

Water-Soluble Polymers:

An Emerging Concern in Freshwater Environments

Eve Tarring

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Introduction to water-soluble polymers (WSPs):

- Polymers vs. Plastics
- Water-Soluble Polymers (WSPs): What Are They?
- Routes Into the Environment
- Environmental Fate and Ecotoxicology

Research Advances and Future Work

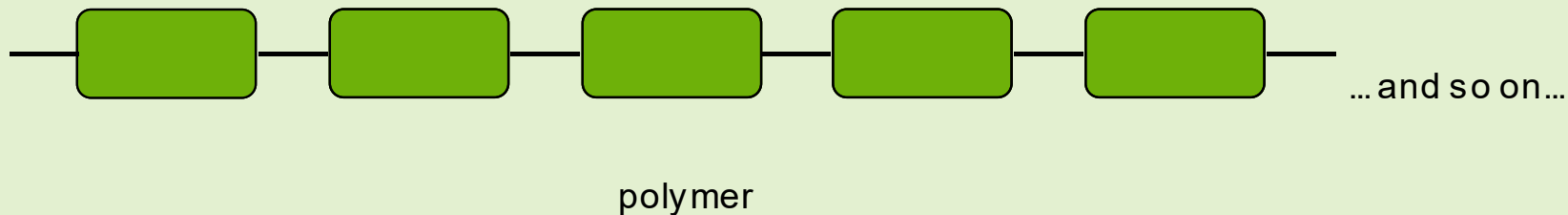
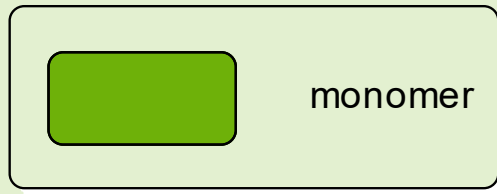
- Separation and quantification of WSPs in personal care products (PCPs) and wastewater
- Future research

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Polymers vs. Plastics

- Polymers are large molecules made up of subunits called monomers
- What makes a polymer a plastic?



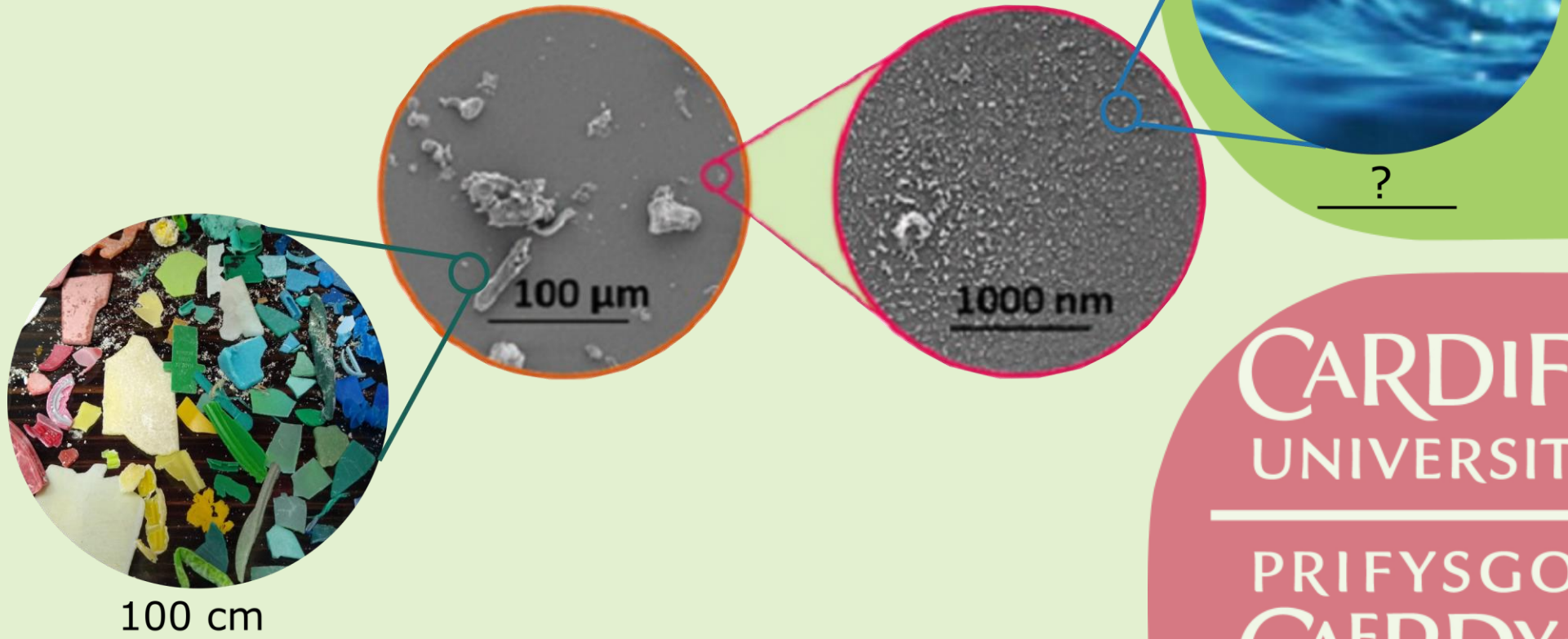
- Plastics are polymers with additives e.g. nylon, PET

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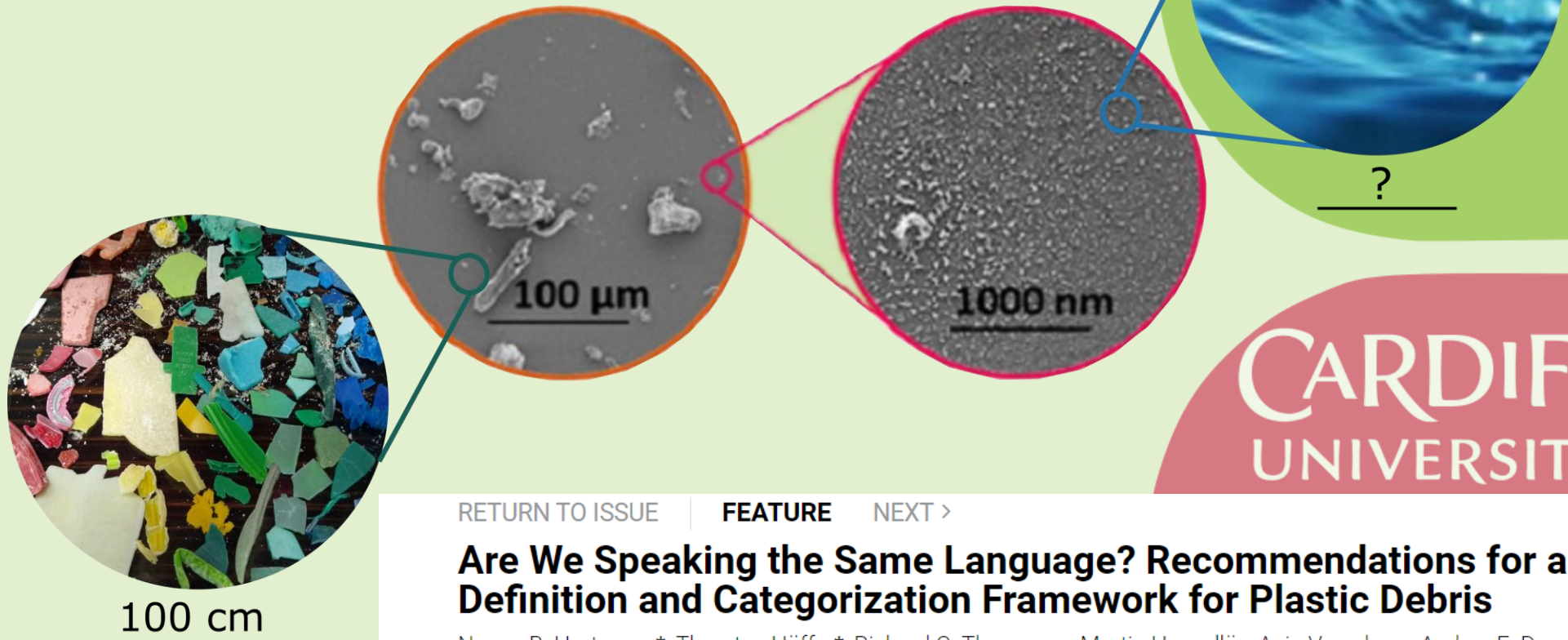
Polymers vs. Plastics

Molecular weight and plastic particle size



Polymers vs. Plastics

Molecular weight and plastic particle size



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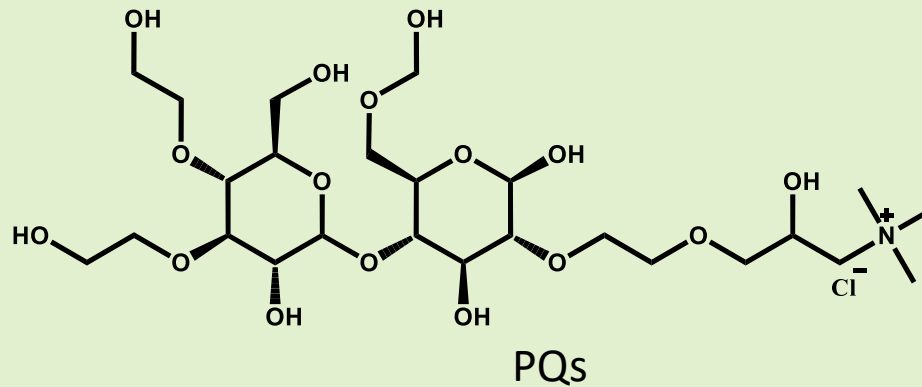
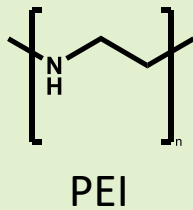
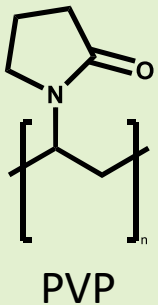
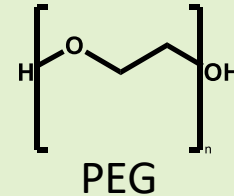
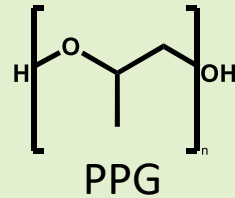
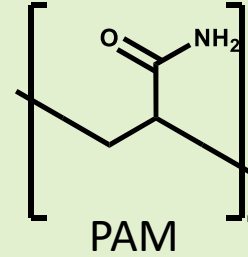
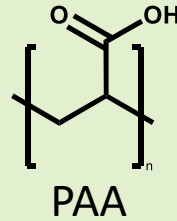
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Are We Speaking the Same Language? Recommendations for a Definition and Categorization Framework for Plastic Debris

Nanna B. Hartmann*, Thorsten Hüffer*, Richard C. Thompson, Martin Hassellöv, Anja Verschoor, Anders E. Daugaard, Sinja Rist, Therese Karlsson, Nicole Brennholt, Matthew Cole, Maria P. Herrling, Maren C. Hess, Natalia P. Ivleva, Amy L. Lusher, and Martin Wagner*

Water-Soluble Polymers (WSPs): What Are They?

- “Dissolve, disperse or swell in water”
- No defined size scale
- Many different types and properties



Types of Water-Soluble Polymer and Uses

Pharmaceutical and personal care products (PPCPs)



Industry



Agriculture

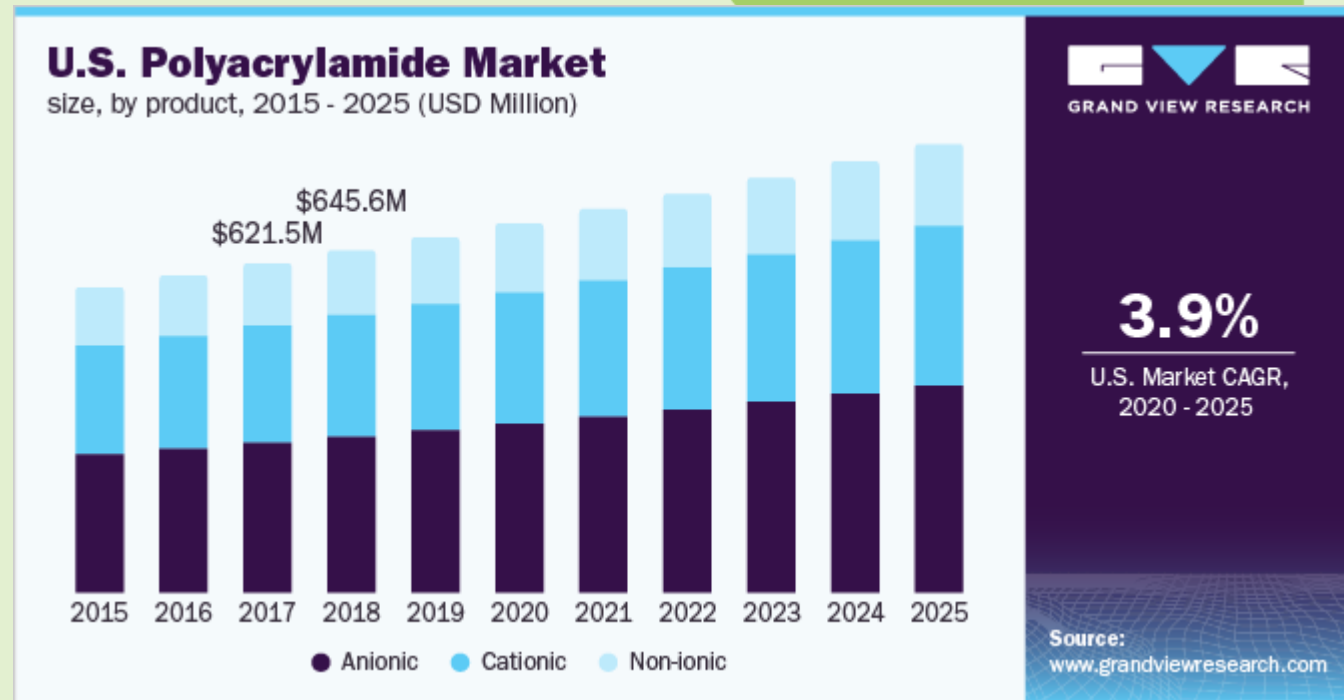


Infrastructure

An Overlooked Class of Polymer?

- No size categorisation = excluded from legislation
- Little research into their behaviour and fate in the environment
- Not monitored under REACH

2. Market analysis report, 2019



Routes Into the Environment

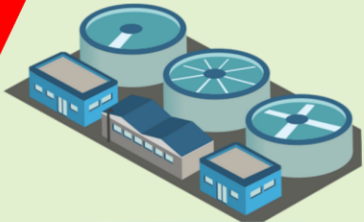
Polymer production

PAA PAM
PEG PEI
PCE PPG



Agriculture

e.g pesticides and fertilisers



Wastewater treatment

e.g PPCPs, household products,
wastewater flocculation agents

PEG PCE PPG
PAM PEI PVP
PAA PQs

Surface water to sewer

PCE PPG
PEG PEI
PAA

Non-point source (NPS)

e.g paints, concrete additives, building materials

Remain in soil

Sludge application

Sorption/ precipitation/ biodegradation

Treated/ untreated water

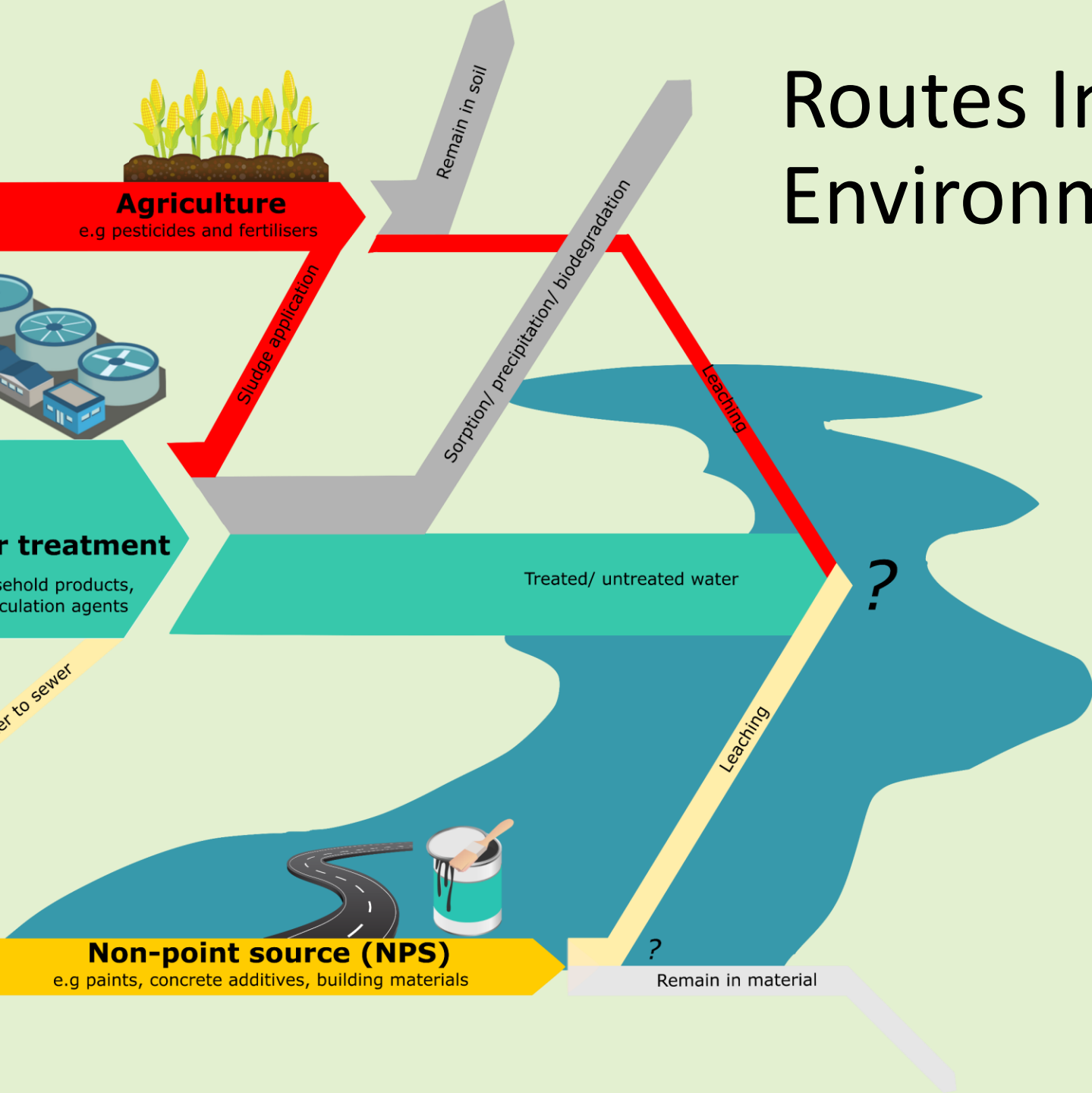
Leaching

Leaching

?

?



Remain in material



Environmental Fate and Ecotoxicity

- Flocculation/ adsorption to natural organic matter (NOM)
- Biodegradation
- Sublethal toxicity
- Detection in surface waters

Beyond microplastics: Water soluble
Narrowing the analytical gap for water-soluble polymers: A novel trace-analytical method and first quantitative occurrence data for polyethylene oxide in surface and wastewater

[Frances Pauelsen](#)¹, [Sven Huppertsberg](#), [Thomas P. Knepper](#), [Daniel Zahn](#)  

Research Advances and Future Work

A graphic element on the right side of the slide, consisting of a large green rounded rectangle with a smaller green circle above it, and a pink rounded rectangle above that.

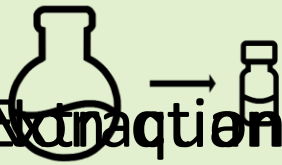
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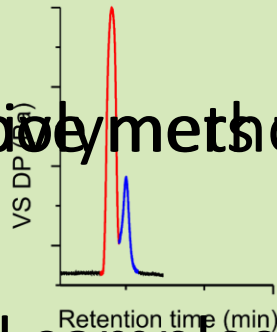
Separation and quantification of WSPs

Applications of WSP methods in environmental samples

- Separation and identification of polymers in PCPs
- Extraction and quantification of polymers from wastewater



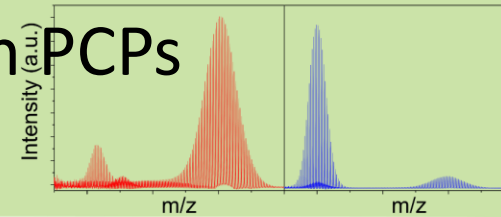
Retention times determined (low flow)



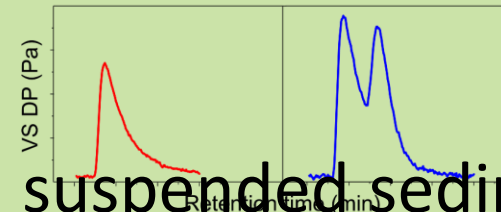
Fractions collected



MW of fractions determined



Fractions re-run (standard flow)



Concentration of individual polymers calculated

- Environmental samples contain DOM, POM, suspended sediment etc.

Separation

Quantification

Future Research

- Greater advances in polymer specific analytical methodology
- Call for physicochemical parameters of WSPs to be explored for legislation to be implemented
- Better understanding of environmental pathways and ecotox impacts

NEWS ARTICLE | 20 January 2022 | Directorate-General for Environment

Chemicals: Commission seeks views on revision of REACH, the EU's chemicals legislation

Conclusions

- WSPs are a source of emerging environmental concern
- Variety of entry points and lack of quantification data means environmental risk is unknown
- Greater focus is needed on detection and environmental behaviour to create future legislation

The logo for Cardiff University, featuring a large green leaf-like shape on the left and a pink shape on the right containing the university's name in English and Welsh.

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Acknowledgements

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Ward group, Cardiff University

WeWash project, Cardiff University

ECORISC CDT (NERC)

The logo for Cardiff University, featuring a large green shape on the left and a pink shape on the right. The pink shape contains the text 'CARDIFF UNIVERSITY' in white, with a horizontal line below it, and 'PRIFYSGOL CAERDYDD' in white below the line.

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