International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-3, January 2020

# Ecotoxicity of Microplastics in Freshwater Biota

**Daniel Biju Eazon, Gajendran Chellaiah**

***Abstract*: Micro plastics are primarily classified as individual pieces of synthetic material made of wide range of organic polymers which is generally called as 'plastic'. Micro plastics are generally preproduction pellets, micro beads, polymer fibers and degraded micro plastic. Micro plastics make up to as much as 85 percentage of the plastic pollution in the shorelines. This large percentage in the total number of pollutant causes ecological stress caused by the biomagnifications along the food chain. Estimations show that globally majority of micro plastics comes from the runoff of 10 rivers along which includes the Ganges and Indus. To understand the role rivers, play as micro plastic carriers from land to oceans, the sampling of micro plastic is done at the relatively less populated part of Noyyal river and test are carried out to identify presence of micro plastic in the sample. Visual Identification method was used to identify the micro plastic components with relative ease and economy.***

***Keywords* : Micro plastics; ecotoxicity; freshwater biota; micro plastic carriers**

## I. INTRODUCTION

Plastic has become a vital resource of modern human civilization. From the genesis of plastic as Bakelite, the polymer-based products have become the corner stone of the fast consumption economy where convenience have taken over logical and environmental aspects. This study aims to identify micro plastic in river water using settlement and visual identification approach which can be considered the simplest and the most cost-effective way of identification of micro plastic in water sample.

Primary micro plastics are manufactured plastic components that are less than 5mm in size. Primary micro plastics are generally preproduction pellets and micro beads. The virgin resins that are formed into consumer products are known as preproduction pellets. Micro beads are used in sanitizers and other skin care products as an exfoliation material.

Secondary micro plastics are derived from breaking down of large plastic waste under the effect of temperature fluctuation, wear and tear and due to the exposure to the solar radiation. The work done by Jambeck et al (1) describes the various plastics which are used and the long-term degradation and accumulation of various forms of plastics.

**Revised Manuscript Received on January 30, 2020.**
***** Correspondence Author
**Daniel Biju Eazon**, Department of Civil Engineering, Karunya Institute of Technology and Science, Coimbatore, India.
**Gajendran Chellaiah***, Department of Civil Engineering, Karunya Institute of Technology and Science, Coimbatore, India.



The fragmentation of plastic from macro plastic to micro plastic causes access for the plastic particles in the food chain which biologically gets accumulated and, in some cases, undergoes bio-magnification.

The understating of plastic as micro plastic requires the ability to convert macro plastic into micro plastic. This was achieved by Coel et al (2) when the researchers were able to develop a novel method for precisely cut the macro fibers into the micro levels which allows for the continuation of studies in the micro plastic impact on ecological systems.

The field work done by Peter et al (3) studied the plastic and waste along the Canadian coast that comes from various local and global sources. The study showed the macro plastic pollution represented a immense threat to the marine life. For instance, the Otariinae in Canadian Coast were reported of being tangled in large waste plastic and equipment used for fishing. Large amount of secondary micro plastic was also found in the study area which showed a higher impact on the ecology through bi magnification. The study revealed that marine life all sizes were threatened to great extend due to plastic pollution. This findings from the study enabled for legislation to list micro beads as Toxic substance under Canadian Environmental Protection Act (CEPA).

Drevera et al (4) studied the large scale death event of bird species Red Phalaropes (Phalaropusfulicarius) for a period of October to November 2016 in the Canadian coast. The individual birds were observed to be weighed lesser than the normal and the bodies showed signs of phycological distress. The intestinal cavities of the dead birds were observed to have large amount of plastic waste which were consumed by the birds. The results suggested the distribution of the birds nearer to the sea shore had larger quantity of plastic as those birds consumed plastic waste were available in large concentration comparing to comparatively sea dwelling birds.

Wanger et al (5) studied the ingestion of micro plastic by aquatic organisms and the log term effects of continuous exposure were found to be less understood. The study predicts advancement in consumer goods and packaging systems that may factor into the types of micro plastics and their accumulation in the riparian fresh water ecologies.

The study done by Hartmann et al (6) narrated the current understanding of nano and micro plastic that lead to ecological toxicity.

The study by Klein et al (7) strategized the collection, storing and processing of possible micro plastic contaminant samples such as water and sediments samples. Such guidelines allow for standardized sampling and identification of micro plastics from various sources.

Dris et al (8) analyzed the life cycle of micro plastic for the hydro systems of Paris megacity.

The study was conducted for three-year time using appropriate sampling strategies and for each compartment. The results obtained showed a high concentration of fibers in the study area and focus study on the area was done.

The sewage and waste water treatment plant disposal and storm-water flow represented the higher quantity of micro plastic.

The work done by Wu et al (9) studied the occurrence of micro plastic in water sources in Asian continent. The existing studies done showed that there is very less data on the origin and life cycle microplastic water sources in Asia. The study in global scenario showed that the micro plastic pollution in water sources in Asia needs more study and may be larger than what is expected.

Khan et al (10) studied the freshwater lakes fauna and found variety of polymers in the gut system of Perch seen in Nile river (Latesniloticus) and Tilapia seen in Nile river (Oreochromis niloticus) in the great African lakes of Lake Victoria and Lake Tanganyika. Anthropogenic sources are understood to have caused the release of these polymers in to the water sources.

The study by Kooi et al (11) reviewed existing understanding of transport and lifecycle modeling of plastic waste in freshwater sources and catchment area, especially on nano and micro plastic. The study provides recommendation need of broader study into the transport and lifecycle modeling of plastic waste both as macro and micro and the need for a framework to be generated so that similar work can be done in various location simultaneously.

A glimpse of hope against micro and macro plastic pollution can be seen in the works of Paço et al (12). The study deals with observations made on the fugus Zalerionmaritimum to variable expositions to polyethylene (PE) pellets microplastic, in a medium, showed results based on the quantified mass differences in both fungus and the micro plastic pellets used. The results showed that under tested conditions the fungus can use PE, resulting decrease in both mass and size, of the pellets. This study showed that naturally occurring organisms can be utilized for the biological degradation of microplastic which earlier thought to be unachievable.

The current study heavily relies on the methodology given as guidelines in Sartain el al (13), which provides simplified step by step guidelines for the selection of site, sampling and identification of micro plastic from different sources.

## II. METHODOLOGY

Surface water is sampled as per the following process. The sample is collected on 6th April 2019 from location coordinates (10° 56' 38.1012" N, 10° 56' 38.1012" N).

An area of relative clearer water flow is chosen. This is done to avoid large amount of sediments from entering the water sample. Sample is collected in a High-Density Plastic container of almost 2liters capacity. The collection container is wide mouthed to avoid turbulence while collecting the sample. The container is dipped in the water allowing the water to enter and then tilted upright as the water fills in to remove air bubbles. The sample is closed with the lid and the container is labeled. The sample is kept for settlement of the sediments and to allow any possible organic matter to die out by storing the sample in the refrigerator for 3 to 4-week period.

**Fig. 3.1: Micro plastic sample before settling of particles**

**Fig. 3.2: Water sample after removal of excess water and clear view of settled particles**

After the sample is stored in the refrigerator, it is taken out on 7th May 2019 and taken directly to the laboratory facility without causing the water to be shaken. Water sample from the container is carefully transferred into a flask without causing the sediments to be transferred. Using pipette, water sample with larger amount of sediments is taken. The pipette sample is transferred into microscope slide and taken under inspection under microscope with 10x and 40x magnification.

**Fig.3.3: Microscope with bottom lighting**

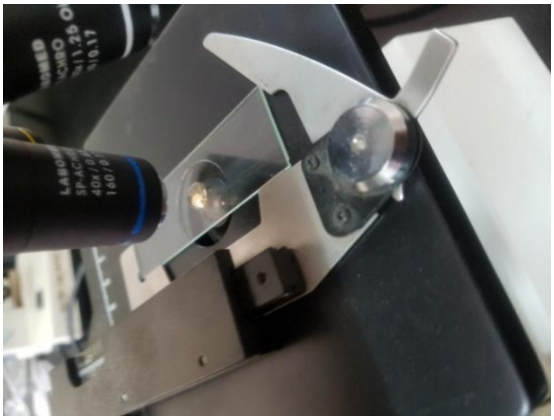

**Fig. 3.4: Slide with sample under microscope with 40x magnification3**

## III. RESULTS AND DISCUSSIONS

The following images are taken after the microscope was focused to observe the slides with the settled particles pipetted from the container.

The slides are observed for the following.

a. Fibers – look like thin threads and are often colored

b. Fragments – pieces of plastic with varying shapes

c. Film – thin pieces of plastic (like grocery bags and plastic food wrappers)

d. Micro beads – spherical plastic pieces

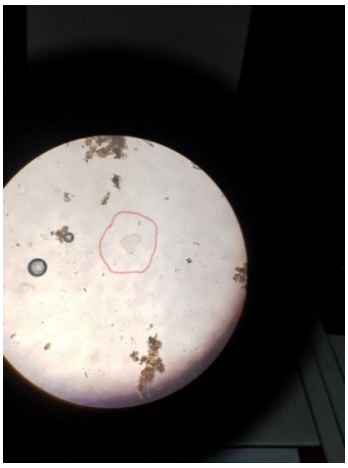

**Fig.4.1: Possible micro plastic fragment under 10x magnification**

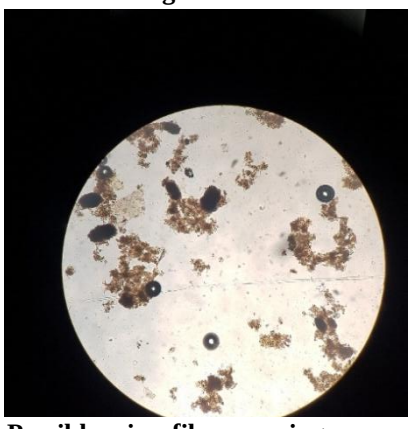

**Fig. 4.2: Possible microfiber running across the slide under 10x magnification**

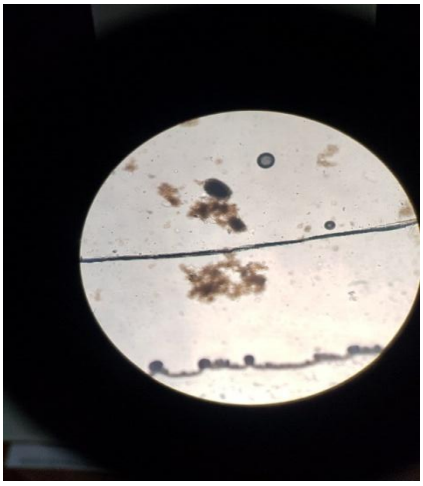

**Fig. 4.3: Possible microfiber same as to in fig. 6; under 40x magnification**

Identification of possible occurrence of micro plastic as micro plastic fiber and micro plastic fragments were observed by visual identification method.

## IV. CONCLUSION

Possible micro plastic identification is done using visual identification method. The presence of micro plastic even from a flowing water body in rural settlement with sparse population indicated the extent of micro plastic pollution in the water body. The identification of possible occurrence of micro plastic is carried out but confirmation of the same is not achieved. For this sample slides with possible identification needs further processing such as spectroscopic analysis. This will allow identifying the individual polymer groups which can lead to the source of the micro plastic pollution. The identification and curbing of micro plastic pollution is an important research and social goal as it affects both the freshwater ecology and the marine ecology in the long term

## REFERENCES

1. Ana Paço, K. D.-S. (2017). Biodegradation of polyethylene microplastics by the marine fungus Zalerion Maritimum. Science of the Total Environment 586 , 10–15.
2. Chenxi Wu, K. Z. (2018). Microplastic Pollution in Inland Waters Focusing on Asia. The Handbook of Environmental Chemistry.
3. Cole, M. (2016). A novel method for preparing microplastic fibers. Scientific Reports, 1-7.
4. Farhan R. Khan, B. S. (2018). Microplastics in Inland African Waters: Presence, Sources, and Fate. The Handbook of Environmental Chemistry.
5. Hartmann, S. R. (n.d.). Aquatic Ecotoxicity of Microplastics and Nanoplastics: Lessons Learned from Engineered Nanomaterials. The Handbook of Environmental Chemistry Volume 58.
6. Jambeck, D. J. (n.d.). Marine Plastics, , University of Georgia, Smithsonian, . Retrieved from https://ocean.si.edu/conservation/pollution/marine-plastics
7. Mandy Sartain, M. S. (2018). Microplastic Sampling and Processing Guidebook. Publication 3243 (POD-06-18) MASGP-17-069, 1 - 36.
8. Mark C. Drevera, ∗. J. (2018). Are ocean conditions and plastic debris resulting in a 'double whammy' for marine birds? Marine Pollution Bulletin 133 , 684–692.
9. Merel Kooi, E. B. (2018). Modeling the Fate and Transport of Plastic Debris in Freshwaters: Review and Guidance. The Handbook of Environmental Chemistry Volume 58.
10. Peter S. Ross, K. L. (n.d.). Plastics in the ocean: micro- and macroplastics as a threat to ocean life in Canada. Ocean Pollution Research Program Ocean Pollution Research Program. Vancouver Aquarium.

11. Rachid Dris, J. G. (2018). Sources and Fate of Microplastics in Urban Areas: A Focus on Paris Megacity. The Handbook of Environmental Chemistry Volume 58.
12. Sascha Klein, I. K. (2018). Analysis, Occurrence, and Degradation of Microplastics in the Aqueous Environment. The Handbook of Environmental Chemistry Volume 58.
13. Wagner, S. L. (2018). Microplastics Are Contaminants of Emerging Concern in Freshwater Environments: An. The Handbook of Environmental Chemistry Volume 58.

## AUTHORS PROFILE

**Daniel Biju Eazon**, is a post graduate scholar of Environmental and Water Resources Engineering, Department of Civil Engineering, Karunya Institute of Technology and Science, Coimbatore Tamil Nadu, India. He is a active researcher in the field of Environment and water Resources Engineering.

**Gajendran Chellaiah** has 17 years of diversified experience in Academics, as of now serving as Associate Professor in Department of Civil Engineering at Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu, Indai. His major research contributions include GIS and Remote Sensing, Isotope Hydrology, Urban Development Study, Transportation, and Water Quality Modeling. He holds 6 National and 25 International publications (which includes conference & journals). He serves as active editor and reviewer in different journals in his research domain.