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PREPARATION AND CHARACTERIZATION OF MICROBEADS FROM POST-CONSUMER POLY(ETHYLENE TEREPHTHALATE) BOTTLES

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Plastic pollution is a formidable challenge to the environment, posing threats to humankind. The demand for plastic continues to surge, with poly(ethylene terephthalate) (PET) serving as a prominent contributor to the problem. Due to its impressive durability, it has a wide range of applications in packaging, mainly as PET bottles. The objective of this study was to derive and characterize microbeads from post-consumer PET bottles. In this study, first, a solvent system was developed to dissolve PET using dichloromethane (DCM) and trifluoroacetic acid (TFA) by varying the ratio of DCM to TFA. The PET concentration optimization was carried out by varying the PET mass dissolved in the optimized solvent system. The microbead synthesis was carried out with an ionotropic gelation technique using two methods: manual process and electrospraying process using the electrospraying unit. In each process, a collector solution, which consisted of distilled water, glutaraldehyde, and sodium dodecyl sulphate (SDS), was used to collect the microbeads. The optimization of glutaraldehyde and SDS concentrations was carried out by varying the concentration of glutaraldehyde between 0% to 0.5% and SDS concentration from 1×10^{-4} g/mL to 1×10^{-1} g/mL. The bead size optimization was carried out by varying the distance between the needle tip and the collector solution between 5.0 cm and 30.0 cm. The beads were characterised using digital microscopic imagining, Fourier transform infrared spectroscopy and thermogravimetric analysis. According to the results, the optimized solvent system was recorded as 1:5 DCM to TFA, PET concentration was 15% (w/v), and optimized concentrations of glutaraldehyde and SDS were 0.1% (v/v) and 1×10^{-4} g/mL, respectively. Spherical beads were formed with both methods with an average diameter of 744.9 ± 38.6 μm and a wide service temperature range of up to 450 °C, which collectively underscores the potential of repurposing PET to microbeads.

Keywords: Ionotropic gelation, Microbeads, Plastic pollution, Poly(ethylene terephthalate)