

# A Review on Identification of Microplastics in Water

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**ABSTRACT:** The presence of microplastics in water has increasingly become a major environmental challenge. A key challenge in their detection resides in the relatively inadequate analytical techniques available preventing deep understanding of microplastics in water. The presence of microplastics in water and wastewater treatment plants poses a concern for the quality of the treated water. Due to their broad but small size and diverse chemical nature microplastics may travel easily along water and wastewater treatment plant. The presence of microplastics in water are correlated to the interactions of microplastics with water and Microplastics identification methods are comprehensively reviewed. This study suggest best identification technique of MPs from water body by comparing identification tools like Microscope, Fourier Transform Infrared Spectroscopy and MicroRaman Spectrometer This critical analysis offers new strategies to limit the microplastics in water to keep water quality up to the required standards and reduce threats on our ecosystems.

**KEYWORDS:** Water pollution ,Microplastic, Micro Raman Spectroscopy, Van Veen Grab, Fourier Transform Infrared spectroscopy

## I.INTRODUCTION

Growth in urbanisation and industrialisation increases in 21<sup>st</sup> century due to population of rural area attracted towards town for getting job opportunity. So, population growth causes pollution to natural sources. Pollution is often classed as point sources and non point sources(line, area).Water,air,noise,soil are the different types of pollution. Water is the most key resources required to live the life on the planet.[1] Water quality of 70% river water has contaminated due to pollutants in India.[3] Water pollution causes due to mixing of organic, inorganic pollutants,heavy metals, pesticides in water.In 2015,pollution killed 9 million people in the world.[10] Due to pollution less amount of rainfall observed in India.In 2015,May water level in Ukai dam was 95 m in 2016, May it was degraded to 90 m in 2017, it was 88.26m observed and In 2018, March it was lowest as 85m.[10]Only 12% water is there in Ukai dam of total Water storage capacity. So due to less amount of water we should worry about existing water quality.If the quality of raw water is degraded it affect the human health.

Plastic has good properties like it is easy to process,durable,light weight and it has low cost. So,due to these reason plastic is widely use worldwide. Plastic production has already exceeds the 5 billion tons by 2050.[2]Due to this large production improper disposal of plastic pollution accrued. It disposal is 4.8 to 12.7 million metric tons increasing each year.[2]Once introduced into the environment, plastic may persist for descends due to its chemical properties and undergo over time to disintegration into smaller fragments under the combined effects mechanical breakdown caused by wavesUV induced photolysis,and biological degradation.This process lead to the formation of very tiny particles called Microplastics(smaller than 5 mm)that represent the new challenge of the plastic contamination problem over 92% of all plastic items currently found at sea are microplastics.[2] Discards of synthetic polymers such as high density polyethylene(HDPE), low density polyethylene(LDPE),polybutylene terephthalate(PBT),polyethylene terephthalate(PET),nylons,polypropylene(PP),polyvinyl chloride(PVC),polystyrene(PS) andpolyurethane(PUR) persists in the environment and pose ecological threats to flora and fauna. Mechanical/biological fragmentation of such plastic debris leads to the formation of Microplastics (<5mm).Plastic micro beads commonly used in personal care products and plastic fibers present in the laundry water of synthetic clothes, may also serve as source of microplastics particles(MPs) to the aquatic environment. Due to their large surface to volume ratio and chemical composition,MPs accumulate waterborne contaminants such as heavy metals.[7] Microplastics occur in a heterogeneous array of shapes and sizes such as spheres, pellets, irregular fragments, filaments,film,foamed plastic,granules and fibres in the marine environment.[6] The effects of plastic pollution is extensive and wide ranging. Also plastic pollution impacting human health,economics, tourism and beach aesthetics.Microplastics in the costal and marine environment causes serious

damage to marine life, fisheries, death of marine animals through entanglement and ingestion of plastic debris, leaching of toxic chemicals and their introduction into the food chain. [6]

## II. LITERATURE REVIEW

[S. Sruthy & E V Ramasamy] studied that

In INDIA, there are only two reports till 2017 on MPs in the water bodies. One is occurrence of small plastic debris (81 mg/kg) in the marine sediments of Gujarat coast. [4] The other study is on assessing plastic debris in the beaches of Mumbai. [8] This study, being the first report from INDIA on MPs in lake sediments. They study of MPs in the sediments of VEMBANAD LAKE, RAMSAR site. Samples were collected from ten sites and two sediment samples were collected from each site using a Van Veengrab (25 cm<sup>2</sup>) sampler tool. Assessment of total 20 sediment samples are reported in this research paper. Identification of polymer components of MPs was done using Micro Raman Spectroscopy. MPs were recovered from all sediment samples, indicating their extensive distribution in the lake. MPs recorded from the sediment samples is in the range of 96-496 particles m<sup>-2</sup> with a mean abundance of 252.80-25.76 particles m<sup>-2</sup>. Low density polyethylene has been identified as the dominant type of polymer components of the MPs. As clams and fishes are the major sources of protein to the local population. [7]

[Francesco Saiu, Simone Montao, et al.]

In this work they surveyed the microplastic contamination in the Faafu Atoll (MALDIVES, INDIAN ocean) across twelve sampling stations, located either inside or outside the reef rim. Sediments and seawater samples were collected. Despite the remoteness of the atoll, the scarce local population and low touristic annual afflux, the detected average abundance were 0.32-0.15 particles/m<sup>3</sup> in the surface water and 22.8-10.5 particles/m<sup>2</sup> in the beach sediments. Polymers identified through Fourier Transform Infrared spectroscopy were mostly polyethylene, polypropylene, polystyrene, polyvinylchloride, polyethyleneterephthalate, and polyamide. Elastoplastic residues and charred micro particles were also found. In particular, the charred micro particles were prevalently located nearby the inhabited island and might be considered a peculiarity of the area, related to local particle of burning plastic waste at the shoreline [2]

[R KARTIK, R S ROBIN, et al.]

In this study they take 25 locations along Tamil Nadu coast (1076 km) MPs debris were quantified and categorized into four different size classes. The beaches were classified according to potential sources of pollution i.e. recreation, tourism and fisheries. Beach samples collected from the high tide contained significantly higher abundance of microplastics than at the low tide line. Higher MPs abundance compared to those influenced by tourism and fishing activities. Out of total detected debris, plastic fragments were the max (47-50%), followed by line/fibers that polyethylene, polypropylene and polystyrene were the main types of MPs present in these beaches. MPs ingestion in 10.1% of fishes. The results indicated that Microplastics presents in these coastal environment, especially close to the river mouths, may be serious concerns, due to enter into the marine food web and highlights the necessity of Microplastics screening from estuarine, coastal waters and other potential sources. [6]

[Martin Pivokonsky, Lenka Cermakova et al.]

The study investigates the content of microplastics particles in freshwater and drinking water. Specifically, three water treatment plants (WTPs) supplied by different kinds of water bodies were selected and their raw and treated water was analysed for Microplastics (MPs). Microplastics were found in all water samples and their average abundance ranged from 1473 ± 34 to 3605 ± 497 particles L<sup>-1</sup> in raw water and from 338 ± 76 to 628 ± 28 particles L<sup>-1</sup> in treated water, depending on the WTP. This study is one of very few that determine Microplastics down to the size of 1 μm, while MPs smaller than 10 μm were the most plentiful in both raw and treated water samples. Despite 12 different materials forming the Microplastics being identified, the majority of the MPs comprised of PET (polyethylene terephthalate), PP (polypropylene) and PE (polyethylene). This study contributes to fill the knowledge gap in the field of emerging microplastics pollution of drinking water and water sources, which is of concern due to the potential exposure of Microplastics to humans. [5]

[Gema alvarez,Alvarao barrors,et al.]

Here, they aimed to provide baseline data for the presence of Microplastics in pellets regurgitated by European shags (*Phalacrocorax aristotelis*)(n= 41) in the Iberia peninsula (NW Spain). We found microplastics fibres in 63% of pellets, suggesting that this type of plastic pollution is prevalent in the study area. According to Fourier Transform Infrared spectrometry, nylon fibres were the most abundant, followed by polyester. We also found that the presence of Microplastics was higher in pellets containing remains of benthic fishes. Our results suggest that shag pellets may be useful to monitor microplastics pollution in coastal waters.[3]

[kai zhang,Hauahong shi,et.al.]

China is the world's largest developing country and the largest plastic producer. The retrieved articles were then screened by study area, and only studies in China's inland water systems, including rivers, lakes, reservoirs and estuaries, were selected. Detection of microplastics in biota from China's inland water systems was also included. Studies on coastal environmental systems were excluded. A total of 15 articles were retrieved.[4]

### III. IDENTIFICATION OF MICROPLASTICS

Wet samples were sieved through 5 mm mesh in order to remove large debris, and to retain particles of <5mm size. The sieved samples were air dried in glass trays covered with aluminium foil. The dried samples were disaggregated and sieved again through 5 mm Sieve. Extraction of MPs from sieved sediment samples was done as per National oceanic and atmospheric Administration (NOAA) protocol. Accordingly, the samples were subjected to wet peroxide oxidation (WPO) process, with 30% hydrogen peroxide, in order to digest organic matter present in the samples. The WPO mixture was subjected to salt density separation using NaCl to separate MPs through floatation. The supernatant was then filtered and the filters were air dried. After this process examination of microplastics are performed by different tools. These tools are Microscope, FTIR, Micro Raman Spectroscopy.

### IV. IDENTIFICATION BY MICROSCOPE

Microplastics are examined under a compound microscope at 10X resolution. Plastic particles served on the filters were classified as line/fiber (thin or fibrous, like plastic), or film (thin plane of flimsy plastic). The extraction processes were performed in a clean fume hood; all glassware were thoroughly rinsed with double distilled water in order to avoid contamination with airborne MPs. Lab blanks used during extraction and identify fraction stages in order to test for cross contamination of plastic materials have resulted negatively with number of MPs in the blanks. Extracted MPs prior to identification were washed using double distilled water in order to make sure no sediment particles adhering over the surface.

### V. BY MICRO RAMAN SPECTROMETER

MPs were analysed under Micro Raman spectrometer with a 532 nm excitation laser and a grating of 600 grooves/mm using 50X objective with integration time of 10 sec. The resulting spectra were compared with the known it all Raman spectral library for polymers provided by Bio-Rad.[7] The extraction processes were performed in a clean fume hood; all glassware were thoroughly rinsed with double distilled water in order to avoid contamination with airborne MPs. Lab blanks used during extraction and identify fraction stages in order to test for cross contamination of plastic materials have resulted negatively with number of MPs in the blanks. Extracted MPs prior to identification were washed using double distilled water in order to make sure no sediment particles adhering over the surface.

### VI. IDENTIFICATION BY FOURIER TRANSFORM INFRARED SPECTROSCOPE

MPs were analysed under Fourier Transform Infrared Spectroscopy. In this process particles are mixed and crushed with (Potassium bromide) KBr. And this powder is filled in FTIR testing bolt and then transition of Infrared rays are increased to sixteen percent more to normal transition because polymer need more transition than other material to identify its chain. Graph is drawn by computer software SHIMADZU attached to FTIR instrument. Graph pictures are matched with IR library and software gives name of polymer which is present as microplastics.

Comparing all three methods of identification of microplastics Fourier Transform Infrared Spectroscopy is the best method for identifying microplastics. FTIR need less sample compare to other method and give accurate and perfect result. Also large quantity analysis are done by taking small samples from it will help to give quick results.

### VII.CONCLUDING REMARKS

In INDIA presence of microplastic particles (MPs) in the sediments of water body is observed.. This serves as the centre of livelihood for thousands of human beings, hence the occurrence of MPs in this and their likely impacts on aquatic organisms of the entire food web are critical issues to be addressed. This study suggests that comparing all three methods of identification of microplastics Fourier Transform Infrared Spectroscopy is the best method for identifying microplastics. FTIR need less sample compare to other method and give accurate and perfect result Also large quantity analysis are done by taking small samples from it will help to give quick results. The morphology of the MPs observed that their origin from fragmentation of larger plastic debris indicating the use and disposal of plastics as their ultimate origin. Therefore, controlling MPs/plastics at the source is the option to be explored seriously, because, once MPs are released into the environment there is much little can be done to limit their distribution and impacts. We can use Van Veen Grab sampler to collect samples and for identification of microplastics we can use micro Raman spectroscopy or Fourier-Transform Infrared spectroscopy. Concentred efforts in improving and monitoring waste management programs, emphasizing on the three R ' principle (reduce, reuse, and recycle) for the plastic management, may reduce the influx of plastics/MPs in the water body.

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