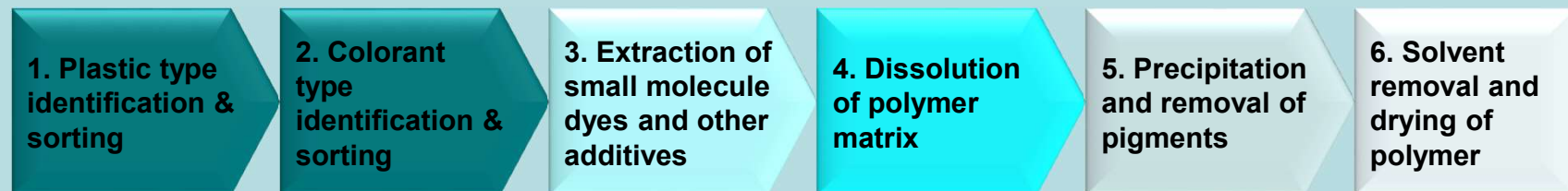
Picture: <http://www.pittsplas.com/>

Thus it is **challenging**

- To cover color with another
- To degrade color thermally
- To use chemical bleaching
- To apply extractive processes

DRIVERS: QUALITY, SAFETY & COST

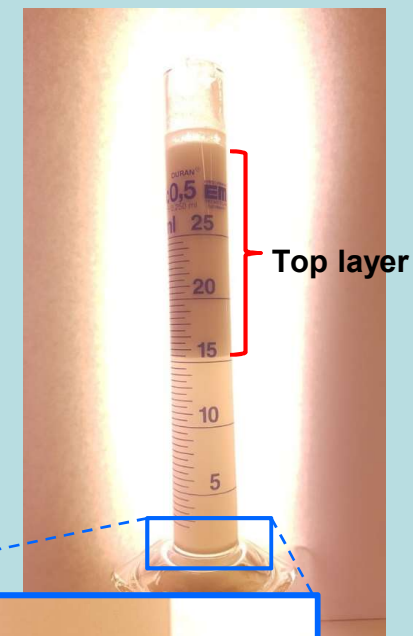
VTT's concept in ARVI for a combinative solution process for colorant removal:





Color Removal from Plastics: Results Briefly

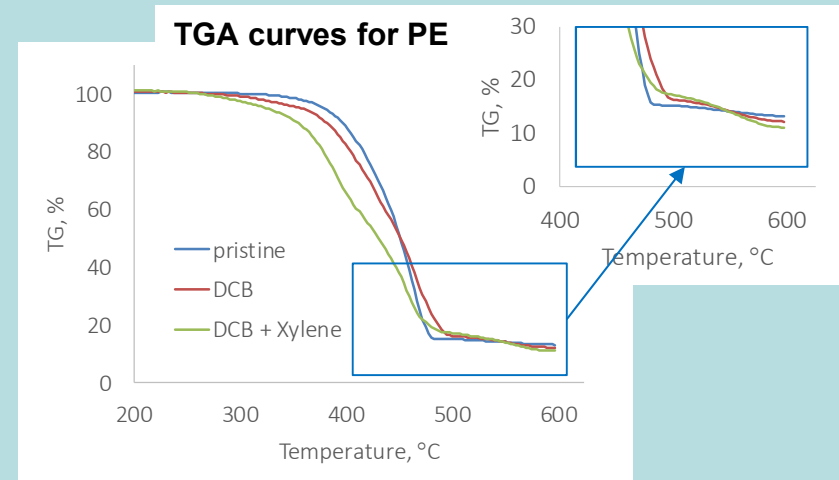
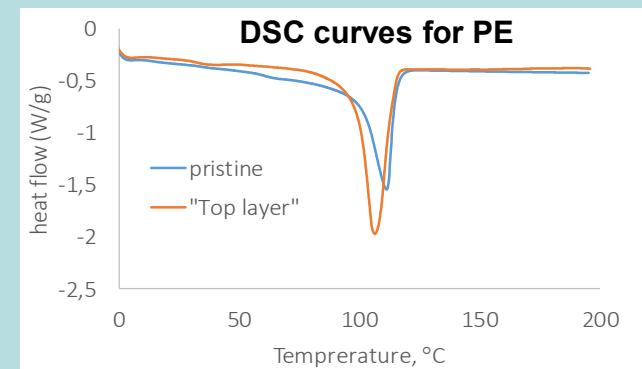
- Test material: commercial white polyethylene (titania pigmented Borealis grade)
- Dissolution at elevated temperature with 1,2-dichlorobenzene (DCB) and its mixtures with o-xylene.
- In DCB separation into three phases:
 - Heaviest titania rich
 - Middle solvent rich
 - Lightest polymer rich, “Top layer”





Color Removal from Plastics: Results Briefly

- The DSC analysis indicated that PE did not degrade in the thermal dissolution process:
 - the on-set melting temperature remained the same (99 °C)
- The thermo gravimetric analysis indicated that titania content decreased 15 % (from 13.2 to 11.0 mass-%)





Outcome

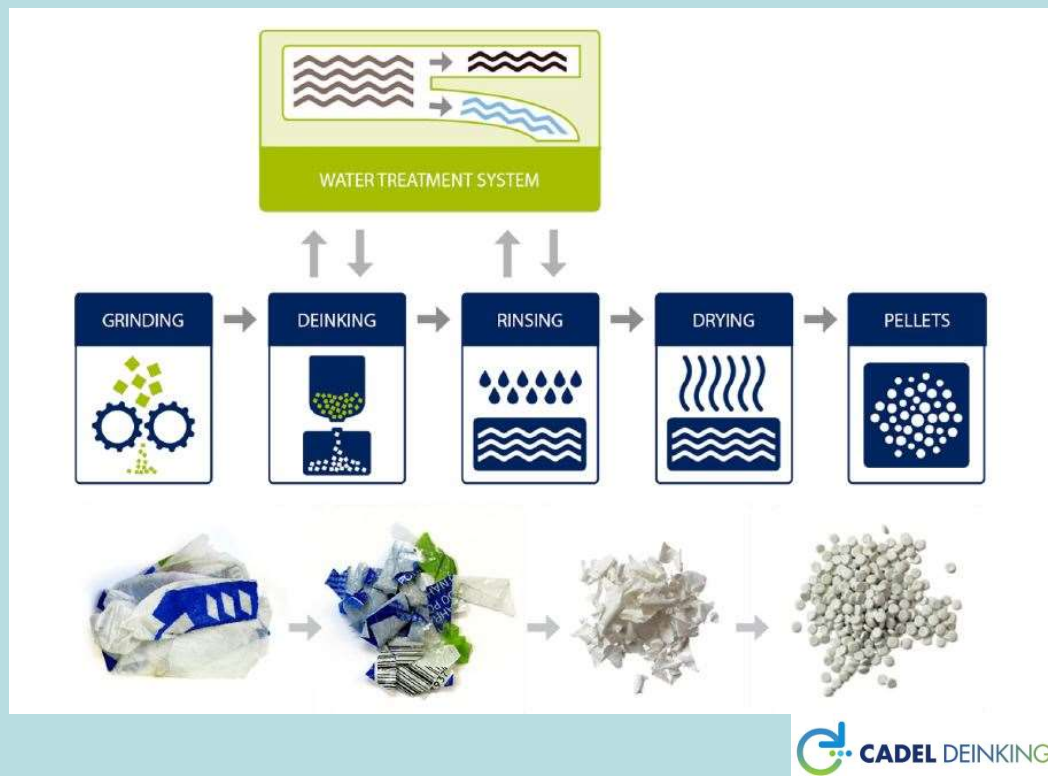
- A thorough literature search was pursued to understand the methods for color removal: in research stage or commercialized
→ No viable method for polyolefins found.

Experimental
work part

- Yield in titania pigment removal remained modest,
- The solvents to solve polyolefins are aromatic hydrocarbons, thus they need closed solvent circulation and regeneration processes or substitution in industrial processes.
- Future questions
 - Physical agitation methods are proposed to enhance phase separation in solution,
 - Optimization of the recovery of the polymer: how to minimize solvent residues and make sure they cannot cause problems for polymer utilization.



Removal of Dyes from Recycled Plastics: Process example



LDPE input



LDPE output



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Thank you for your attention!

***Special thanks for all ARVI partners for
good and inspiring collaboration***