# New strategy for microplastic bioremediation: cellulose biopolymer-based hydrogel

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**Abstract**

The drastic environmental damage caused by microplastics (MPs) are of great concern, and wastewater treatment plants are considered a focal point for MPs release. Natural flocculants are gaining interest due to their eco-friendly features. Bacterial cellulose (BC), a natural extracellular polymer secreted by bacteria, presents unique structural features showing vast potential in a wide range of fields. Bacterial cellulose hydrogel (BCH) (grounded residues of BC) was evaluated as a potential bioflocculant towards the removal of MPs from contaminated waters. Response surface methodology (RSM) and techniques like UV-Vis, ATR-FTIR, IGC, water uptake assays, fluorescence and SEM microscopy were employed to determine the viability of BCHs for the removal of MPs. For different environmental (temperature, pH, salinity, and metal ion presence) and operational (BCH:MPs ratio, BCH griding, mixing time, immersion time) conditions, several experiments were performed with MPs-contaminated water (2g/L). The MPs were adsorbed and retained in the biopolymer's network. BCH unveiled a very high flocculation rate (80.42%) when compared to commercial flocculants, like xanthan gum and alginate (-95.18% and -87.75%). The microporous nature of the hydrogel revealed by electron microscopy is the likely driver of strong MPs bioflocculant activity. The paraments of maximum flocculation (88.59%), revealed by the RSM, were grinding time of 1 min, the ratio of 31.65:1, temperature of 22.9∘C and immersion time of 76 min. BCH displayed suitability in a wide range of pH (3-8), salinity (0-37‰), and cationic (Fe3+, Ca2+, Mg2+, and K+) conditions, with a short mixing time (5 min). Only 13.01% of MPs were released from the biofilm after a 24h intense wash cycle. BCH shows to be a highly efficient bioflocculant, in a wide range of conditions, potentiating its economic viability. These findings suggest that BCH could be a potential replacement of synthetic flocculants in wastewater remediation processes.

**Keywords:** Bacterial cellulose, Water treatment, Microplastics, Bioflocculant, Bioremediation

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