POLLUTANT IN VANDIYUR LAKE

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Abstract

Significant growth of industrialization and rapid urbanization people from villages started migrating to cities which creates the large amount of solid waste daily, resulting in environmental problem for cities. Among all solid waste, 1–4% of waste is coming from plastic waste, out of which most plastic generates from household use, industrial product, food packaging and water bottles. Also, a few states in India have a coastal region which generates plastic waste from recreational activities on the seashore. Inappropriate dumping of such waste collected outside the villages and cities which creates unhealthy and chaotic conditions which not only affect the health of the people staying around it but also create landfill problems results in major environmental implications contributing to pollution of ground water. Like many urban lakes, the Vandiyur lake in Madurai, Tamilnadu is contaminated with micro plastics. Wastewater effluents from cities could be a main source of micro plastics within the Vandiyur lake, and therefore the urban tributaries might act as retention systems for micro plastics. Among these micro plastics, over 56% of them were less than 0.5 mm. The most shapes of micro plastics were film, fragment, and fiber, the foremost common polymer sorts of these micro plastics were polethylene (27%) and PVC (22%). This study reveals the contamination and characteristics of micro plastics within the Vandiyur Lake and provides important data for further research on micro plastics in freshwater ecosystems

Introduction

Plastic pollution, accumulation in the environment of synthetic plastic products to the point where they create problems for wildlife and their habitats as well as for human populations. In 1907 the invention of Bakelite brought about a revolution in materials by introducing truly synthetic plastic resins into world commerce. By the end of the 20th century, however, plastics had been found to be persistent polluters of many environmental niches, from Mount Everest to the bottom of the sea. Whether being mistaken for food by animals, flooding low-lying areas by clogging drainage systems, or simply causing significant aesthetic blight, plastics have attracted increasing attention as a large-scale pollutant. Plastic is a polymeric material that is, a material whose molecules are very large, often resembling long chains made up of a seemingly endless series of interconnected links. Natural polymers such as rubber and silk exist in abundance, but nature's "plastics" have not been implicated in environmental pollution, because they do not persist in the environment. Today, however, the average consumer comes into daily contact with all kinds of plastic materials that have been developed specifically to defeat natural decay processes materials derived mainly from

petroleum that can be molded, cast, spun, or applied as a coating. Since synthetic plastics are largely non-biodegradable, they tend to persist in natural environments. Moreover, many lightweight single-use plastic products and packaging materials, which account for approximately 50 percent of all plastics produced, are not deposited in containers for subsequent removal to landfills, recycling centers, or incinerators. Instead, they are improperly disposed of at or near the location where they end their usefulness to the consumer. Dropped on the ground, thrown out of a car window, heaped onto an already full rubbish bin, or inadvertently carried off by a gust of wind, they immediately begin to pollute the environment. Indeed, landscapes littered by plastic packaging have become common in many parts of the world. (Illegal dumping of plastic and overflowing of containment structures also play a role.) In this paper identified Micro plastic distribution in Vandiyur Lake and studied the characteristics and composition of Micro plastic in Vandiyur Lake.

Materials and Method

This chapter deals with the explanation of the study area, conceptual methodology and analysis method adopted in this study. This study is focused on micro plastic contamination in Vandiyur Lake. The abundance, size, color, and shape of micro plastics in surface water from 5 sites were investigated. It is also explored the polymer types of micro plastics by Raman spectra. This study will provide basic data for monitoring micro plastics in the water resources of Vandiyur Lake.

Sample Collection and Testing

Sampling

Water samples were collected from 5 sites in the Vandiyur lake .Before sampling; all tools were cleaned using distilled water. Samples of 20 L of surface water were collected using a 5 L water sampler and then passed through a 50 mm stainless steel sieve. The residue on the sieve was washed with pure water and removed into 50 mL glass bottle. Water samples were taken in the same way at each location. Before the experimental analysis, samples were preserved at 4 degree Celsius.

Table 1 Sample and Location

Sample	Location
Sample 1	Sundaram park
Sample 2	Melamadai
Sample 3	Gomathipuram
Sample 4	Pandi kovil
Sample 5	Lake area

Micro Plastic Extraction

In the laboratory, to dissolve the natural organics in the water sample, samples were treated with 30% H2O2 for 24 h at room temperature in the dark. Then the samples were filtered through 0.45

mm filter paper under a vacuum pump, and the filter papers were placed in a dish and air-dried at room temperature.

Microscope Inspection

The particles were observed on the filter paper with a stereomicroscope and measured with an eyepiece micrometer. Based on previous studies micro plastics can be divided into three types according to their morphology: fiber, fragment, or film. According to the size, micro plastics are divided into 3 classes: class 1, <0.5 mm; class 2, 0.5-2.5 mm; class 3, 2.5-5 mm. The quantity, type and size of the micro plastics in each sample were recorded Hence water samples analyse and number of Micro plastics present in it was found.

Table 2 Samples for Number of Micro plastics

Sample	No of Microplastics
Sundaram park	215
Melamadai	250
Gomathipuram	169
Pandi kovil	190
Lake area	232

Microplastics Identification

Microplastics cannot be completely accurately identified by visual observation alone Raman spectroscopy can be used to analyze the composition of sample particles, as previously reported. In this study, samples are analyzed by micro-Raman spectroscope. The obtained spectra were compared with the spectral libraries on the instrument.

Result and Discussion

Size of Micro Plastic

According to the size, Microplastics are divided into 3 classes: class 1, <0.5 mm; class 2, 0.5-2.5 mm; class 3, 2.5-5 mm.

Table 3 Micro Plastic Sizes

SIZE(mm)	<0.5	0.5-2.5	2.5-5
Sundaram park	81	14	5
Melamadai	86	9.2	4.8
Gomathipuram	52.85	22.95	24.2
Pandi kovil	20.8	23	12.6

Larger proportion of micro plastics observed is less than 0.5mm and microplastics of size 0.5-2.5mm is observed in least proportion. On average 45% of particles observed are less than 0.5mm followed by 22% of particles within size of 0.5mm-2.5mm and 28% of particle within 2.5-5mm. In Sundaram park, Gomathipuram, Melamadai major proportion of particles are less than 0.5mm. In Lake Area large number of particles is of size 2.5mm- 5mm. In Pandi kovil most of the particles are in size 0.5mm-2.5mm.

Types of Micro Plastic

Microplastics in these samples were classified into three shapes: **film, granule**, or **fiber.** film is a thin piece of plastic debris. granule is a spherical or cylindrical piece or fragment, fiber is a thin and long item. Different proportions of the three shapes were observed at different sampling sites Film was the most dominant component, with an average of 49% followed by granule and fiber constituting about 28% and 23% respectively.

Table.4 Type of Microplastics

Types of Microplastics	Film	Granule	Fiber
Sundaram park	55	30	15
Melamadai	30.8	40.8	28.4
Gomathipuram	47.6	30.95	21.45
Pandi kovil	62	21.4	16.6
Lake area	40.4	35.7	23.9

From the samples collected it is observed that about 49% of the microplastics observed are film followed by 28% are granule and 23% are fibre. Except Melamadai in all the remaining 4 location film type of microplastic is present in larger number.

SEM Analysis

The scanning electron microscope (SEM) uses electrons instead of light to form a high resolution image. Since their development in the early 1950's,

Table 5 Composition of Micro Plastic

Composition of Micro Plastic	%
Polypropylene(PP)	18
Polyvinyl chloride(PVC)	22
Polyethylene(PE)	27
Polypropylene terephthalate(PET)	13
Others	20

Composition of Microplastic Identified by Micro-Raman Spectroscopy

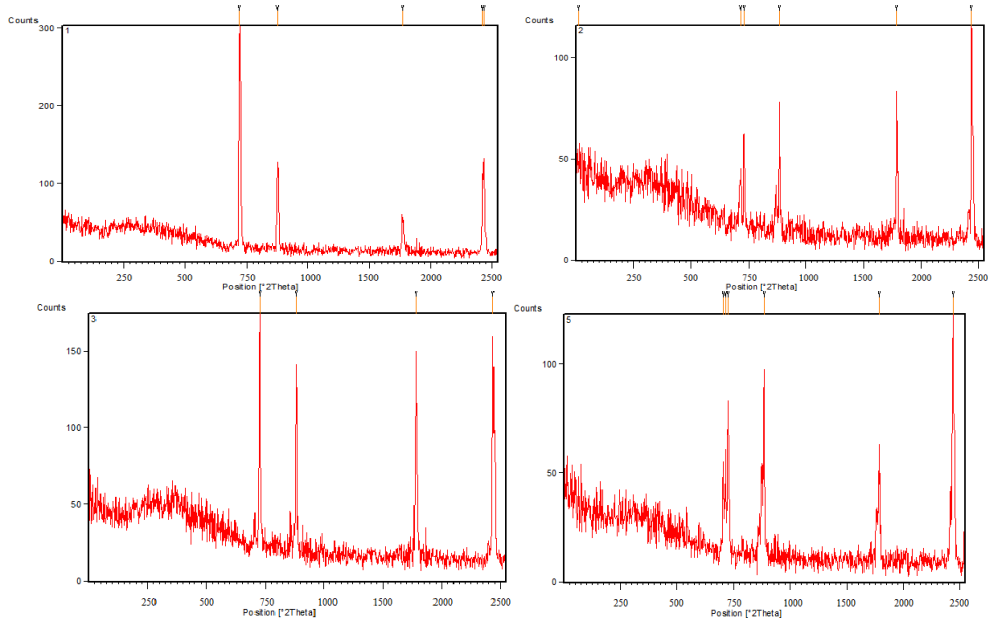

Figure 1 (a) Micro Raman Spectroscopy of Polyamide, (b) Polyethylene, (c) Polypropylene, (d) PVC

Raman spectroscopy is a "surface technique", thus large, visually sorted microplastic particles can be analyzed and the technique can also be coupled with microscopy. Raman micro-spectroscopy is straightforward and uses a scattering technique. The Raman scattered light occurs at wavelengths that are shifted from incident light by the energies of molecular vibrations giving out spectra. The peak height of Polyethylene, polypropylene and PVC are 718 cm-1, 2839 cm-1 and 696 cm-1 respectively.

Removal of Micro Plastic from Water Using Ferro Fluids

Nontoxic magnetic liquids consisting of magnetite liquid and oil that are very reactive to magnets. It worked because Ferro fluids attract microplastics because of the nonpolar properties of both (plastic and oil). By adding oil to a suspension containing a known concentration of microplastics. After these migrated into the oil phase, magnetite powder was added. The resulting microplastic-containing ferro-fluid was removed using strong magnets. The method used was most effective on fibres obtained from a washing machine, and least effective on polypropylene plastics.

Table 6 Removal of microplastic from water using Ferro fluids

No. of. Microplastic in water sample	
Before treatment	**After treatment**
186	148
Efficiency of the treatment = 80%	

Efficiency of treatment

Efficiency of treatment = After treatment = 148 = 80%

Before treatment 186

Conclusion

This study was designed to investigate the characteristics of microplastics pollution in Vaigai River. By analyzing water samples from 5 sites in the lake, it revealed serious microplastics pollution in some parts of Vaigai River. Totally over 2655 pieces of microplastics are identified from the 10 sampling sites at Vaigai Lake. Larger proportion of microplastics observed is less than 0.5mm and microplastics of size 0.5-2.5mm is observed in least proportion. Film was the most dominant component, with an average of 49% followed by granule and fiber constituting about 28% and 23% respectively .These results suggest that reducing human activities could aid remediation of the microplastics pollution in vaigai river. About 80% of microplastics are removed by using Ferro fluids. Hence this method could form the basis for an effective method of microplastic extraction from water.

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