A Review on Micro Plastic Traces in Water Bodies

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Abstract

Water pollution is the contamination of water bodies, usually as a result of human activities. The planning commission, government of india has estimated from 710 BCM (Billion cubic meter) to almost 1180 BCM in2050.So, It's very important to treat discharge of untreated sewage in water. A 2007 study found that discharge of untreated sewage is the single most important source of pollution of surface and ground water in India. Samples of sediments can collected by Van Veen grab (25 cm^2).Analysis of samples can be done as per National Oceanic and Atmospheric Administration (NOAA) protocol. Polymers identified through Micro Raman Spectroscopy or Fourier-Transform Infrared spectroscopy. From Present Study we conclude that once Micro Plastic are released into water little can be done to limit it^s distribution and effects to environment. So, by reducing plastic use is the best key to reduce micro plastic pollution.

Keyword- Water Pollution, Micro Plastic, Micro Raman Spectroscopy, Van Veen Grab, Fourier-Transform Infrared Spectroscopy

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I. INTRODUCTION

Growth in urbanisation and industrialisation increases in 21st 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. Water pollution causes due to mixing of organic, inorganic pollutants, heavy metals, pesticides in water.[10] In 2015, pollution killed 9 million people in the world. Due to pollution less amount of rainfall observed in last few years. In 2015, May water level in Ukai dam is 95 m in 2016, May it is degraded to 90 m in 2017 it is 88.26m observed and In 2018 March it is lowest 85m.Only 12% water is there in Ukai dam to 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.[10]

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 waves, UV induced photolysis, and biological degradation. This process lead to the formation of very tiny particles called micro plastics (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 micro plastic.[2] Discards of synthetic polymers such as high density polyethylene (HDPE), low density polyethylene (LDPE), polybutylene terephathalate (PBT), polyethylene terephathalate (PET), nylons, polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS) and polyurethane(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 micro plastics (<5mm).Plastic micro beads commonly used in personal care products and plastic fibbers present in the laundry water of synthetic clothes, may also serve as source of micro plastic 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] Micro plastics 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 plastics are extensive and wide ranging, impacting human health, economics, and tourism and beach aesthetics. Micro plastics 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]

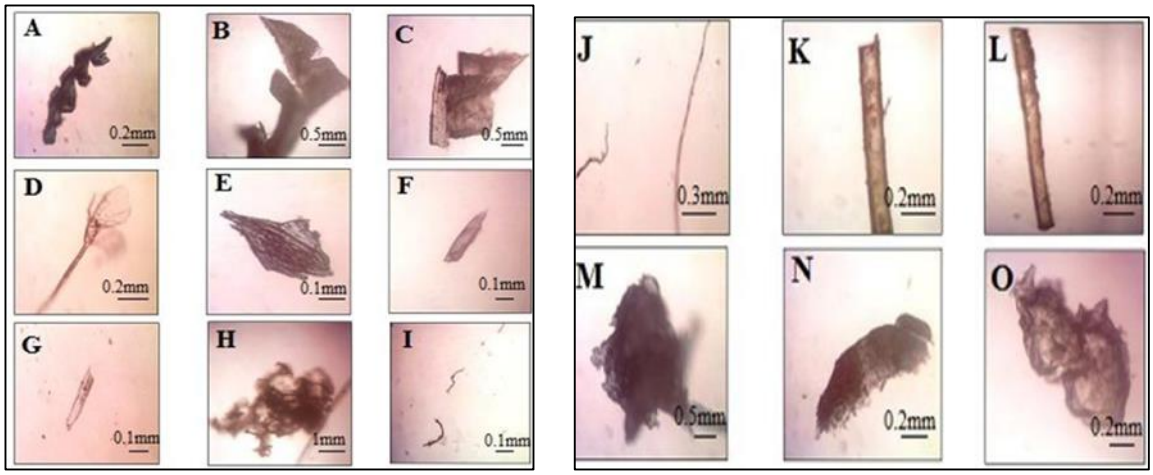

Fig. 1: Micro plastic each particle type category: fragment (a-c), film (d-g), foam (h), fiber/line (i-l) pallet (m-o) [9]

A. Identification of Micro Plastics

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 remain in the sample. 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 the subjected to salt density separation using NaCl to separate MPS through floatation. The supernatant was then filers were air dried, and examined under a compound microscope at 10 resolution. Plastic particles served on the filters were classified as line/fibbers (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 no 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. MPS were analysed under micro Raman spectrometer with a 532 nm excitation laser and a grating of 600 roves/mm using 50X objective with integration time of 10s.The resulting spectra were compared with the know it all Raman spectral library for polymers provided by Bio-Rad.[7]

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 sits and two sediment samples were collected from each site using a Van Veen grab (25 cm^2) giving a total 20 sediments samples. Identification of polymer components of MPs was done using micro Raman spectroscopy. MPS were recovered from all sediments samples, indicating their extensive distribution in the lake. MPs recorded from the sediments samples is in the range of 96-496 particles m-2 with a mean abundance of 252.80-25.76 particles m-2.Low density polyethylene has been identified as the dominant type of polymers 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 micro plastic contamination in the Faafu Atoll (MALDIVES, Indian Ocean) across twelve sampling station, 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/m3 in the surface water and 22.8-10.5 particles/m2 in the beach sediments. Polymers identified through Fourrier –Transform Infrared spectroscopy were mostly polyethylene, polypropylene, polystyrene, polyvinylchloride, polyethyleneterephathalet, and polyamide. Elastropic residues and charred micro particles were also found. In particular, the charred micro particles were prevalently located nearby the inhabited island and the 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. reverie, tourism and fisheries. Beach samples collected from the high tide contained significantly higher abundance of micro plastic than at the low tide line. Higher MPS abundance compared to those influenced by tourism and fishing activates. Out of total detected debris, plastic fragments were the max (47-50%), followed by line/fibbers 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 micro plastics presents in these costal environment, especially close to the river mouths, may be serious concerns, due to enter into

the marine food web and highlights the necessity of micro plastics screening from estuarine, coastal waters and others potential sources.[6]

[Martin Pivokonsky, Lenka cermakova et. al.]The study investigates the content of micro plastic 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 micro plastics (MPs). Micro plastics were found in all water samples and their average abundance ranged from 1473 ± 34 to 3605 ± 497 particles L-1 in raw water and from 338 ± 76 to 628 ± 28 particles L-1 in treated water, depending on the WTP. This study is one of very few that determine micro plastics down to the size of 1μ m, while MPs smaller than 10 μ m were the most plentiful in both raw and treated water samples. Despite 12 different materials forming the micro plastics being identified, the majority of the MPs (N70%) comprised of PET (polyethylene terephathalate), PP (polypropylene) and PE (polyethylene). This study contributes to fill the knowledge gap in the field of emerging micro plastic pollution of drinking water and water sources, which is of concern due to the potential exposure of micro plastics to humans.[5]

[Gema alvarez,Alvarao barrors,et al.] Here, they aimed to provide baseline data for the presence of micro plastics in pellets regurgitated by European shags (Phalacrocorax aristotelis)(n= 41) in the Iberia peninsula (NW Spain).We found micro plastic 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 micro plastics was higher in pellets containing remains of benthic fishes. Our results suggest that shag pellets may be useful to monitor micro plastic 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, eservoirsndstuaries, were selected. Detection of micro plastics 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. CONCLUDING REMARK

In INDIA presence of micro plastic 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. The morphology of the MPs observed in this study suggests 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 micro plastic 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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