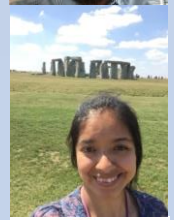
Biochar: Circular Economy in Selective Sustainable Water Treatment

C.E.M.E.G.
Chemistry Engineering Materials Environment Group

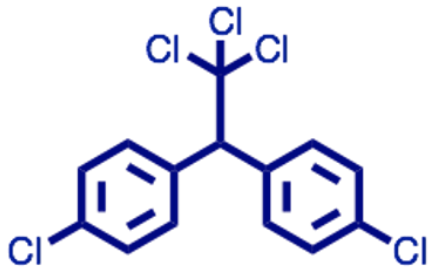

Dr Stuart Cairns


Dr Diana Meza Rojas

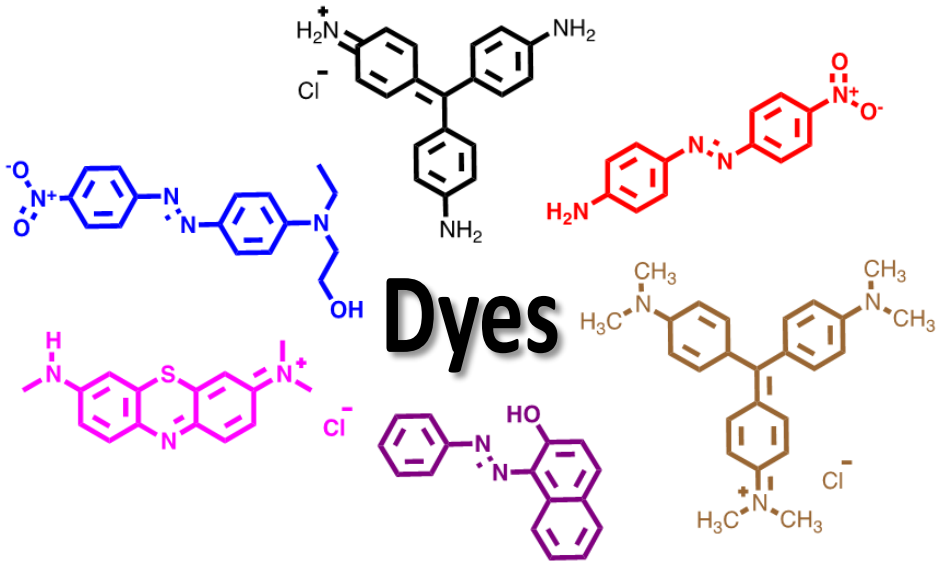

Professor Peter Holliman

Principal Water Contaminants

Pesticides



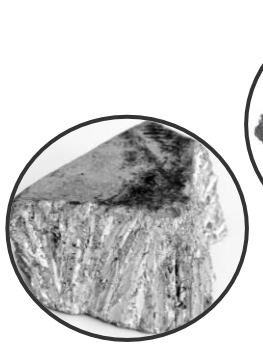
Dyes



POLLUTANTS

Microplastics

Heavy Metals

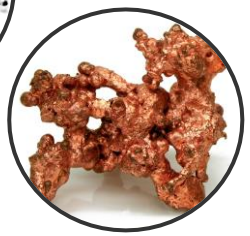

Zinc


Lead


Iodine


Magnesium


Mercury


Copper


Selenium

Potential health effects of water contamination

Anthropogenic Activities

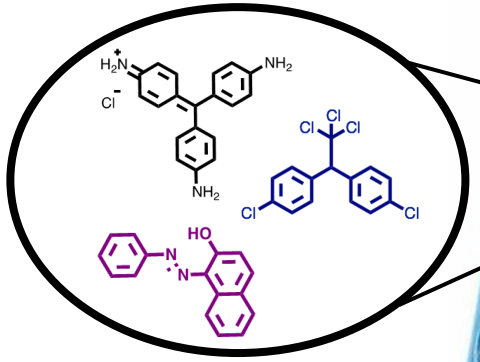
Microplastics (MPs)

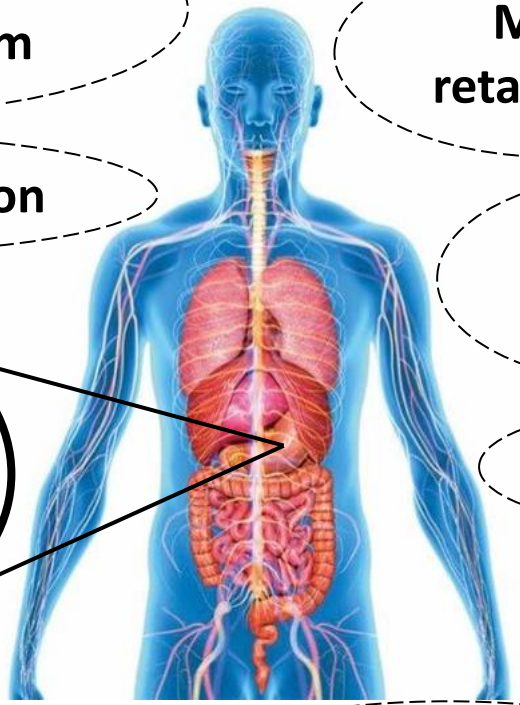
Aquatic Life

Seafood

Potential Health Effects

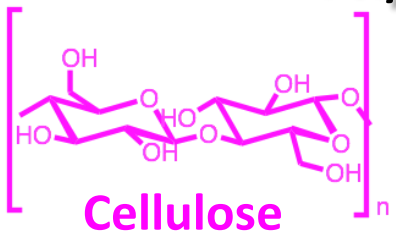
- Damage to central nervous system
- Skin inflammation
- Metal retardation
- Vomiting and ulcer
- Dry cough
- Diarrhea
- Circulatory systems issues
- Pulmonary fibrosis
- Pulmonary congestion
- Lung Cancer



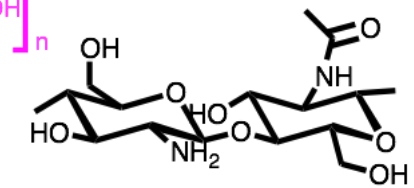


Current UK water treatment: Adsorption and Filtration

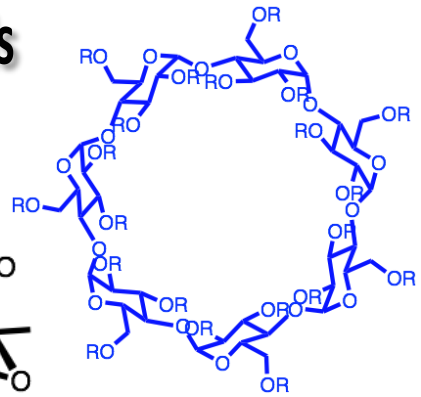
Polymeric Materials



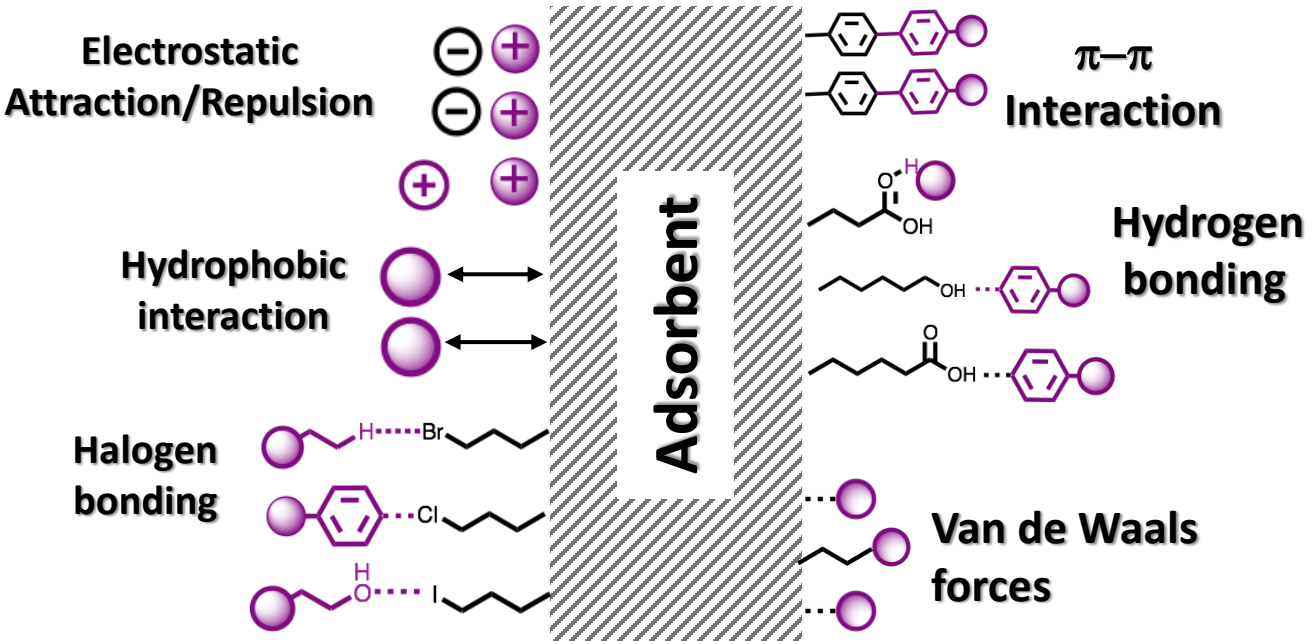
Cellulose



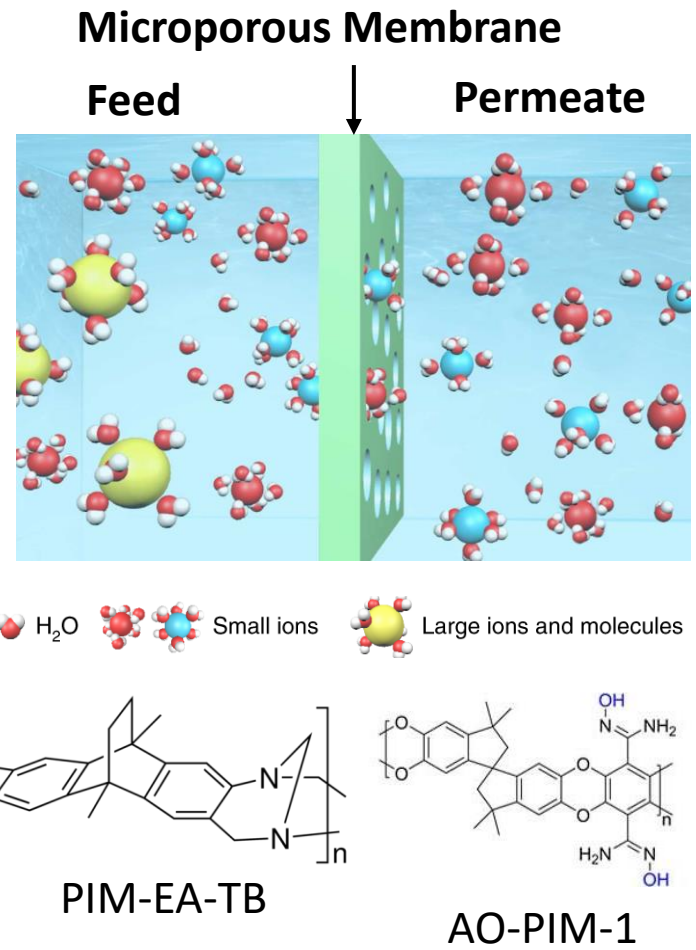
Chitosan



Cyclodextrin



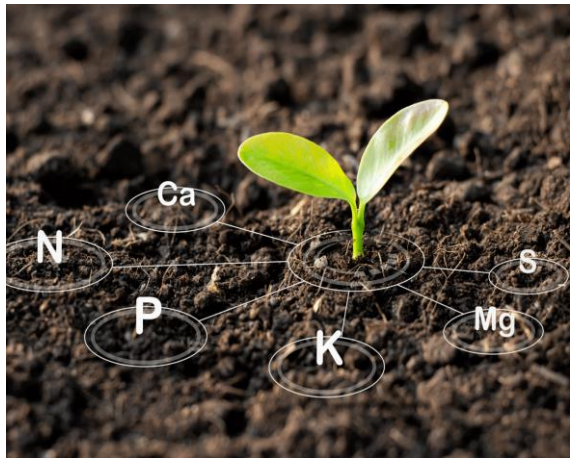
Membranes Technology (i)



(i) Tan, R., Wang, A., Malpass-Evans, R. *et al.* Hydrophilic microporous membranes for selective ion separation and flow-battery energy storage. *Nat. Mater.* **19**, 195–202 (2020)

(ii) Gesevičius, D., Neels, A., Jenatsch, S., Hack, E., Viani, L., Athanasopoulos, S., Nüesch, F., Heier, J., *Adv. Sci.* 2018, 5, 1700496

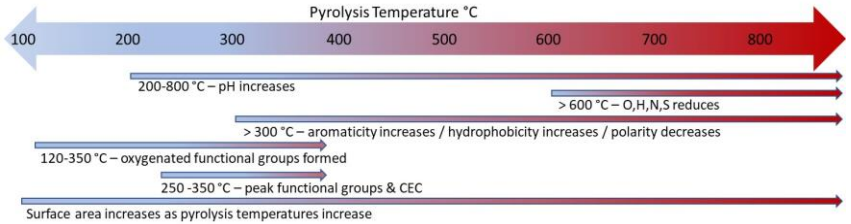
Biochar: a sustainable solution



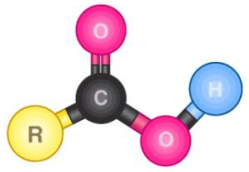
Biochar: three key levers

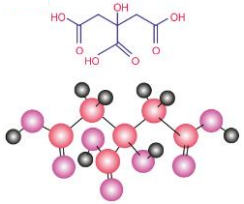
Feedstock

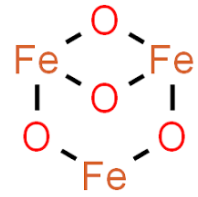
Temperature



Modification







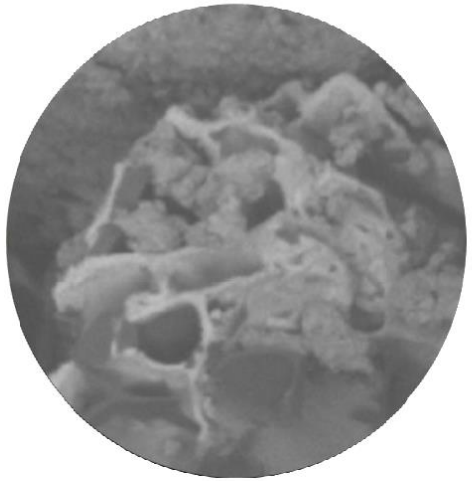
Biochar: metal immobilisation results

Larch wood chip feedstock

Pyrolyzed at 530°C for 90 seconds

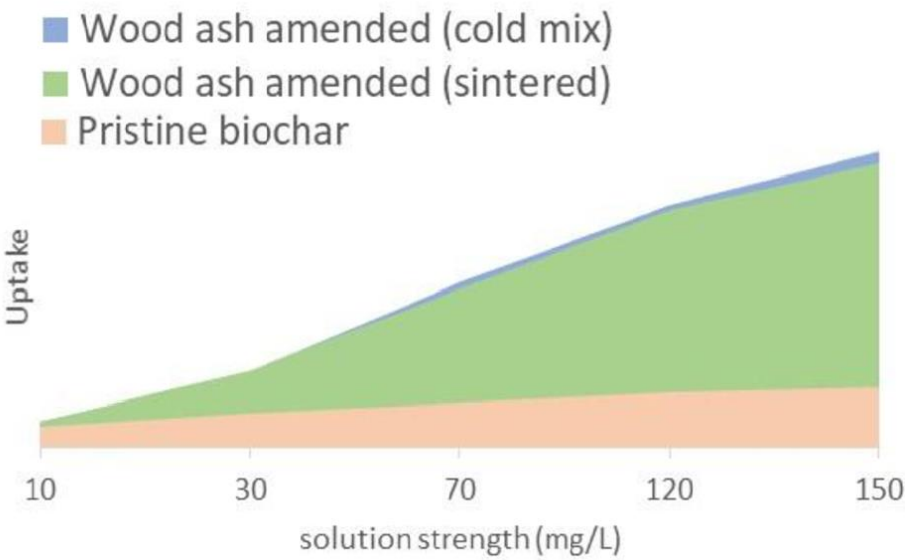
Amended with wood ash

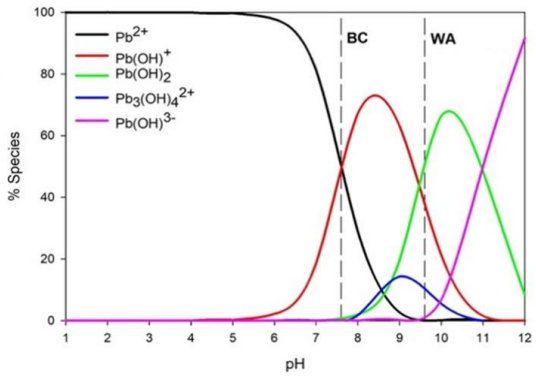
minerals



pH buffering capacity

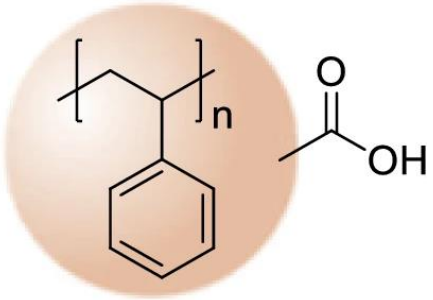
Increased removal





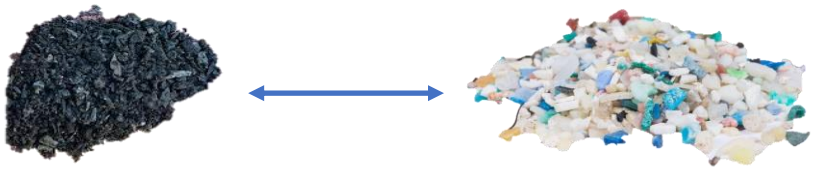
Due to precipitation and ion exchange

Biochar: emerging contaminant removal



Carboxyl Polystyrene

pH range for most inland freshwater
5.5 - 9



Electrostatic repulsion

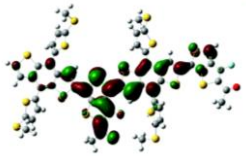
Feedstock

Temperature

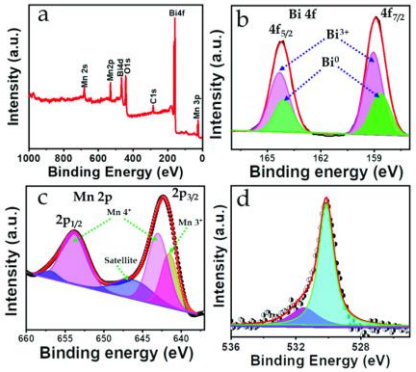
Modification

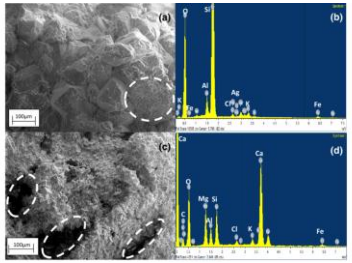
Density Functional Theory (DFT) and Machine Learning (ML)

Design & Synthesis

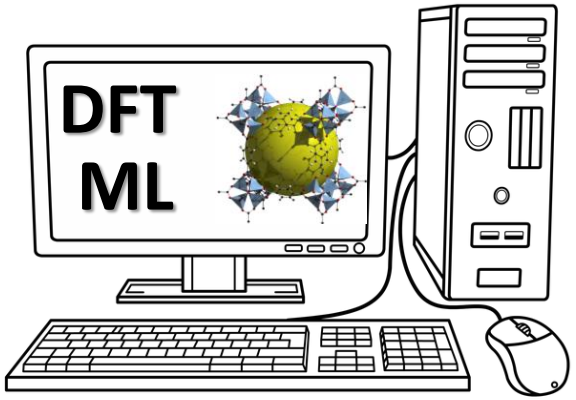


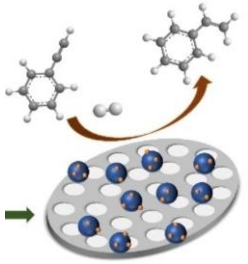
Results Analysis



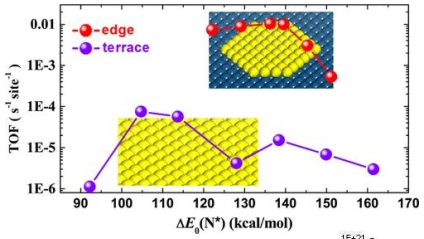


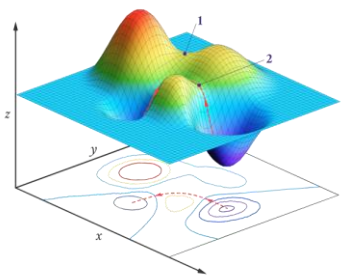
Modelling

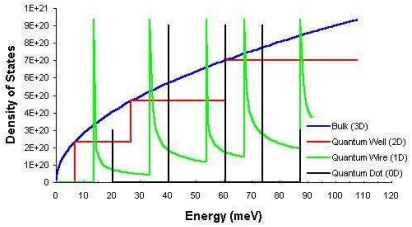




Analysis Prediction







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