Chitosan-Based Flocculation for Microplastic Removal - Angela Wang

This innovation was inspired by a presentation I attended on oil-spill cleanup, where I learned about the difficulty of removing microplastics from water. Their small size and negative surface charges can keep them suspended and make them difficult to capture. (Enfrin et al., 2019) My innovation tests chitosan, a biodegradable polymer derived from materials such as shrimp shells, as a flocculant. In acidic conditions, chitosan becomes positively charged and can attach to negatively charged microplastics, helping them form larger clumps, or flocs, that can settle from the water. (Rinaudo, 2006) I tested chitosan using 104–240 nm polystyrene (PS) nanoparticles as models for microplastics under different pH and salt conditions. Particle size and surface charge were measured using dynamic light scattering (DLS) and zeta potential. Pluronic F-127 and mPEG-PLA were used as negative controls.

Chitosan changed the surface charge of 240 nm PS from −57 mV to +41 mV, demonstrating its attachment to the particles. Adjusting pH reduced excess charge and promoted flocculation. The strongest results occurred in saline, where chitosan caused 240 nm PS to flocculate within about 20 minutes. The method also worked with 195 nm and 104 nm particles, which flocculated within approximately 30 and 15 minutes, respectively. A chitosan-to-PS mass ratio of approximately 1:5.6 successfully flocculated both smaller particle sizes. These results demonstrate that chitosan can cause small plastic particles to form larger, easier-to-remove clumps. Future testing with real water samples and different types of microplastics could help determine its potential as a sustainable microplastic-removal method.

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