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Occurrence and distribution of microplastics in wastewater system and their adsorptive removal using CTAB-modified magnetic biochar from aqueous matrices

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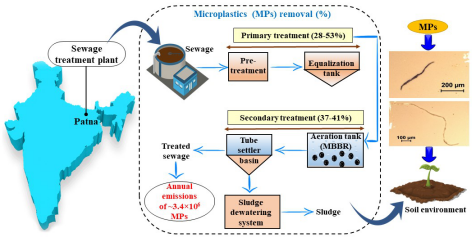

Microplastics (MPs) are globally acknowledged as emerging contaminants in the aquatic environment including the wastewater system. Sewage treatment plants (STPs) as a carrier of MPs have received the attention worldwide recently. In India, the majority of studies on MPs have been conducted in sediments, riverine, and marine systems, while knowledge on MPs occurrence in STPs are scarce. This study for the first time deals with the assessment of MPs occurrence of varying shape, size, and polymeric composition in a moving bed biofilm reactor (MBBR)-based hybrid growth STP system from the East Indian region. Further, the abundance and removal efficacy of MPs at different treatment units and sludge of the studied STP was assessed and compared as shown in Fig.1. Moreover, efficient MPs removal in the wastewater treatment system is still a significant challenge. Agricultural wastes-derived biochars have a low adsorption capacity with their tedious separation and recovery. Surface modification of magnetic biochars by a cationic surfactant can overcome such limitations. Therefore, this study provides novel insights into the efficient adsorptive removal of polystyrene MPs from aqueous matrices using magnetic biochar modified with cetyl trimethyl ammonium bromide (CTAB), a cationic surfactant. The physico-chemical and morphological properties of developed biochar were characterized and compared. Effects of various factors like contact time, adsorbent dosage, MPs concentration, pH, dissolved organic matter, and competitive ions were analyzed during batch studies. The results showed that after modification with CTAB, the specific surface area, pore volume, and pore diameter of the adsorbent has been significantly increased and a maximum MPs removal (>97%) was achieved using CTAB-modified biochar. Also, the MPs removal performance of the developed adsorbent in actual sewage water with optimal operating conditions were examined and mechanistic insights for MPs adsorption onto the adsorbent elucidated. Thus, the success of the present work has paved way for the development of a novel adsorbent for efficient MPs removal from wastewater systems.