A Green Method of Removing Immiscible Pollutants From Waterways Using Vitamin E and a Magnetic Suspension

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Microplastics (MPs) are plastic particles <5 mm that have increasingly adverse effects on practically all aspects of the environment. Solvent dyes are contaminants to waterways through textile industry pollution that pose dangers to aquatic equilibrium. Magnetic nanoparticle materials have been proven to be efficient in developing mitigation tactics to subsidize the impacts of hydrocarbon-based pollutants. To remove these immiscible organic contaminants from waterways using an environmentally-benign treatment, a co-precipitated magnetite colloid suspension was developed with the lipid-soluble antioxidant solvent, vitamin E (alpha-tocopherol), and the surfactant, palmitic acid. Water samples containing the three most common plastics (PET, HDPE, PVC) and Solvent Blue 35 were tested against the treatment that was magnetized onto a neodymium magnet as the removal tactic. Using ImageJ, fluorescence microscopy was applied utilizing the lipophilic dye, Nile red, to quantify microplastic particles and measure grayscale intensity for the solvent dye. Calibration curves were calculated to predict concentrations for the dye and percent area coverage for the particles. The average removal rate between each plastic was determined to be 96.67%±0.88%, with the remaining mean microplastic concentration being 0.034±0.017 particles/mL (PVC), 0.072±0.012 particles/mL (PET), and 0.045±0.010 particles/mL (HDPE) with a statistical difference. The average removal rate of the solvent dye was between 75-88%. With an efficacy rate of >75% for all pollutants, the treatment shows significant potential in their removal. Further studies include investigating the rigidity of semi-crystalline and amorphous polymers and whether this factor significantly differs the efficacy of the magnetic suspension.