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Synthesis of bacterial cellulose from mixed fruit waste for microplastic removal

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Introduction

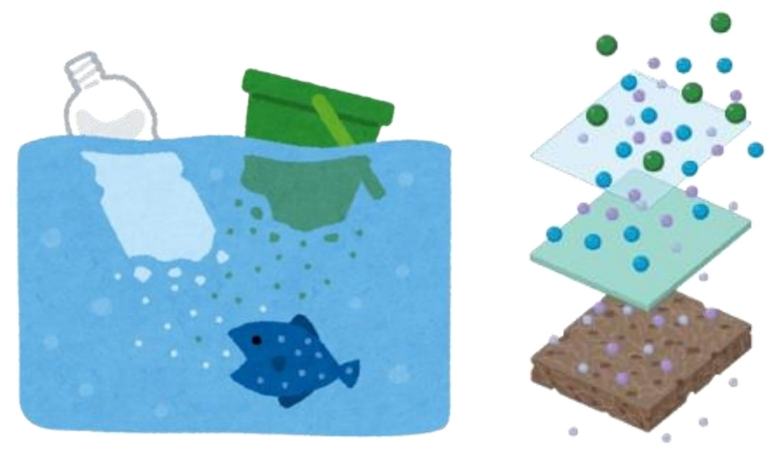
Challenge

Population growth contributes to increased microplastics (MPs) pollution and climate change due to higher levels of food waste

Solution

Use food waste to produce materials for microplastics removal

Goals



Develop sustainable and biodegradable nanocellulose-based materials to remove microplastics

Experimental methods

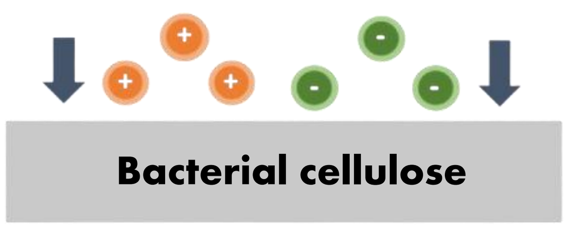
Sample collection

Bacterial cellulose (BC) synthesis

Gluconacetobacter xylinus InaCC B425

Bacterial cellulose

Adsorption

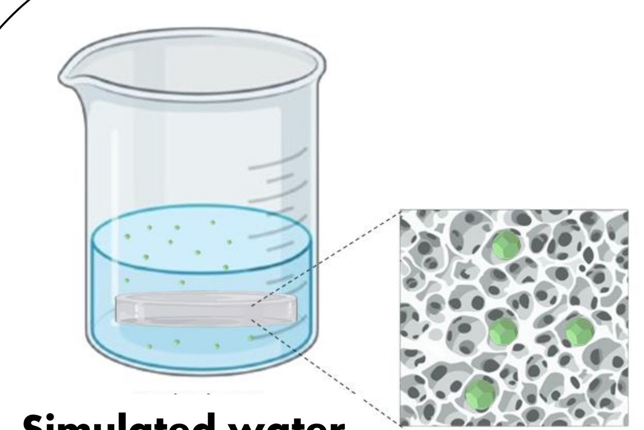


Microplastics used	
Cationic Latex bead fluorescent	λ_{ex} = ~520 nm; λ_{em} = ~540 nm
Anionic latex bead fluorescent	λ_{ex} = ~470 nm; λ_{em} = ~505 nm

Performance evaluation

- Effect of time: 0h, 1 h, 2h, 3h, 4h, 5h, 6h
- Effect of agitation: No agitation, and 150 rpm
- Effect of ionic charge: Cationic MPs and Anionic MPs
- Effect of pH: 4, 6.8, and 9

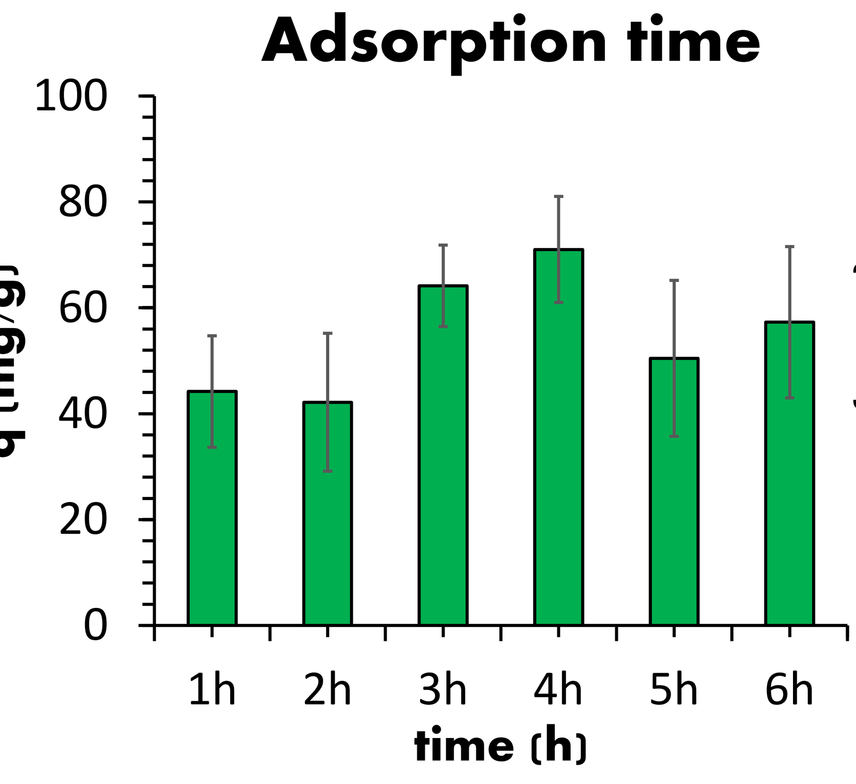
Results and Discussion



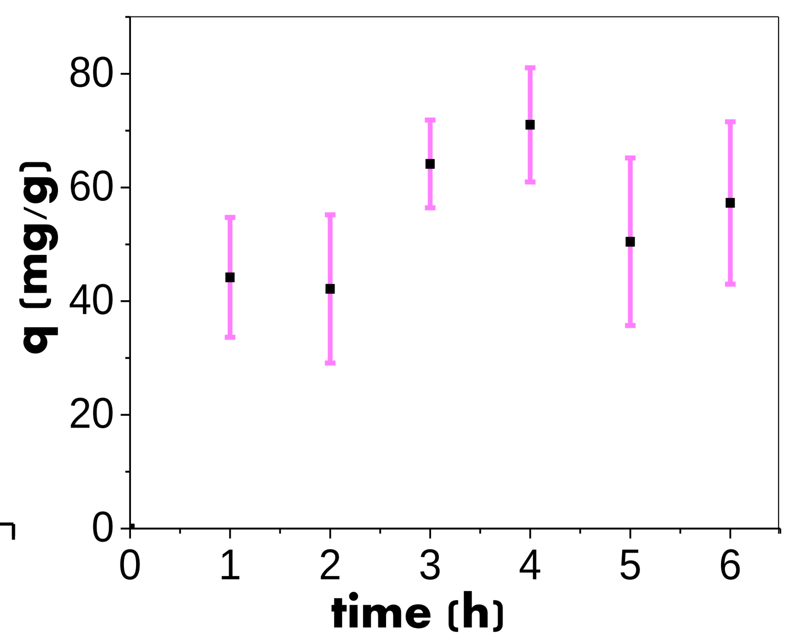
Simulated water containing MPs

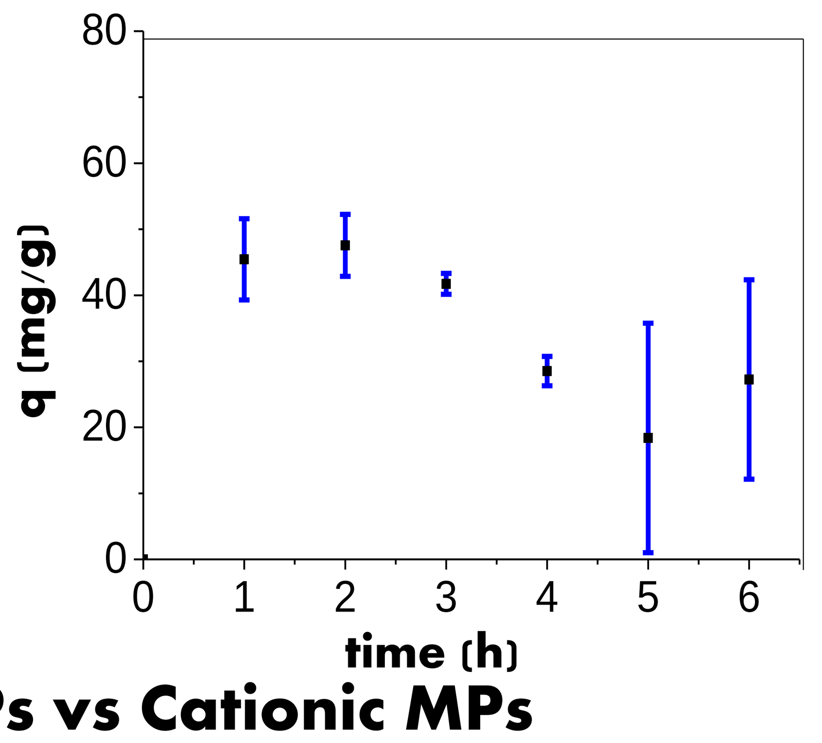
MP trapped in BC's pores

Adsorption time



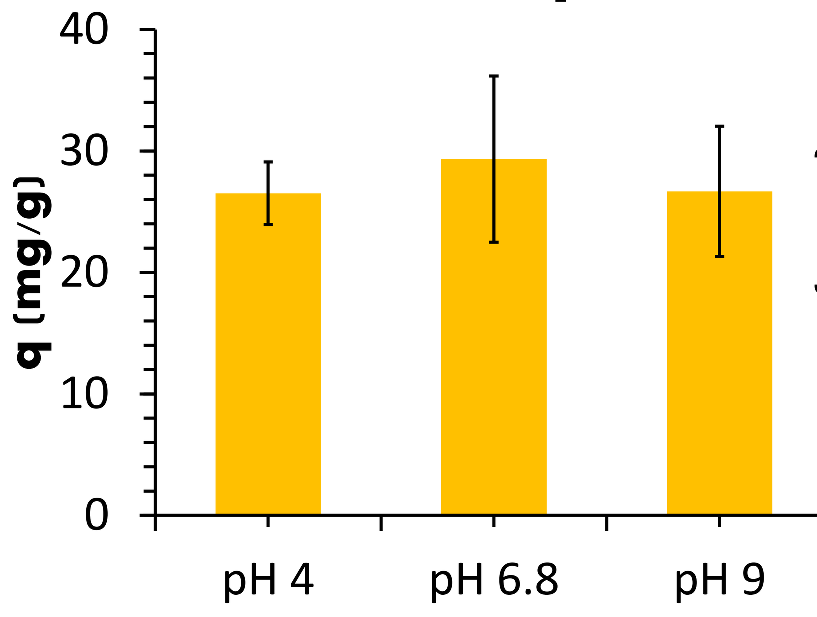
Static vs Agitated



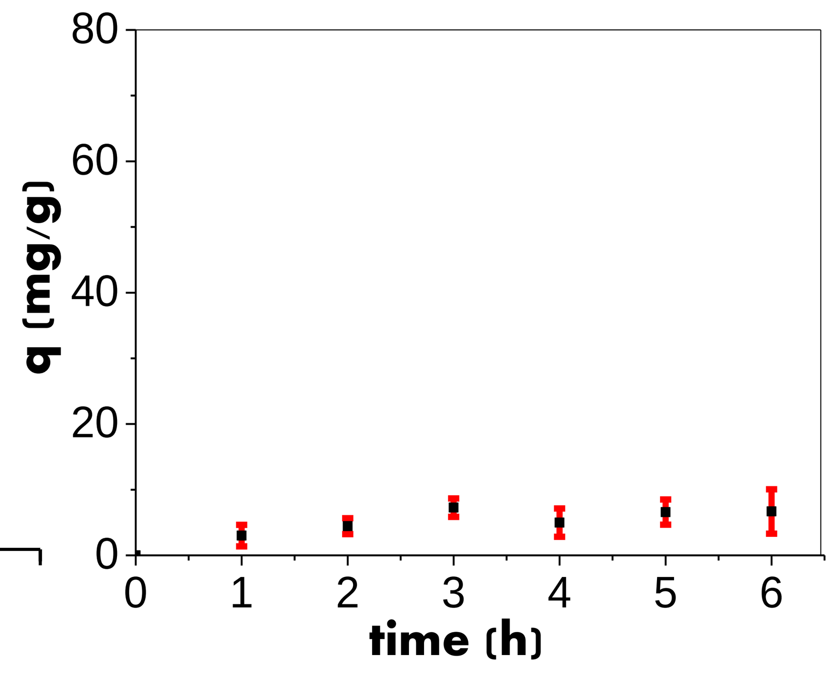


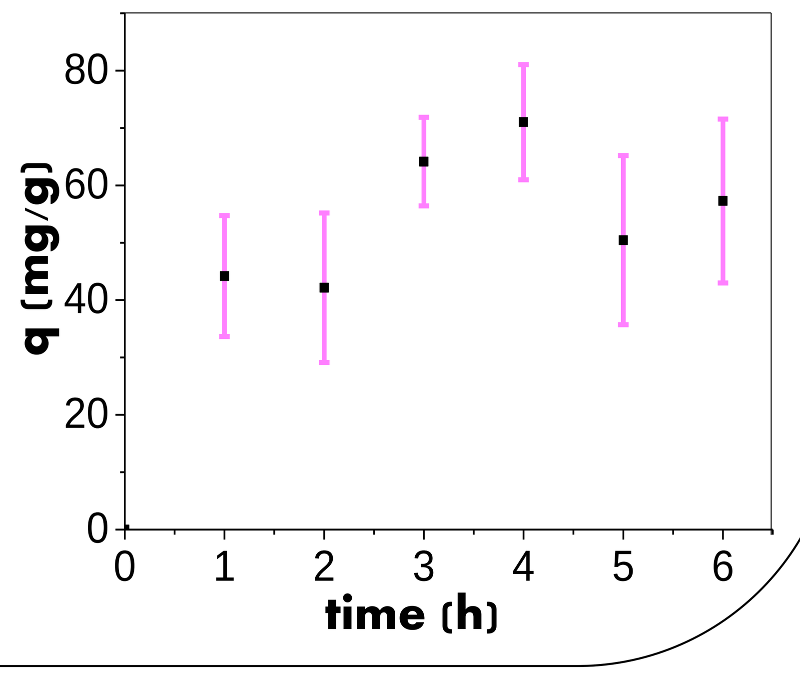
Fluorescent microscopy image of the adsorbed MPs

Effect of pH



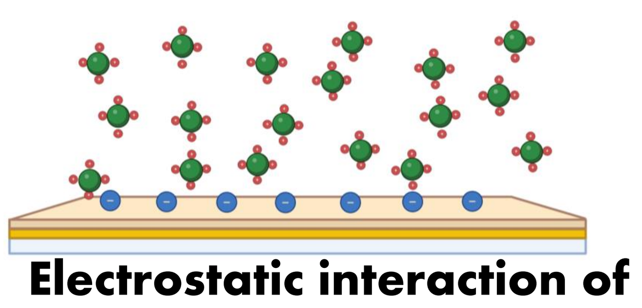
Anionic MPs vs Cationic MPs





Conclusions

- The optimum time of adsorption was four hours.
- The microplastic adsorption by BC was more effective in static conditions.
- Due to electrostatic interaction, BC adsorb more cationic MP than anionic MP.
- Highest adsorption capacity is observed in neutral condition.
- Electrostatic interaction play more significant role in adsorption than pore filling.



Electrostatic interaction of MPs and BC

Outlook

- Analyze the adsorption kinetics and adsorption isotherm.
- Analyze the effect of salinity on the adsorption.
- Perform the adsorption using Quartz Crystal Microbalance (QCM).

References

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