ECP 2024 Conference

The 3rd International Electronic Conference on Processes

29–31 May 2024 | Online

A Systematic Review of Microplastic Detection in Water

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INTRODUCTION & AIM

The prevalent presence of microplastics has been documented across various environmental matrices, including marine and terrestrial ecosystems.

The presence of microplastics in water bodies directly and indirectly affects humans and animals that rely on aquatic ecosystems.

The development and application of diverse methodologies for microplastic detection and identification in aquatic environments is crucial for mitigating microplastic pollution.

This knowledge empowers the formulation of effective policies and preventive measures to safeguard water quality.

METHOD

Materials

The data was gathered from recognized and prestigious databases for data universality and replicability.

Data from Elsevier's Scopus, OIP Science, ACS Publications, Research Gate and MPDI are initiated for scientific perspective and broader access of valuable knowledge in microplastic detection.

Methodology

Inclusion Criteria

The data is selected based on the following parameters: ***(i)*** **relevance**, ***(ii)*** **significance on detection in microplastic**, ***(iii)*** **replicability of the methodology**, ***(iv)*** **advancement of technology**.

Literature Search

The data is search by plugging in the following words, **"microplastics", "Microplastic detection", "microplastics in water", "detection of microplastics in water".** Information are thoroughly screen as initial stage by identification of the title relevant to the research area. After the initial screening articles that that met the criterial are thoroughly review their abstract and full-text.

CONCLUSION

Microplastics, tiny plastic fragments contaminating our environment, demand effective detection methods to assess their ecological and potential human health risks. This passage explores various analytical techniques used to identify microplastics in water samples. These methods can be broadly categorized into microscopy and spectroscopy. Microscopy techniques, like light or scanning electron microscopy, involve visually counting microplastics under a microscope. While effective for larger microplastics, they might miss smaller ones. Spectroscopy, on the other hand, analyzes the chemical properties of microplastics using light or electron beams. Techniques like FTIR and Raman spectroscopy can identify smaller microplastics and even reveal their polymer type. Selecting the most suitable technique depends on the research goals and the size and type of microplastics being investigated. As microplastic pollution becomes a growing concern, developing more sensitive and efficient detection methods is crucial for a clearer understanding of this environmental threat.

RESULTS & DISCUSSION

Microscopic Counting

Microscopy uses various techniques to magnify and analyze microplastics. This includes stereomicroscopy for initial sorting, followed by potentially using scanning electron microscopy (SEM) to confirm the material is plastic by its chemical composition.

Fourier Transform Infrared Spectroscopy (FTIR)

FTIR spectroscopy is a powerful tool for identifying microplastics. It works by analyzing the chemical bonds in the plastic, creating a unique fingerprint that can differentiate plastics from other materials. This technique is especially useful for small microplastics (less than 10 micrometers) where visual identification is difficult. A special type of FTIR called micro-FTIR is used for these tiny particles.

Raman Spectroscopy

Raman spectroscopy is a powerful technique for detecting microplastics, especially very small ones (under 20 micrometers) that are invisible to other methods like FTIR. It works by shining a laser on the sample and analyzing the light that bounces back, revealing the material's composition like a fingerprint.

Scanning Electron Microscopy (SEM)

A microscopic technique that provides information about the morphological surface structure of MPs by generating high-resolution images of the surface state. Also determines the elemental composition of the sample using energy-dispersive X-ray spectroscopy (EDS)

Liquid Chromatography

Liquid Chromatography, often coupled with detectors like UV or Mass Spectrometry, is a common tool for analyzing organic pollutants absorbed by microplastics. This helps assess the factors influencing sorption (absorption) of pollutants by microplastics.

Tagging Method

A special dye (Nile Red) that sticks to microplastics and glows under blue light helps identify them in ocean sediments. The study found the best results with a 10 minute incubation time and a specific dye concentration. This method is useful because it works on many common types of plastic debris.

Light Scattering Method

New laser and camera method detects tiny, clear microplastics in water that were invisible before. This portable device has promise for real-time monitoring in lakes, rivers and even wastewater plants.

FUTURE WORK

The studies on microplastics detections is a variety of exploration to distinguish varieties of its presence in the bodies of water, air and land. This raises concerns about potential human exposure through inhalation, crops, and meats. Detecting microplastics is challenging due to their small size and the presence of other particles. Techniques like Raman spectroscopy and microscopy are used for identification, but there's a need for standardized methods to ensure consistent data collection across different studies.