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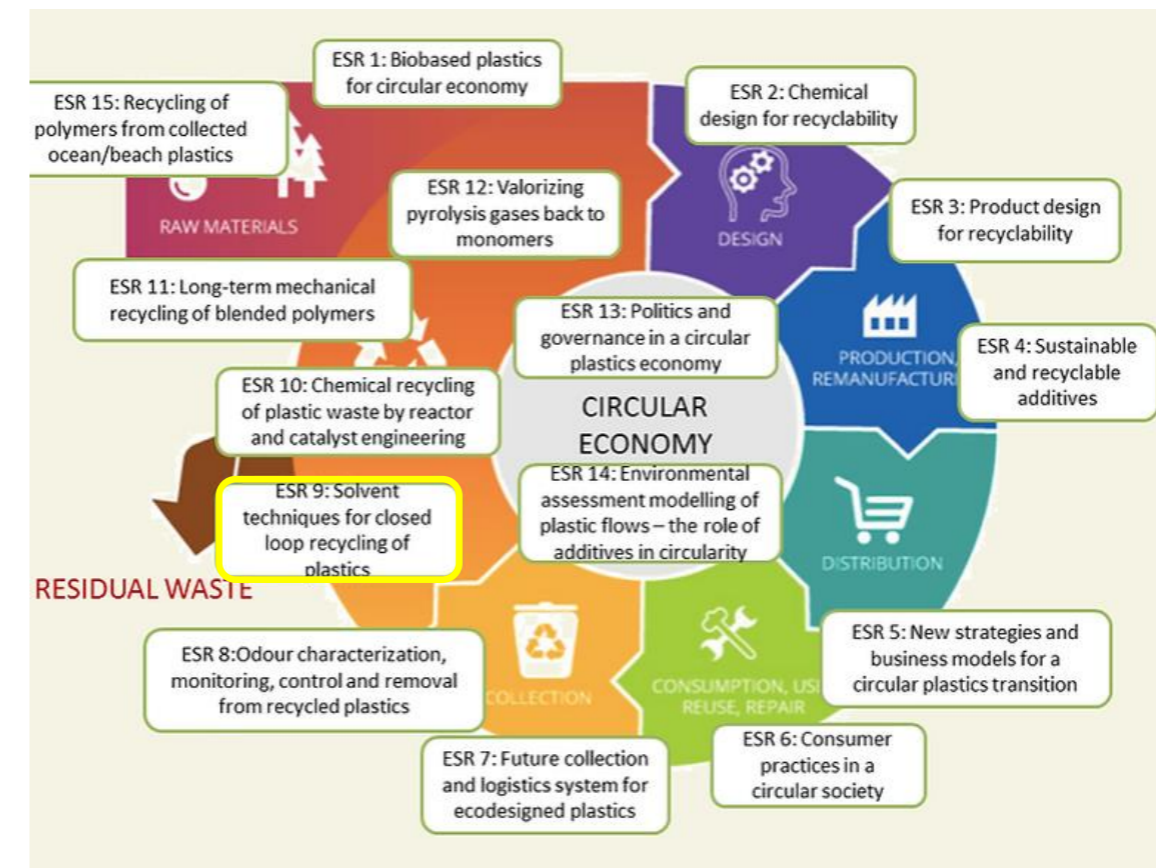
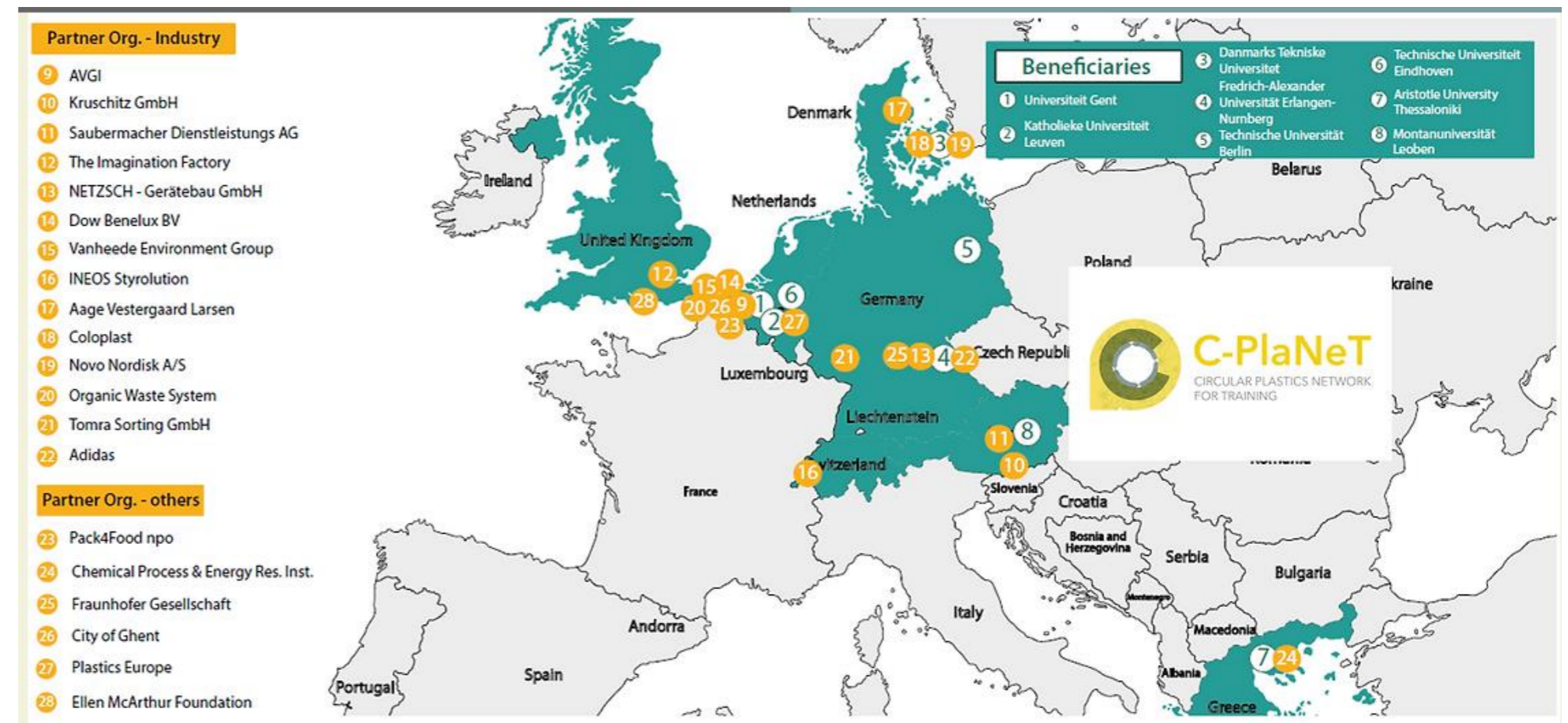
SOLVENT-BASED RECYCLING OF PLASTIC WASTE

CAPTURE Plastic to Resource

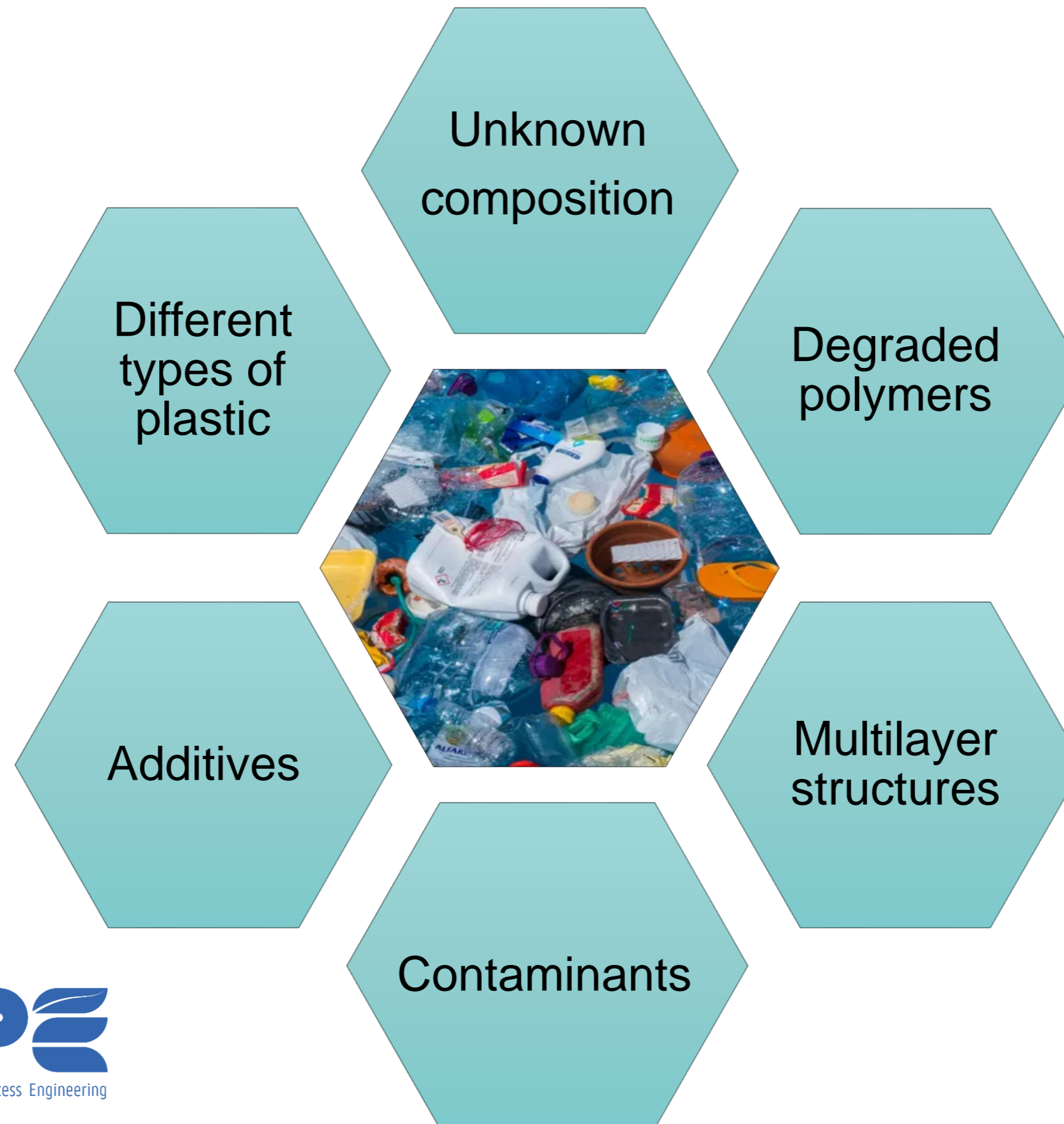
Rita Kol – 17/05/2022

C-PLANET

- CAPTURE Plastic to Resource
- C-PlaNet – Circular Plastics Network for Training.
- H2020 Marie S. Curie Actions – Innovative Training Networks.
- Multidisciplinary consortium of universities, research institutes and companies.
- 15 ESRs (PhD topics).



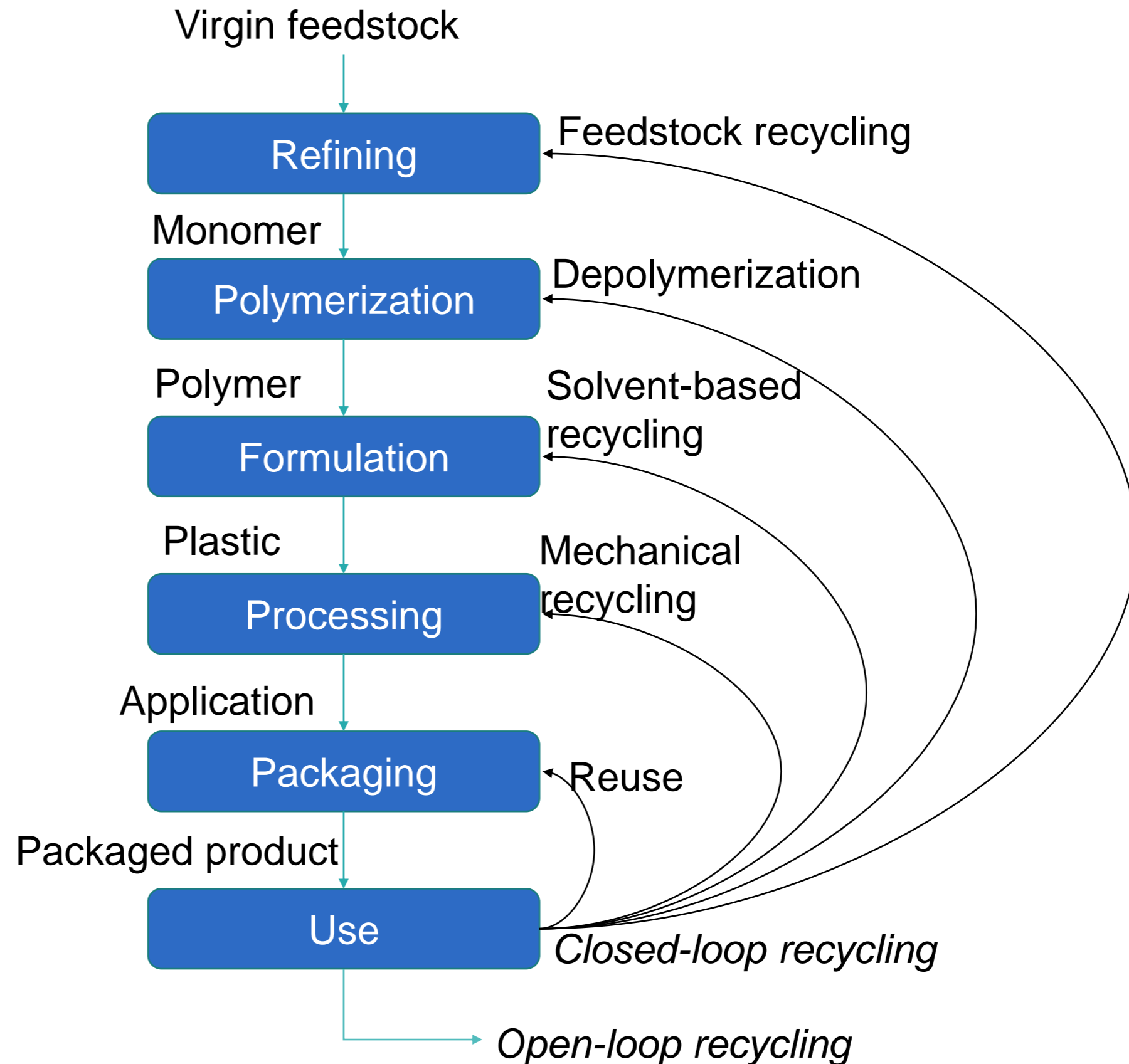
CHALLENGES IN PLASTIC RECYCLING



SOLVENT-BASED RECYCLING



Solvent-based recycling (physical recycling):







Composition of the polymer
is not changed \neq chemical
recycling

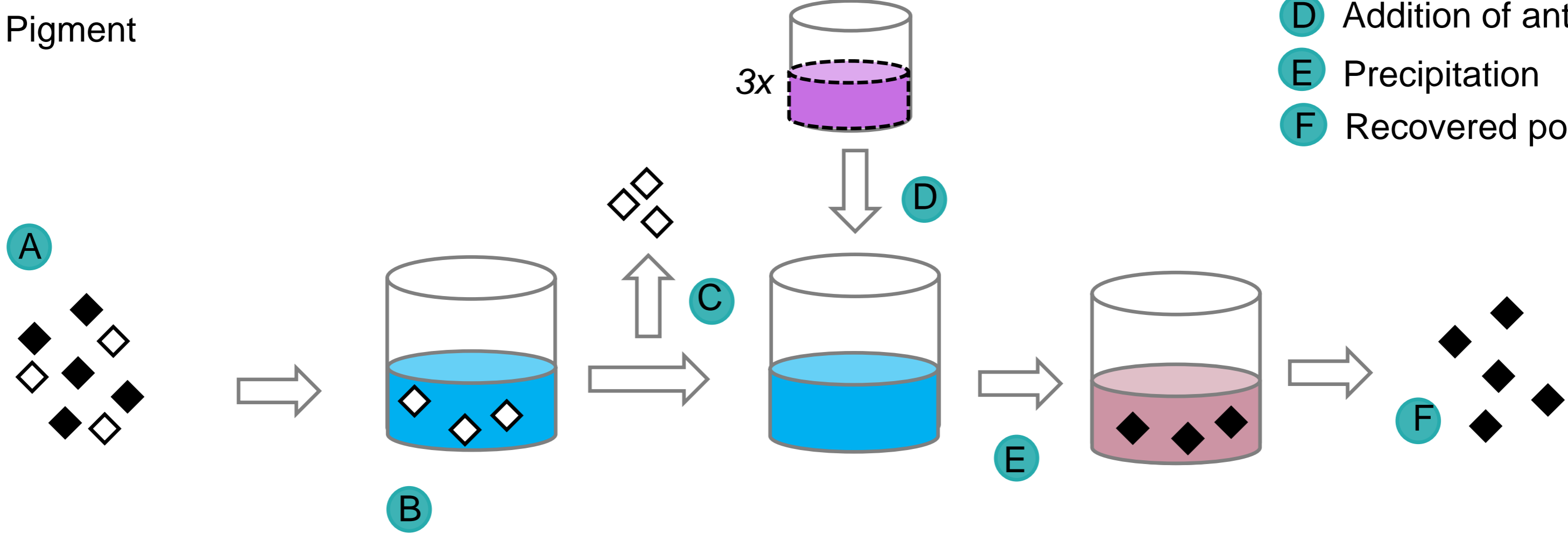


DISSOLUTION-PRECIPIATION TECHNIQUE

 Solvent
 Antisolvent

 Polymer
 Pigment

-  A Colored plastic
-  B Dissolution
-  C Filtration/Centrifugation
-  D Addition of antisolvent
-  E Precipitation
-  F Recovered polymer



SELECTIVE DISSOLUTION

Separation of different polymers

❑ Changing solvents

❑ Temperature

- Xylene @25°C for PS
- Xylene @85°C for LDPE
- Xylene @150°C for HDPE

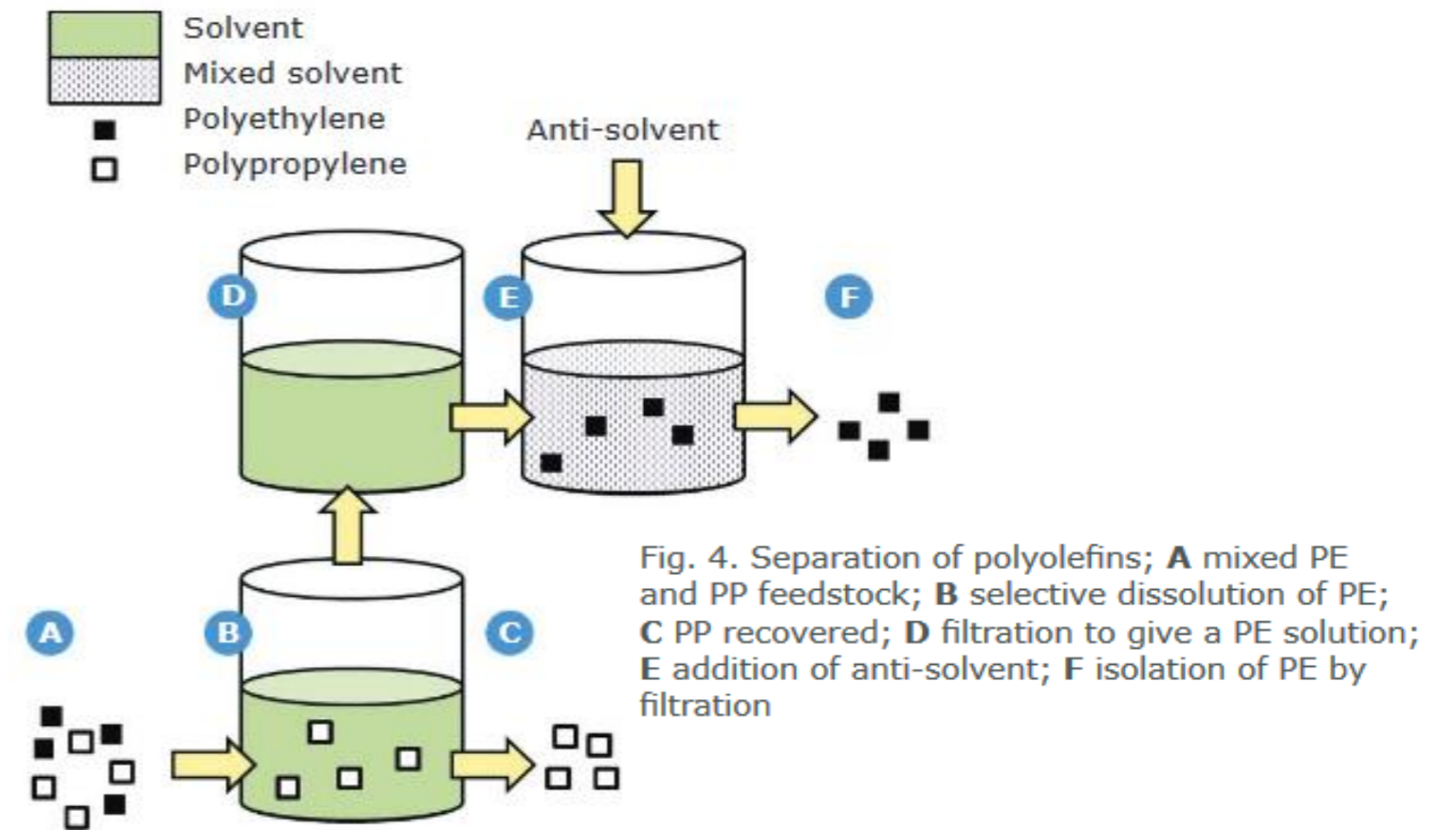


Fig. 4. Separation of polyolefins; **A** mixed PE and PP feedstock; **B** selective dissolution of PE; **C** PP recovered; **D** filtration to give a PE solution; **E** addition of anti-solvent; **F** isolation of PE by filtration

Figure from J. Sherwood (2020) Closed-loop recycling of polymers using solvents. Johnson Matthey Technology Review. pp. 4-15

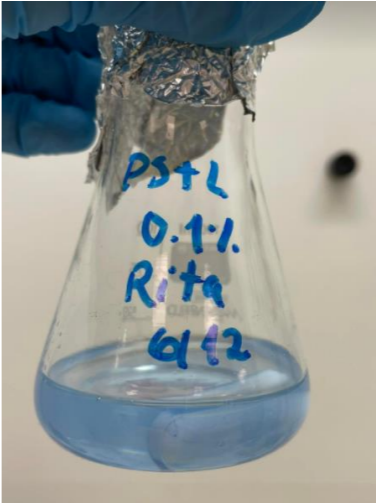
- CreaSolv® (PE,PP multilayer)
- Newcycling® (PE multilayer)
- PureCycle TechnologiesSM (PP)
- Polyloop® (PVC)

DISSOLUTION OF MUSHROOM TRAY

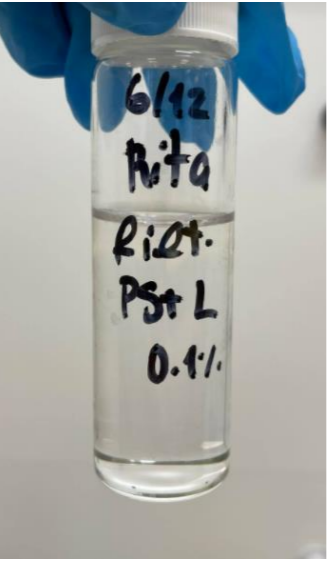


Food-contacting packaging (polystyrene)

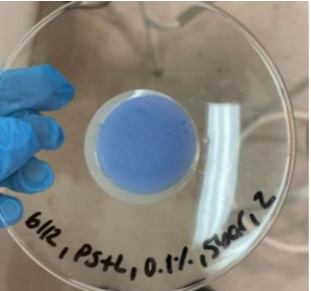
Dissolution



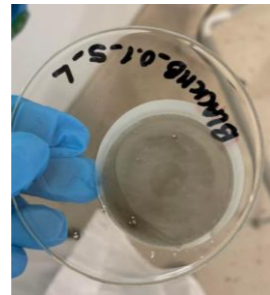
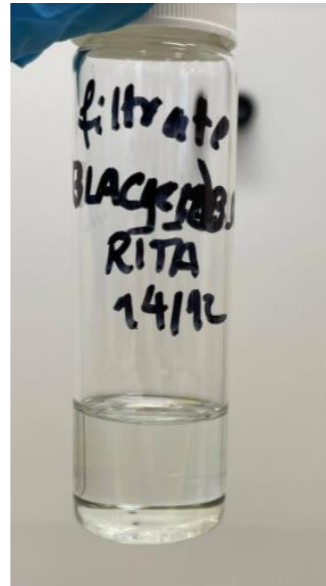
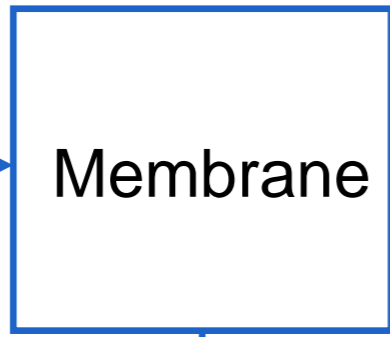
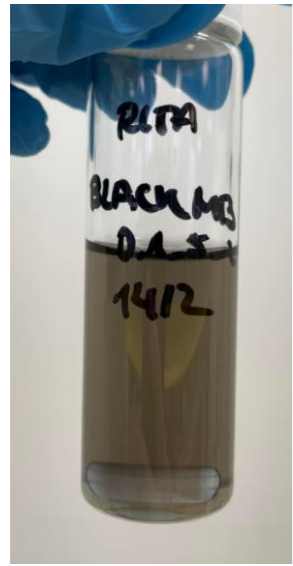
Pressurized filtration set-up
Dead-end configuration



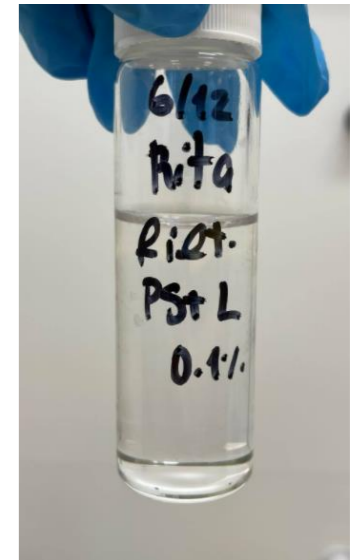
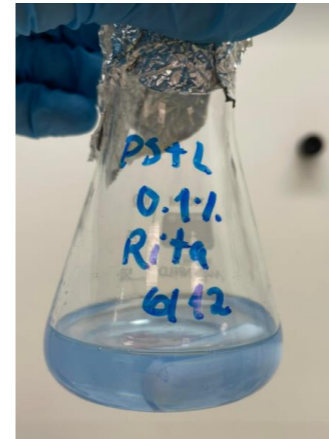
Antisolvent +
Recovery of
polymer



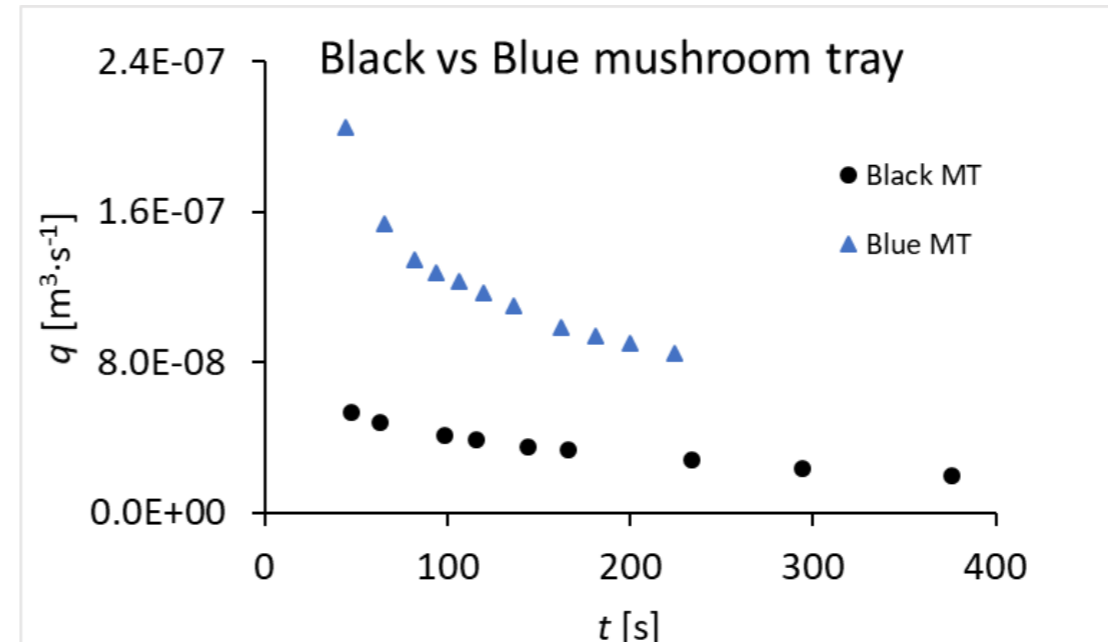
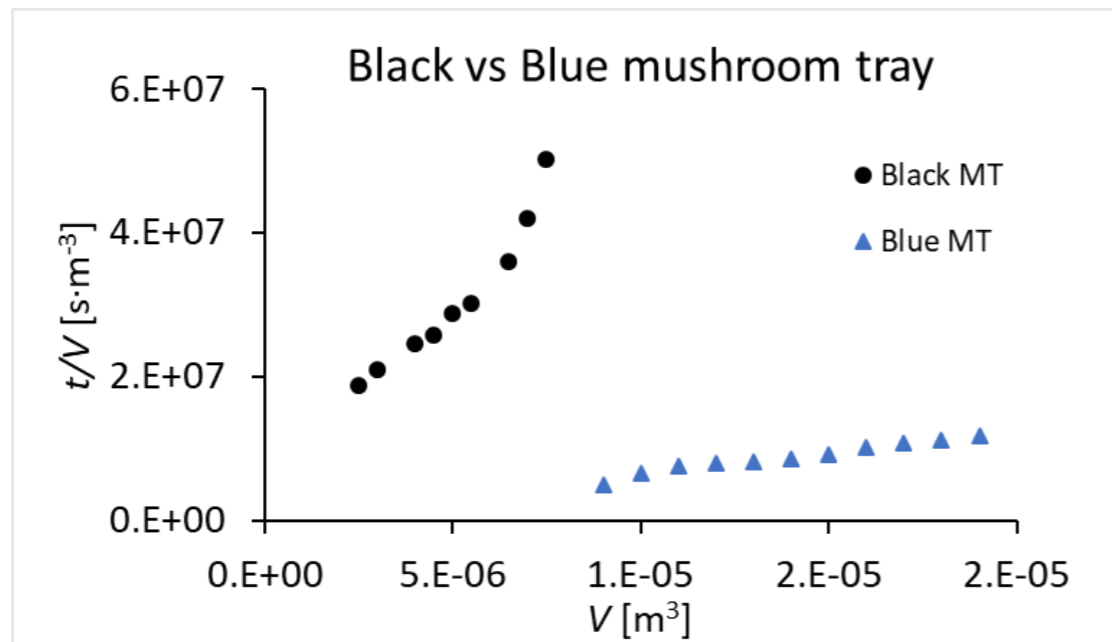
BLUE VS BLACK MUSHROOM TRAY



96% turbidity reduction

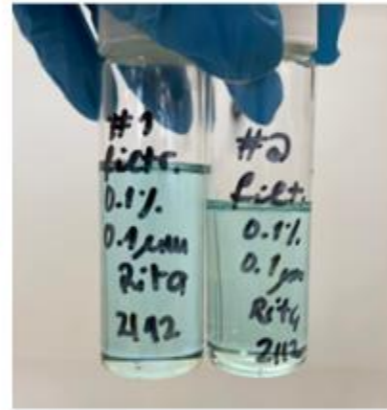
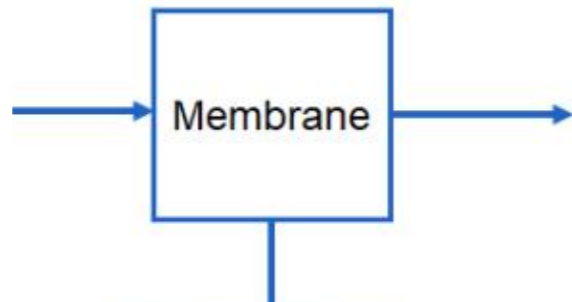
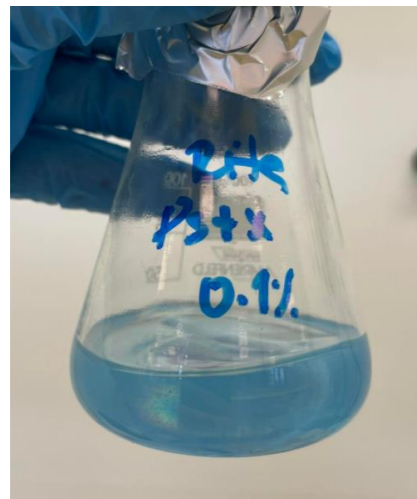


97% turbidity reduction

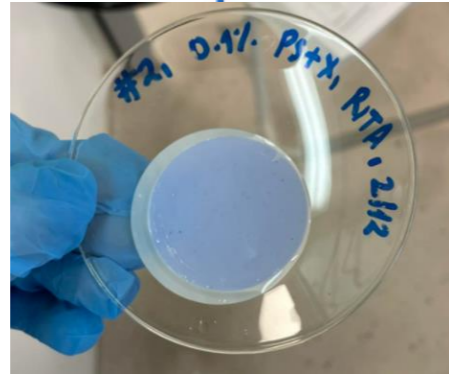


- M_w
- Pigment
- % of rubber (HIPS)

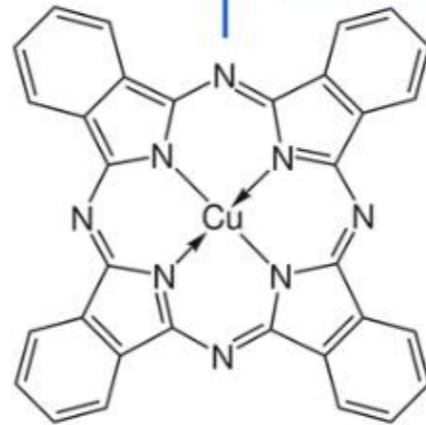
INFLUENCE OF SOLVENT



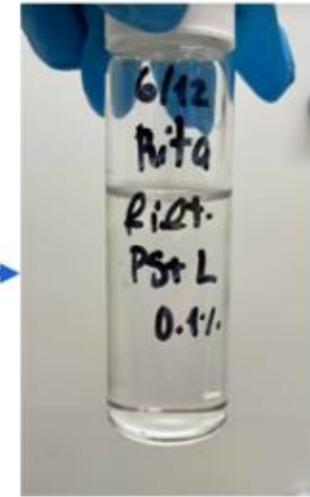
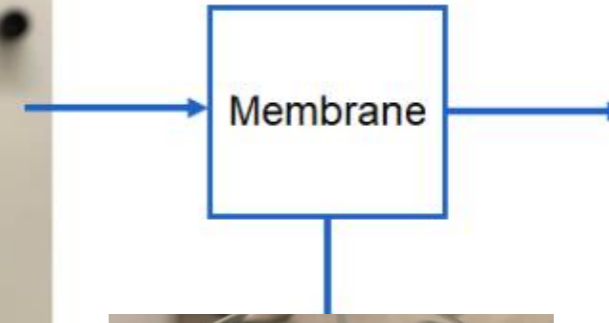
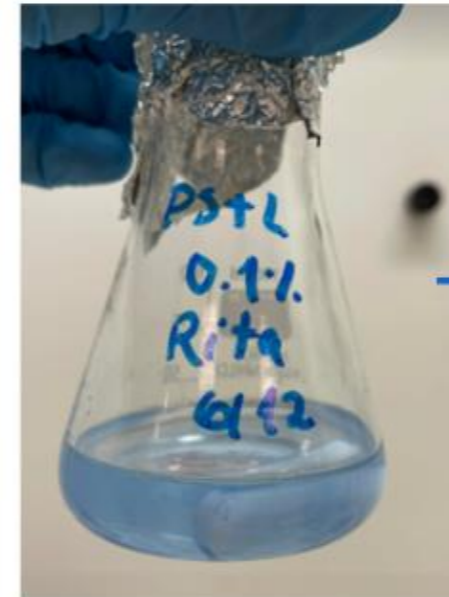
Remaining pigment



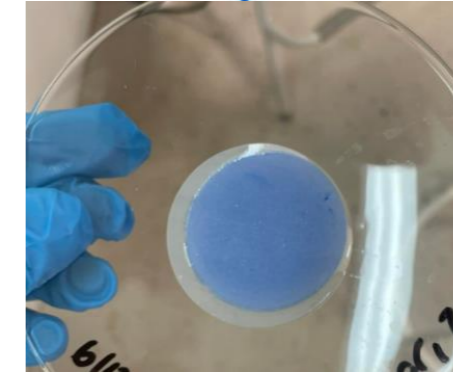
Additive some solubility in xylene



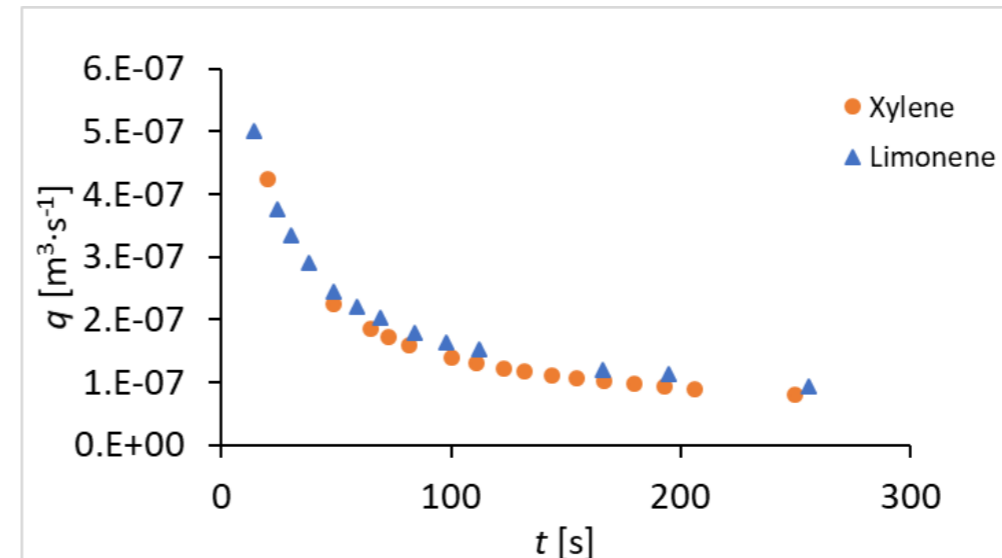
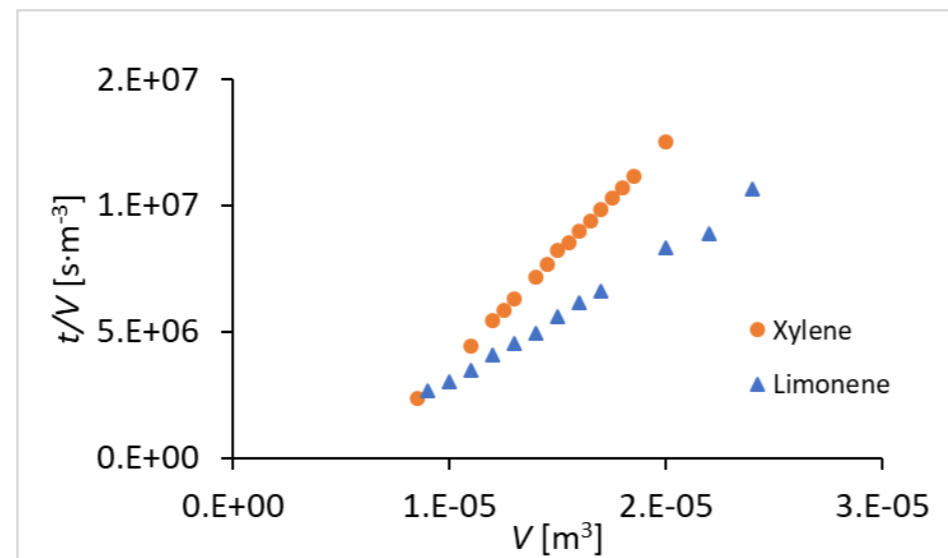
Pigment blue 15:3



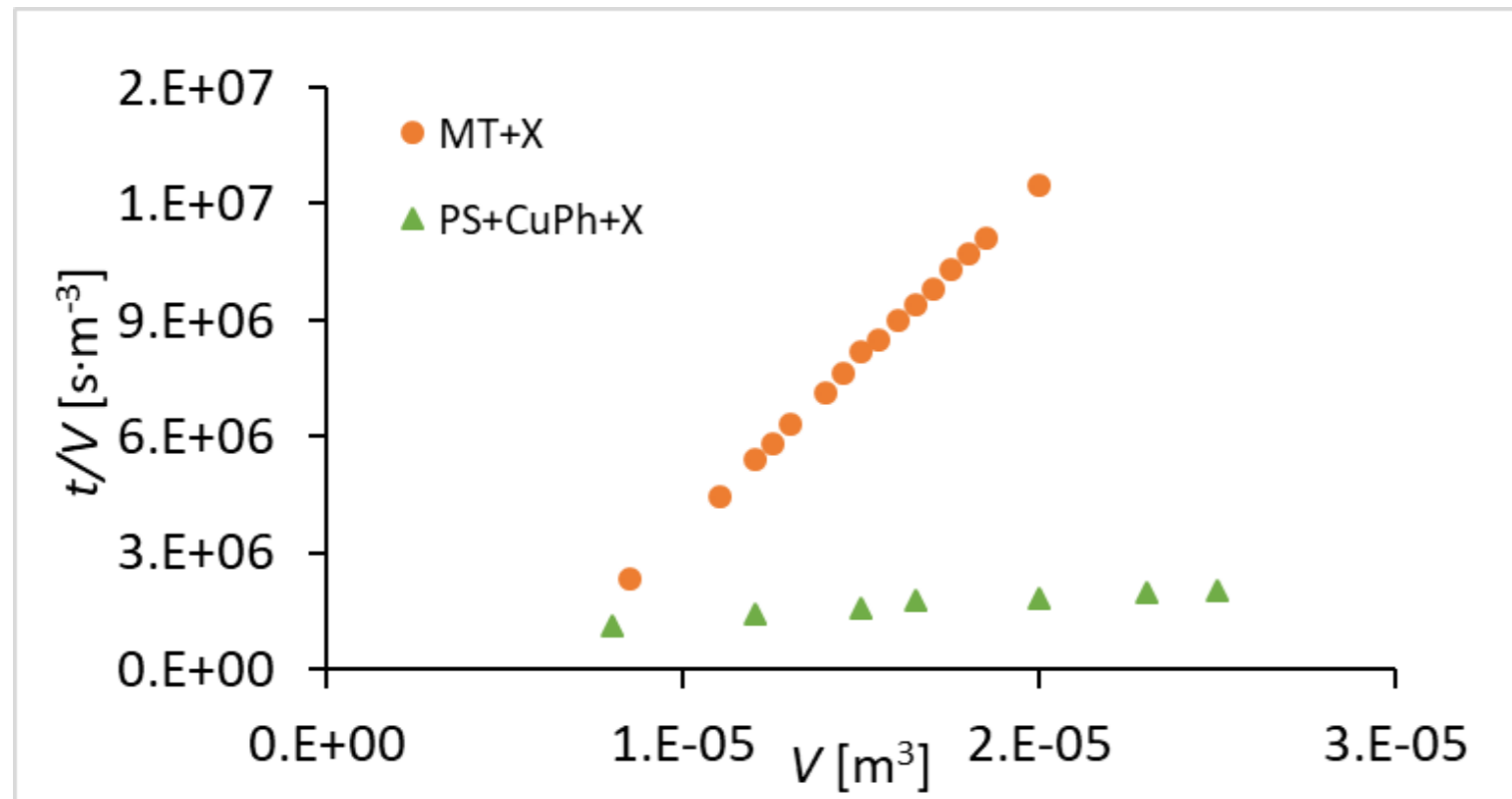
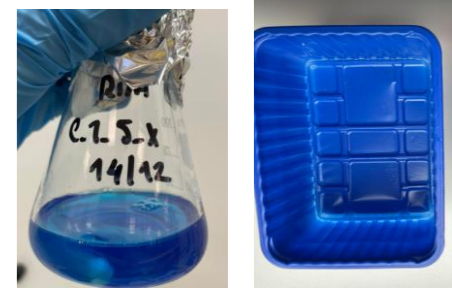
Clean polymer



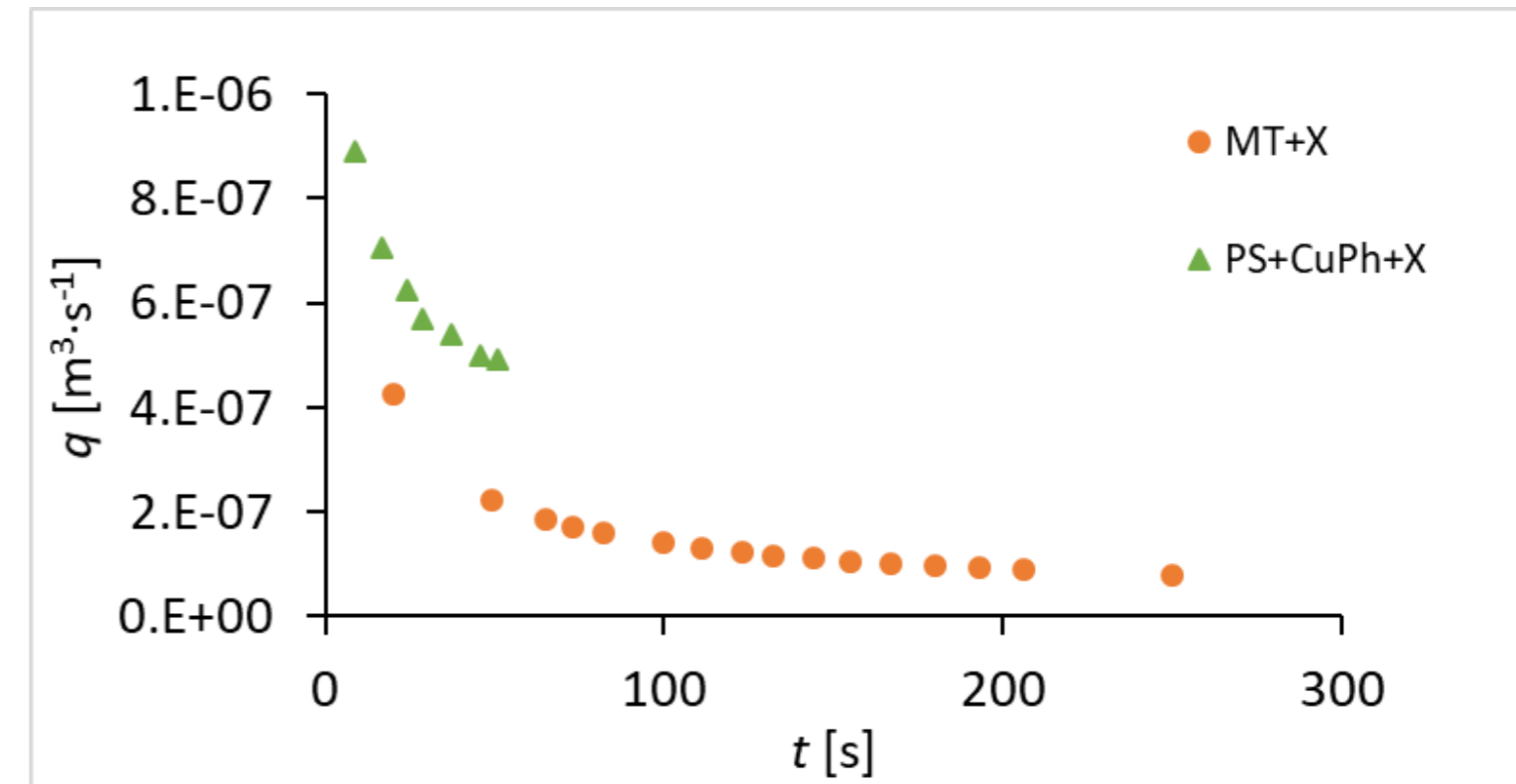
Additive hardly any solubility in limonene



MODEL SOLUTION VS WASTE



Waste → higher resistance



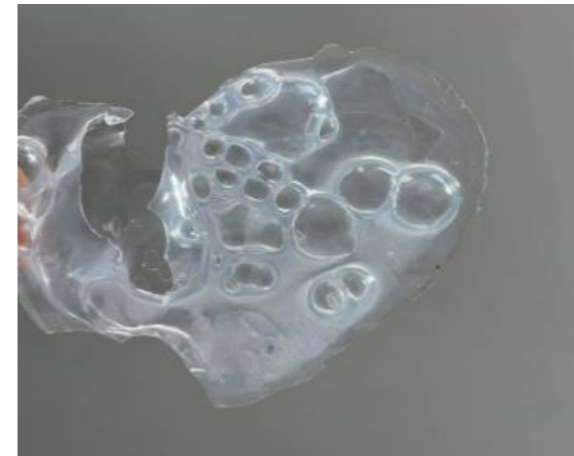
Waste → lower flow rate

- Waste: M_w , HIPS (rubber part), additives
- Low concentrations → optimization needed

POLYMER RECOVERY

Addition of
antisolvent

Method 1



Brittle film

Method 2



Powder

- AS/S ratio
- AS/S combination
- Temperature
- Solid-liquid separation process

CONCLUSIONS & NEXT STEPS

- Solvent-based recycling promising route for plastic recycling.
- Filtration efficiency is influenced by: concentration, polymer, additives.
- Solvent choice plays an important role.
- Currently optimizing a process for the removal of colourants from polystyrene-based waste.

Next steps:

- Assessment of the recovered polymer properties.
- Tackle other polymer.



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REFERENCES

Slides 5,6,7,8: adapted from R. Kol, *Solvent techniques for closed loop recycling of plastics*, Microteaching, C-PlaNet EU H2020 project (2021), <https://doi.org/10.5281/zenodo.5710332>