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Current Techniques in Density Separation, Identification Methods, and Characterization of Microplastics in Sedimentary Environments: A Comprehensive Review of Currents Studies

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Abstract

Plastic particles, often less than 5 mm in size, known as microplastics (MP), cause catastrophic pollution which is a significant environmental concern globally. In recent decades, scientific investigations have substantiated the ubiquitous presence of microplastics across diverse environmental compartments, encompassing oceans, rivers, soil, and atmospheric aerosols. Notably, emphasis within the realm of microplastic research has predominantly centred on sedimentary matrices. Therefore, this literature aimed to summarize abundance of microplastics, factors affecting for abundance of microplastics, accurate and cost-effective procedures of identifying microplastics in different sediments, including sample collection, sample pre-treatment, density separation, chemical digestion and identification methods, issues that occurred during the studies, and prospective developments. For evidentiary support, an exhaustive review of thirty papers published between 2019 and 2023 was conducted via Google Scholar and Science Direct. Predominantly, the studies scrutinized the microplastic content in sediments sourced from diverse environments, including rivers, lakes, beaches, coral reefs, sea grass beds, wetlands, estuaries, lagoons, and mangrove forests. Varieties of microplastic shapes, such as fibres, films, fragments, microbeads, pellets, and foams, were consistently detected. Most recent studies (73%) used saturated Sodium chloride solution (density 1.2 gcm^{-3}) while few studies used Zinc chloride, Calcium chloride, Sodium bromide, Potassium iodide, and Potassium formate solutions to separate microplastics from sediment matrices by density separation. In conclusion, this comprehensive review underscores the pivotal role of microscopic techniques, particularly stereomicroscopy, alongside advanced analytical instruments such as Fourier-transform infrared spectroscopy and Micro-Raman spectroscopy in enhancing the identification and characterization of microplastics within sedimentary environments. The exploration of these methodologies reveals promising avenues for overcoming existing limitations, paving the way for more precise and efficient analyses of microplastics in sediments. Within this review, the integration of new analytical instruments and effective microscopic techniques holds significant potential for advancing our understanding of microplastic pollution in aquatic ecosystems and informing strategies for mitigation and remediation.

***Keywords**:* Density separation, Identification techniques, Microplastics, Sediments, Limitations