Facile Liquid-Liquid Fractionation for the Reuse of Magnetite Nanoparticles in the Eco-Friendly Removal of Immiscible Pollutants

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Microplastics, plastic particles <5mm, are toxic in waterways due to their role as a transporter for harmful microbes and other substances. In previous works, research was developed by creating an eco-friendly method of removing this immiscible pollutant through its attraction to a magnetite-based suspension. The novel method showed significant potential by using palmitic acid as the surfactant and alpha-tocopherol as the nonpolar solvent, with an average removal rate of about 96% of 2-3mm microplastics. A subsequent step of developing a separation apparatus for the dissolution of the attraction between the pollutants and the iron oxide suspension will be used to encourage reuse, decrease cost, and increase sustainability. Microplastic creation was developed through cryogenic processes and then ground to ensure size class. Deep eutectic solvents were developed to improve the manufacturability of the proposed suspension, and liquid-liquid fractionation was used in the separation process through the application of aqueous two-phase systems (ATPs). Polyethylene glycol 6000 and sodium citrate were used to develop a polymer-salt ATP, where Fe-ions were proposed to be attracted to the polymer-rich phase, cited from previous research. UV/NIR spectroscopy was used to determine the identities between each phase. Scattering was calculated to assess the efficacy of the ATP from recognition of distinct shifts of either or both the pollutant or iron oxide suspension. The determination of fractional migration of the suspension shows that the solvent fractionation could be more prosperous in future experimentation by exploring controlling additional factors, such as other ligands' affinity to the polymer.

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