

**BEFORE THE NATIONAL GREEN TRIBUNAL  
SOUTHERN BENCH, CHENNAI.**

**Original Application No. 99 of 2021(SZ)**

Suo Motu based on the News item  
in the Times of India Newspaper  
Chennai edition dated 5.4.2021 under the  
caption "Chennai you are breathing micro plastic"

Vs

The Chief Secretary to Government  
Tamil Nadu, Chennai and Ors

...Respondents

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Filed by  
Thiru. S. Sai Sathya Jith  
Advocate, Chennai.

**REPORT OF THE JOINT COMMITTEE IN THE MATTER OA NO. 99/2021 IN SUO MOTO REGISTERED ON THE BASIS OF NEWS PAPER REPORT PUBLISHED IN "THE TIMES OF INDIA CHENNAI EDITION" DATED 05.04.2021 UNDER CAPTION "CHENNAI YOU ARE BREATHING MICRO PLASTIC"**

**1.0 Background**

It is informed that an Original Application No. 99 of 2021 taken up by the NGT Suo Motu case based on the News item published in the Times of India Newspaper, Chennai Edition, Dated 05.04.2021, under the caption "Chennai you are breathing micro Plastic". In this regard, the Hon'ble NGT has passed order dated 16.06.2021 and issued the following directions among other things inter alia as follows:

..... *"Para 5: we feel that it is necessary to appoint a Joint Committee to consider this aspect. So, we constitute Joint Committee consist of 1) Senior Scientist from Central Pollution Control Board, Integrated Regional Office, Chennai, 2) Senior Scientist from Tamil Nadu Pollution Control Board as designated by its Chairman and 3) Scientist having expertise in this filed from Center for Environment, Anna University, Chennai to inspect the area in question and also consider the problem that has been projected in the newspaper reports and come with a suitable recommendations and suggestions as to how this can be mitigated in an effective manner.*

*6. Tamil Nadu Pollution Control will be the nodal agency for coordination and providing necessary logistic for this purpose.*

*7. The Committee is directed to take water samples from the nearby wells in and around the Perungudi dump yard and also consider the air samples from the available monitoring station near that place and also in Chennai area so as to find out whether micro plastic particles are found in groundwater as well as in the atmosphere which is being unknowingly consumed by the public resulting in other unknown diseases as well. The Committee is directed to submit the report to this Tribunal on or before 27.08.2021.*

8. *The Central Pollution Control Board, New Delhi is also directed to provide necessary logistic or other technical and expertise support, if any required for this Committee by deputing any suitable person as member of the Committee to do the study effectively” .....*

**The case was taken up for hearing on 08.11.2021 and NGT directed the Joint Committee as follows:**

*“The learned Counsel appearing for the TNPCB submitted that they have already taken samples and they wanted some more time to file the report. The CPCB also wanted two months time for approving the Memorandum of Understanding (MoU), with Indian Institute of Technology (IIT), Kanpur and 12 months time for finalizing the report. Since it is quite a long time till then pollution of the environment cannot be allowed as it will have severe adverse impact on human health. The above officials are directed to submit the report to this Tribunal on or before 09.12.2021 by e-filing in the searchable PDF/OCR”.*

## **2.0 Constitution of Joint Committee**

Tamil Nadu Pollution Control Board (TNPCB) as the nodal agency requested all the concerned authorities for the nomination of the officials from concerned organization for the formation of the joint committee as per the directions of NGT. Based on the nominations received from the Central Pollution Control Board (CPCB) Regional Directorate - Chennai and The Centre for Environmental Studies, Anna University; the joint committee was constituted with following members:

- i. Dr. S. Kanmani, Director, Centre for Environmental Studies, Anna University, Chennai
- ii. Smt. Poornima B.M, Scientist ‘D’, Central Pollution Control Board (CPCB), Regional Directorate - Chennai
- iii. Thiru. V. Thyagarajan, Deputy Director (Labs), Tamil Nadu Pollution Control Board (TNPCB), Chennai

### **3.0 Meeting of the Joint Committee**

The first meeting of Joint Committee was held on 16.08.2021 at Centre for Environmental Studies, Anna University. The Committee members deliberated upon samples, analysis of the samples and available air quality monitoring stations near that dumpsites place. The following decisions were made:

- i. Visit and inspection of Perungudi and Kodungaiyur dumpsites by Joint Committee on August 25, 2021.
- ii. To survey and finalize the surface & ground water sampling and ambient air quality monitoring stations locations in and around the two dumpsites on August 25, 2021.
- iii. To identify laboratories for analyzing presence of micro plastics in water and ambient air samples before collection of samples.
- iv. To finalize parameters for analyzing surface & ground water samples.
- v. The Deputy Director (Labs) to collect details for analyzing micro plastics in water and air from the Central Institute of Plastics Engineering Technology (CIPET), Chennai.

### **4.0 Site Visit and Inspection of the Joint Committee**

The joint committee carried out site visit of the two dumpsites located at Kodungaiyur & Perungudi on 25.8.2021 to ascertain the ground level conditions and also to identify/finalize locations for water & ambient air monitoring. During visit/inspection following officials were also present along with committee members. In addition, the supporting staffs of TNPCB Laboratory were also present and extended support for the committee members in sampling & monitoring. During visit/inspection following officials were also present along with committee members. In addition, the supporting staffs of TNPCB Laboratory were also present and extended support for the committee members in sampling & monitoring.

After the site inspection, the committee visited nearby residences and commercial places in and around Kodungaiyur & Perungudi dumpsites and identified locations for surface & ground water samples and ambient air quality monitoring.

#### 4.1 General Observation on Kodungaiyur dumpsite

The following observations were made by the committee during site visit:

- i. It was informed that Kodungaiyur dumpsite as an area of about 269 acres and operated from more than 35 years. The habitation is located within 500m from the dumpsite
- ii. About 64.02 lakhs cubic meter of legacy waste is accumulated in dumpsite.
- iii. During inspection it was noticed that fresh solid waste is being dumped on top legacy waste due to space constraints. The dumpsite has occupied about 90 % of available land and there is no space available for the fresh solid waste dumping. Hence the daily generated solid waste is dumped vertically creating hill like structures.
- iv. It was reported that about 2600 to 2800 TPD of fresh solid waste generated from Zone 1 to 8 is being dumped in this site.
- v. There was a lack of segregation of waste (dry & wet waste); the trucks carried unsegregated solid waste and being dumped.
- vi. The garland drains have been created to collect the leachate generated from these dumps, during inspection oozing of leachates was noticed and all the drains were filled with leachates. The leachate was allowed to flow directly into the Kodungaiyur canal flowing in front of the dumpsite. This canal joins Buckingham canal, which is located adjacent to dumpsite and finally reaches the sea.
- vii. In the dumpsite, Construction & Demolition waste processing facility of 600TPD capacity has been installed and is operating at trail run. GCC has obtained consent for establish and consent for operation from TNPCB.

- viii. Greater Chennai Corporation (GCC) has not started bio-mining/bio-remediation process of legacy waste in Kodungaiyur dumpsite. It was reported that Detailed Project Report (DPR) is under preparation.

#### **4.2 General observations on Perungudi dumpsite**

The following observations were made by the committee during site visit:

- i. It was informed that Perungudi dumpsite is spread in an area of about 220 acres land and is being operated from more than 30 years. The habitation is located within 500m from the dumpsite.
- ii. About 34.29 lakhs cubic meter of legacy waste is accumulated in dumpsite. At present, 2400 to 2800 TPD of unsegregated fresh solid waste is being dumped in this site.
- iii. This dumpsite has also accumulated maximum space and vertical dumping of fresh solid waste was noticed. The domestic solid waste generated from Zone 9 to Zone 15 is being dumped in this site.
- iv. From the dumpsite it was noticed that segregation of waste is very poor in these zones.
- v. The garland drains have been created around all dumps to collect the leachate generated, during inspection oozing of leachates were noticed and all the drains were filled with leachates. The leachate was allowed to flow directly into the storm water drains joining the canal and ultimately reaching the sea.
- vi. The Perungudi marshland located at the backside of the dumpsite was found filled with leachates due to rainfall occurred previous day of the site visit.

- vii. GCC has obtained solid waste authorization as per the Solid waste management Rules, 2016 for bio-mining/bio-remediation process of 34. 29 cubic meter of legacy waste from TNPCB on 09.08.2021 and valid up to 31.03.2022.
- viii. GCC awarded work order for the biomining of legacy waste and during site visit; the erection of machineries for the bio-mining process was noticed.

#### 5.0. Details of sampling locations

The surface & ground water locations are all within the 1km radius from the dumpsites and details of sampling location is depicted in table 1 & 2 and the ambient air quality monitoring stations details is depicted in table 3.

**Table no. 1: Sampling locations of surface & ground water in Kodungaiyur dumpsite**

S. No.	Type of sample	Sampling location	Latitude/ Longitude	Distance & direction from the dumpsite
1	Leachate	Leachate from dumpsite near Admin. Office	13.130697 N 80.274822 E	56m,SE
2	Canal	Kodungaiyur canal before the inlet of leachate	13.133098 N 80.276041 E	90m,E
3	Canal	B' Canal near mixing point of Outlet from CMWSSB sewage	13.135092 N 80.277154 E	150m, NE
4	Open well	Nethaji Nagar, 6th Street, No.17 Maiammal House	13.130542 N 80.267308 E	135m, S
5	Bore Well	Rajarathinam School, Govt. Chennai School 3rd Street, Kodungaiyur	13.13388 N 80.262069 E	130m, SW

**Table 2: Sampling locations of surface & ground water samples at Perungudi dumpsite**

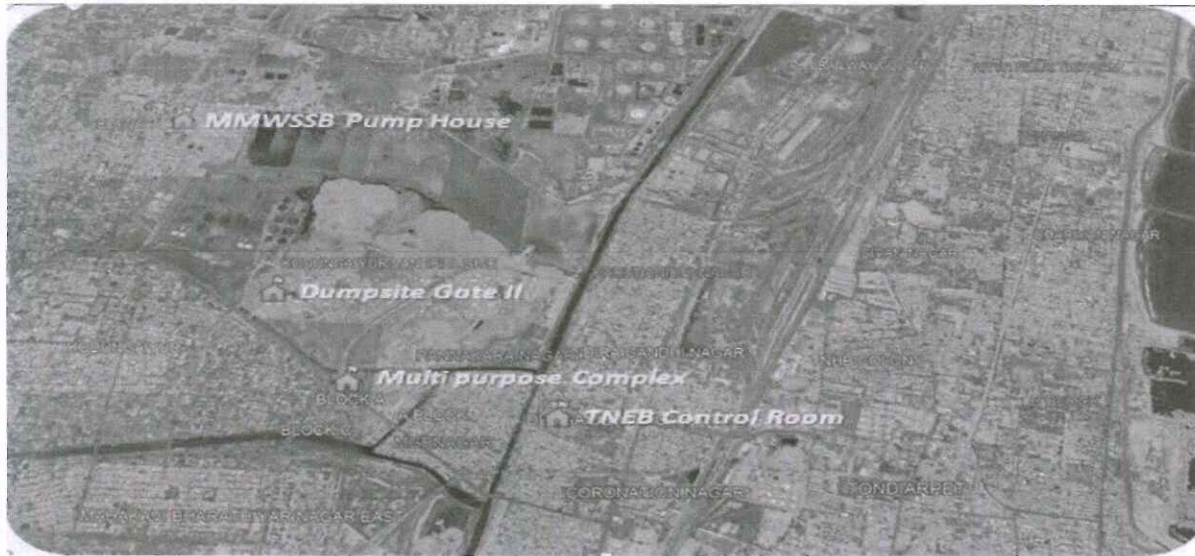
6	Bore well	Sh. Saravanan House Ist Cross Street Sarvana Nagar Perungudi	12.951626 N 80.21390 E	100m, SW
7	Open sump	Opposite to Admin, GCC office	12.949000 N 80.216634 E	100m, SW
8	Bore Well	Inside the dumpsite Fresh waste dumping area	13.955027 N 80.236146 E	0m
9	Open Well	Sh. T. S. Shanmuga Krishnan, Sri Sai Nagar, opp. to Park, Perungudi	12.951604 N 80.235080 E	900m, E
10	Bore Well	Sh. S. Kannan No. 1/137, Kulakarai	12.956177 N	500m, E

		Street	80.240164 E	
11	Surface water	Marsh Land behind dumpsite	12.950230 N 80.237345 E	100m, E

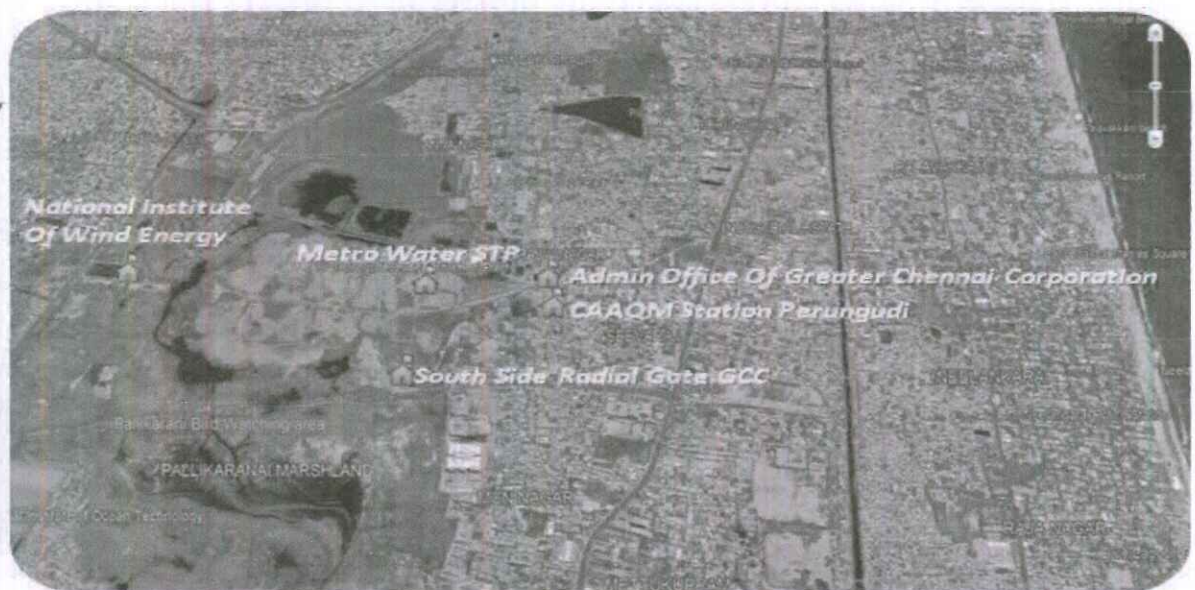
**Table 3: Sampling locations of Ambient Air Quality monitoring stations (AAQMS) at Kodungaiyur & Perungudi dumpsites**

<b>In and around Kodungaiyur dumpsite</b>			
<b>S. No.</b>	<b>Sampling Location</b>	<b>Latitude/ Longitude</b>	<b>Distance &amp; direction from dumpsite</b>
1	On top of platform near TNEB control room (AD Office), Ennore High Road	13.12808 N 80.27559 E	350m, SE
2	On building top of Multipurpose complex, Corporation of Chennai, Tondiarpet High road	13.12935 N 80.26767 E	220m, W
3	On top of platform near Kodungaiyur Dumpsite Gate II	13.13389 N 80.264 E	0m, SW
4	On building top of MMWSSB pump house, Thendral Nagar, Kodungaiyur	13.14393 N 80.25801 E	850m, NW
<b>In and around Perungudi dumpsite</b>			
5	Metro water STP – eastern	12.9661 N 80.2428 E	1.5Km, NE
6	Admin office of Greater Chennai Corporation	12.5723 N 80.1359 E	30m, E
7	CAAQM station at Perungudi	12.9653 N 80.2461 E	65m, SE
8	South side Radial Gate of GCC (entrance of the dumpsite)	12.9655 N 80.2445 E	30m, S
9	National institute of wind energy, backside	12.9566 N 80.2143 E	180m, W





*Picture 1: Representation of AAQMS at Kodungaiyur dumpyard*



*Picture 1: Representation of AAQMS at Perungudi Dumpyard*

**6. Analysis results of surface & ground water and ambient air quality at Kodungaiyur & Perungudi dumpsites**

**6.1 Analysis results of surface & groundwater samples**

The surface & groundwater samples from the Kodungaiyur & Perungudi dumpsites as per the sampling locations mentioned in table 1 & 2 were collected on 24.09.2021. The samples were

analyzed at Central Laboratory, TNPCB and for Heavy metals parameters, samples were analyzed in M/s SGS Laboratory, Chennai. The table 4A, 4B & 5 depicts the analysis results of surface & groundwater samples from the Kodungaiyur & Perungudi dumpsites. The analysis results show

**Table 4A: Analysis results of leachate & surface water samples in Kodungaiyur dumpsite**

<i>Parameters all in mg/L except pH</i>	<i>Monitoring locations</i>		
	<i>Leachate from dumpsite near Admin. Office</i>	<i>Kodungaiyur canal before the inlet of leachate</i>	<i>B' Canal near mixing point</i>
Turbidity (NTU)	203	51.1	28.4
pH	7.4	7.0	6.9
Oil & Grease (mg/L)	8	<2	<2
COD	<b>1040</b>	<b>264</b>	<b>168</b>
BOD	<b>360</b>	<b>66</b>	<b>44</b>
TDS	<b>5130</b>	838	960
Nitrate	<1	<1	<1
Nitrite	<0.05	<0.05	<0.05
Total Residual Chlorine	<1	<1	<1
Cyanide	<0.05	<0.05	<0.05
Fluoride	0.52	0.34	0.5
Chloride	<b>1510</b>	<b>320</b>	<b>355</b>
Sulphate	80	163	168
Sulphide	<1	<1	<1
Total Hardness	1040	<b>325</b>	<b>380</b>
Phosphates	<0.5	0.58	0.65
Alkalinity	1390	<b>534</b>	<b>522</b>
Total Kjeldal Nitrogen	<b>336</b>	19	18
Ammonical Nitrogen	<b>186</b>	11	10
Phenolic compounds	<b>5.52</b>	2.8	1.8
Zinc	0.159	0.2	0.26
Nickel	0.283	0.2	<0.006
Copper	0.16	0.04	0.03

Hexavalent Chromium	<0.05	<0.05	<0.05
Total Chromium	<0.05	<0.05	<0.05
Lead	0.005	<0.015	<0.015
Manganese	0.404	0.21	0.16
Total iron	3.389	0.23	0.16

The untreated leachate generated from the dumpsite joins the Kodungaiyur canal which carries untreated sewage in turn joins the Buckingham canal. The treated sewage from the Kodungaiyur sewage treatment plant is also let into the canal. Hence in spite of dilution, the values of BOD, COD are higher and confirms the pollution of canal due to influx of leachate and untreated sewage which clearly indicates in the table 4A. The canal falls under class E as per the designated best use (DBU) water quality criteria.

**Table 4B: Analysis results of ground water samples around Kodungaiyur dumpsite**

<i>Parameters all in mg/L except pH</i>	<i>Monitoring Locations</i>		<i>Drinking water standards (BIS:IS:10500, 2012)</i>
	<i>Nethaji Nagar, open well</i>	<i>Rajarathinam Govt. School (Bore well)</i>	
Turbidity (NTU)	12.6	1.69	1
pH	6.8	7.1	6.5 – 8.5
Oil & Grease (mg/L)	<2	24	-
COD	144	40	-
BOD	13	8	-
TDS	11314	684	500
Nitrate	<1	6.6	45
Nitrite	<0.05	<0.05	-
Total Residual Chlorine	42	<1	0.2 (only when water is chlorinated)
Cyanide	<0.05	<0.05	0.05
Fluoride	0.13	0.1	1.0
Chloride	4060	190	250
Sulphate	4756	144	200
Sulphide	<1	<1	0.05
Total	1920	270	200

Hardness			
Phosphates	0.57	0.62	
Alkalinity	<b>538</b>	<b>406</b>	<b>200</b>
Total Kjeldal Nitrogen	4	<2	-
Ammonical Nitrogen	2.24	<2	-
Phenolic compounds	<0.1	<0.1	-
Zinc	0.23	<0.20	5
Nickel	<0.006	0.36	-
Copper	<0.0015	<0.0015	0.05
Hexavalent Chromium	<0.05	<0.05	-
Total Chromium	<0.05	<0.05	0.05
Lead	<0.015	<0.015	0.01
Manganese	0.86	0.079	0.1
Total iron	0.19	<b>&lt;0.5</b>	<b>0.3</b>

The bore well samples taken from the residence near the Kodungaiyur dumpsite is not meeting the BIS drinking water standards and except heavy metals & phenolic compounds all other parameters are exceeding the standards.

**Table 5: Analysis results of ground water samples from Perungudi dumpsite**

<i>Parameters all in mg/L except pH</i>	<i>Monitoring locations</i>					
	Sh. Saravanan House	Open sump Opposite to Admin, GCC office	Inside dumpsite	Sh. T. S. Shanmuga Krishnan	Sh. S. Kannan	Marsh land behind dumpsite
Turbidity (NTU)	2.07	1.8	<b>2142</b>	<b>37.3</b>	0.48	<b>26.4</b>
pH	6.5	<b>7.1</b>	<b>7.4</b>	<b>6.8</b>	<b>6.9</b>	7.4
Oil & Grease (mg/L)	16	<2	<b>32</b>	<2	<2	<2
COD	200	128	<b>2560</b>	56	48	264

BOD	15	12	<b>840</b>	9	7	39
TDS	<b>24226</b>	<b>1288</b>	<b>7812</b>	<b>2228</b>	<b>2016</b>	<b>1718</b>
Nitrate	<1	<1	<1	<1	4.1	<1
Nitrite	<0.05	<0.05	<0.05	<0.05	0.6	<1
Total Residual Chlorine	<1	<1	<1	<1	<b>55</b>	<1
Cyanide	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoride	0.15	0.29	0.58	0.22	0.26	0.58
Chloride	<b>11325</b>	<b>435</b>	<b>1820</b>	<b>935</b>	<b>775</b>	<b>570</b>
Sulphate	<b>1224</b>	70	<b>396</b>	<b>678</b>	<b>388</b>	59
Sulphide	<1	<1	28	<1	<1	<1
Total Hardness	<b>7600</b>	<b>370</b>	<b>2050</b>	<b>640</b>	<b>590</b>	<b>460</b>
Phosphates	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Alkalinity	<b>302</b>	<b>394</b>	<b>528</b>	<b>402</b>	<b>508</b>	<b>1216</b>
Total Kjeldal Nitrogen	<2	<2	<b>627</b>	5.6	3.3	74
Ammonical Nitrogen	<2	<2	<b>349</b>	3.4	2.2	41.4
Phenolic compounds	<0.1	<0.1	0.81	<0.1	<0.1	0.94
Zinc	0.16	0.13	0.27	0.14	0.26	0.14
Nickel	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Copper	<0.015	<0.015	<b>0.644</b>	<0.015	<0.015	<0.015
Hexavalent Chromium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Chromium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Manganese	<b>2.17</b>	<0.01	<b>1.21</b>	<b>0.41</b>	<0.01	0.16
Total iron	0.22	0.11	<b>45</b>	0.27	0.13	<b>0.59</b>

The ground water samples taken from the bore well located inside the dumpsites are at higher levels for all the parameters, which clearly suggest the ground water pollution due to dumpsite and mismanagement of leachates from the dumpsite. The ground water samples collected from the vicinity of the dumpsites are also not meeting the BIS drinking water standards.

## 6.2 Analysis results of ambient air quality samples

The monitoring of ambient air quality at five locations in & around Perungudi dumpsite was monitored during 15.09.2021 to 16.09.2021. The analysis results are depicted in table 6 & 7 below, the results shows that metro water STP, South gate of dumpsite & admin office located in dumpsite are not meeting the PM<sub>10</sub> standard. The prominent wind direction during the day of monitoring at the stations was north east to south west direction. This may be due to movement of trucks carrying the solid waste for disposal in the dumpsite and also there is contribution of solid waste dumpsite for the increase in the concentration of PM<sub>10</sub> at the downwind direction (South side radial gate GCC).

*Table 6: Analysis results of AAQ at Perungudi dumpsites*

S. No.	Pollutants concentration in µg/m <sup>3</sup>	NAAQM Standards for 24 hrs.	Monitoring Locations				
			Metro water STP	Admin office of GCC	Near CAAQM station Perungudi	South side radial gate GCC	National institute of wind energy
1	PM <sub>10</sub>	100	136.0	145	67	168	62
2	PM <sub>2.5</sub>	60	22	-	-	32	18
3	SO <sub>2</sub>	80	13	11	9	13	9
4	NO <sub>2</sub>	80	16	17	14	18	10

The monitoring of ambient air quality at four locations in & around Kodungaiyur dumpsite was monitored during 15.09.2021 to 16.09.2021. The analysis results are depicted in table 7 below, the results shows that TNEB control room and Multi-purpose complex, GCC locations are not meeting the PM<sub>10</sub> standard. The prominent wind direction during the day of monitoring at the stations was north east to south west direction. This may be due to movement of traffic in the vicinity of dumpsite and also due to vehicular movement in the dumpsites.

*Table 7: Analysis results of AAQ at Kodungaiyur dumpsites*

S.	Pollutants	NAAQM	Monitoring Locations
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No.	concentration in $\mu\text{g}/\text{m}^3$	Standards for 24 hrs.	TNEB control room	Multi-purpose complex, GCC	Dumpsite gate II	MMWSSB pump house
1	PM <sub>10</sub>	100	132	138	87	74
2	PM <sub>2.5</sub>	60	40	-	35	-
3	SO <sub>2</sub>	80	9	11	8	8
4	NO <sub>2</sub>	80	14	14	14	12

### 7.0 Analysis of microplastics (MPs) in ground water and ambient air around the dumpsites

For the analysis of MPs in water and air, the sample preparation was done in the TSPCB, Central laboratory. The Morphological characterization for identifying colour and number of MPs present in the sample was carried out by Centre for Environment Science, Anna University. However the results were not satisfactory. Hence the committee decided to resample & analysis of the microplastics. The committee engaged National Centre for Sustainable Coastal Management (NCSCM), MoEF&CC located at Anna University, Kotturpuram, Chennai to carry out the possibility of microplastics leakage from the solid waste dumpsite of Greater Chennai Corporation. NCSCM research team has been actively working on the assessment of microplastics and marine debris and its impact on the marine environment. The work was awarded by TNPCB to NCSCM on 29-12-2021 for the qualitative & quantitative assessment of microplastics from the leachate, surface water, ground water and in ambient air around the Kodungaiyur and Perungudi dumpsites.

A joint field survey and sample collection was carried out by committee members & NCSCM to verify the status of microplastics pollution from the Kodungaiyur and Perungudi dumpsites on 06.01.2022 and 07.01.2022. A total of 12 samples were collected including the leachate and water samples within 500m radius of the landfill site. In case of ambient air, sampling carried out at 9 locations in and around the landfill sites by TNPCB was assessed from the filter papers by microscopic identification. The detailed information on the sample collection is given in Table 8.

**Table 8: Details of Microplastics Sample Collection from Kodungaiyur and Perungudi dumpsites**

S. No.	Type of sample	Sampling location with code	Latitude/ Longitude	Distance from dumpsite
<b>In and around Kodungaiyur dumpsite</b>				
1	Leachate	Landfill leachate discharge point (K1)	N13°07'50.00" E80°16'01.80"	20m
2	Kodungaiyur Canal	Canal through the landfill (K2)	N13°07'49.80" E80°16'01.06"	50m
3	Buckingham Canal	Patel Nagar (School Backside) (K3)	N13°08'12.14" E80°16'36.58"	100m
4	Closed well	Patel Nagar (Residential) (K4)	N13°08'01.47" E80°16'34.38"	~100m
5	Borewell	Rajarathinam Govt. School (K5)	N13°07'41.99" E80°16'05.35"	~400m
6	Borewell	Kaviarasu Kannadhasan Nagar (K6)	N13°08'00.90" E80°15'42.70"	~100m
<b>In and around Perungudi dumpsite</b>				
7	Borewell	Perungudi STP opposite	N12°57'17.30" E80°14'09.80"	~500m
8	Open well	STP opposite to Perungudi dumpsite	N12°57'18.17" E80°14'10.12"	~500m
9	Leachate outlet	Landfill leachate	N12°57'16.27" E80°13'31.86"	30m
10	Borewell	Sai Nagar from the landfill	N12°57'06.10" E80°14'07.30"	~600m
11	Borewell	Thuraipakkam from the landfill	N12°57'08.70" E80°14'12.79"	~500m
12	Leachate outlet	Leachate outlet connected to marshland	N12°56'59.04" E80°13'33.24"	Backside of dumpsite

## 7.1 Methodology

### Collection and extraction

A total of 12 samples were collected including the leachate and water samples from the canal and ground water within 500m radius of the landfill site (Table 8). Water samples of 2.5L to 20L were collected using a clean bucket and filtered through 20 µm mesh. The residue was



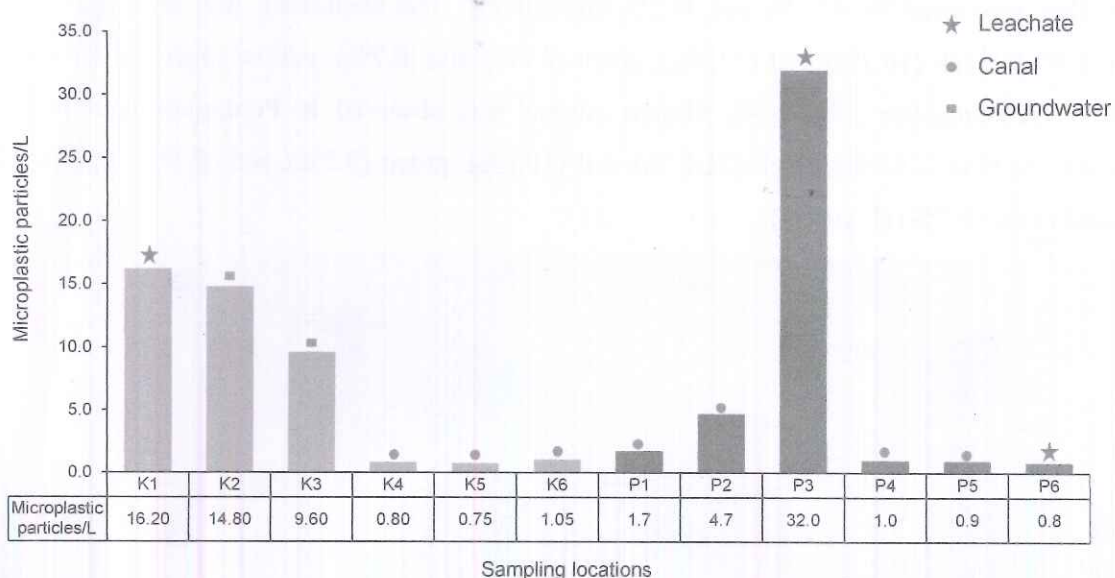
collected in 500ml glass containers, labeled, stored in ice box and transported to laboratory. All the materials used for sampling was previously washed with Milli-Q water and between the collection at each location. Similarly, ambient air sampling was carried out for PM<sub>10</sub> and PM<sub>2.5</sub> by using Respirable Dust Sampler and Ambient Fine Dust Sampler, respectively, at 9 locations in and around the landfill sites (as in table 3). The air sampling was performed by TNPCB by following the standard protocols (IS 5182 Part-23: 2006; IS 5182 Part-24: 2019) and the filter papers were handed over to NCSCM with required information for further process

### **7.2. Spatial distribution of microplastics**

The density of microplastics in the waters of leachate, canal and ground water ranged between 0.75 and 32.0 particles/L. The maximum density was found in the leachates, invariably at both the sites (Figure 1). The concentrations of microplastics in the leachate in the current study were comparable to those reported for other areas of the world where urban and industrial development have occurred (Table 9).

### **7.3 Morphological characteristics of microplastics**

Microplastics were characterized in to different types and colors which determine the source, chemical composition, degradation state and palatability in the environment. Fiber/lines were the most abundant type of microplastics that accounted for 41.3% and 46.6% at Kodungaiyur and Perungudi, respectively. Other types in the order of abundance include fragment > film > foam > pellet at Kodungaiyur and film > fragment > foam > pellet at Perungudi (Figure 2 & 3).

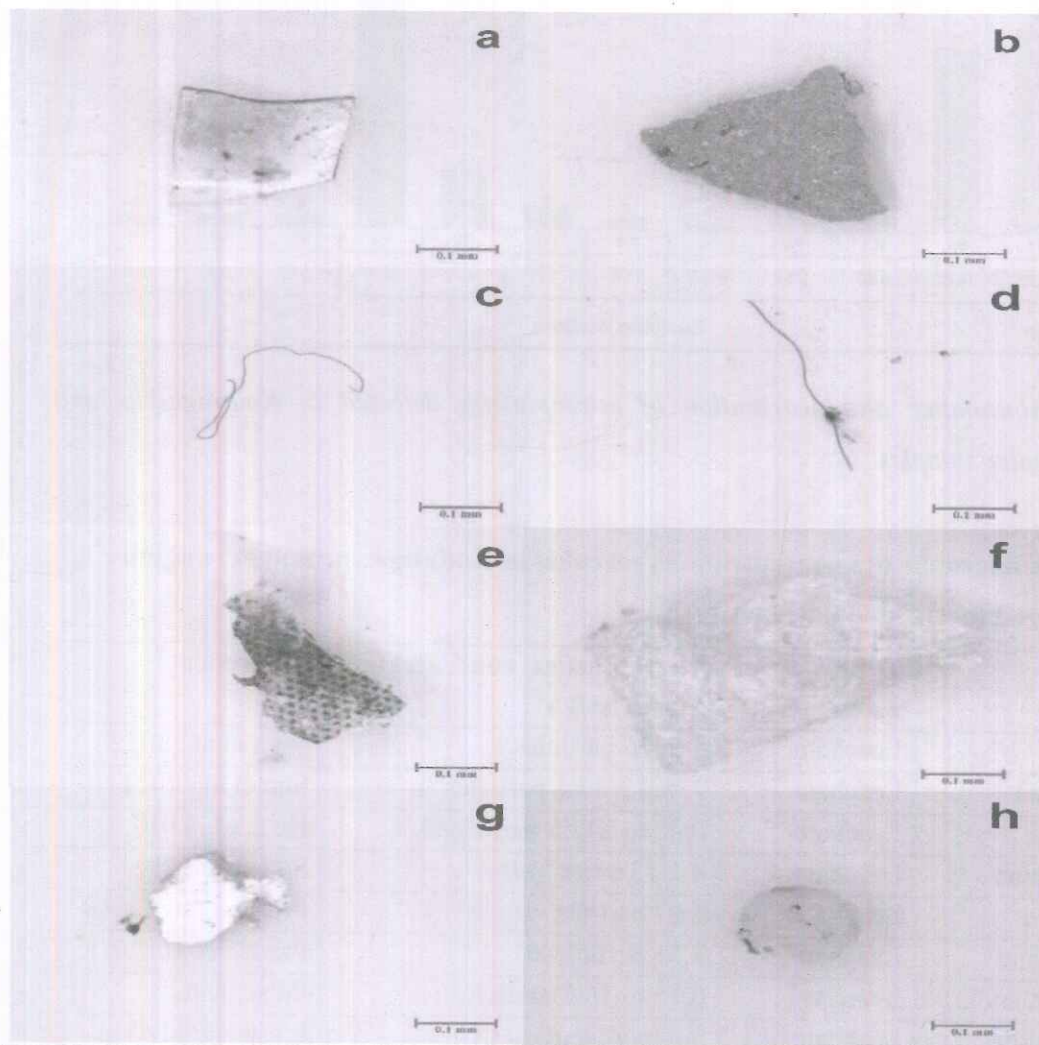


**Figure 1: Abundance and distribution of microplastics detected in Kodungaiyur and Perungudi water samples.**

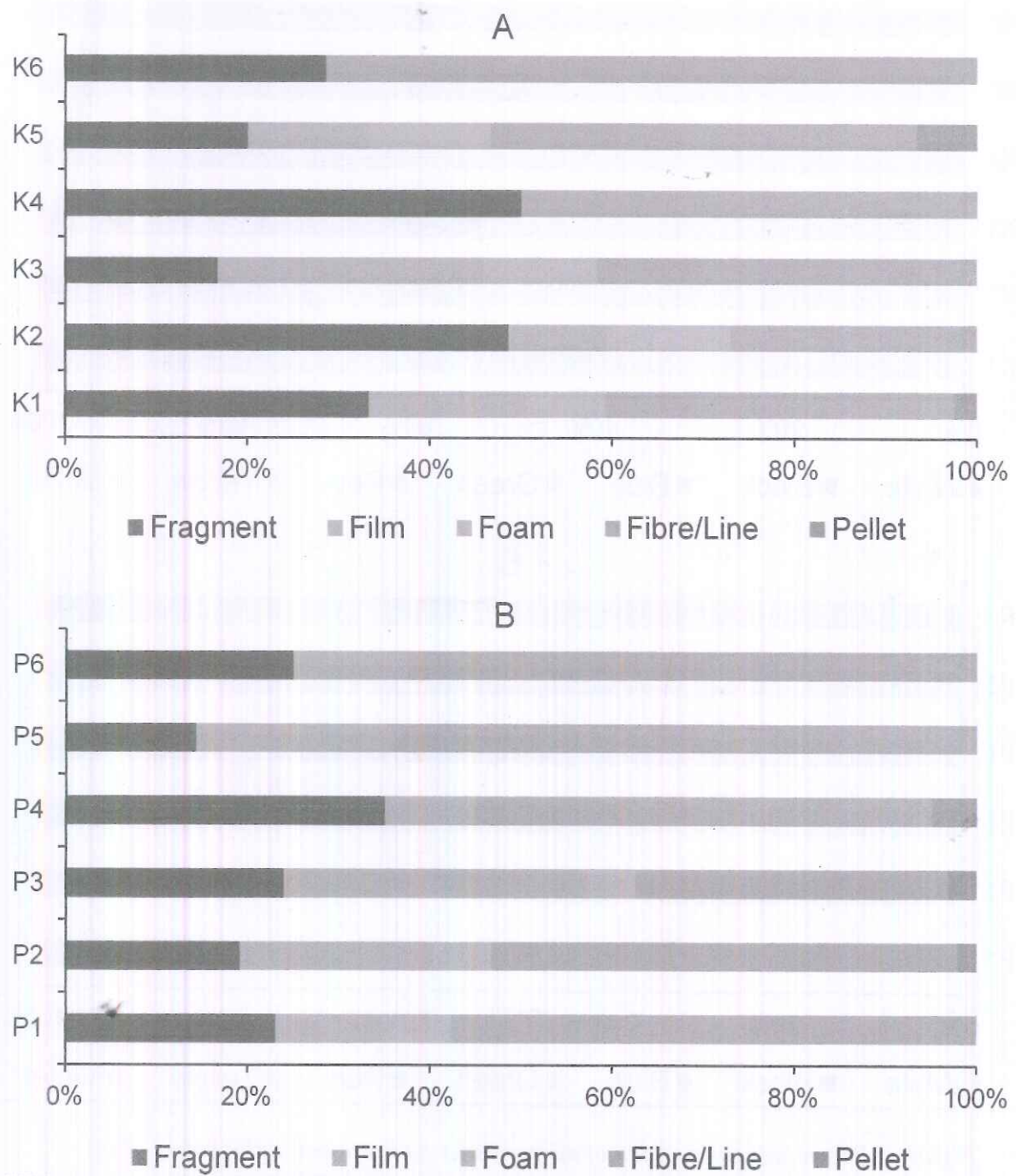
**Table 9: The microplastics concentrations revealed in Kodungaiyur and Perungudi were compared to worldwide values.**

Location	Type of water	Microplastics concentration (particles/L)	Reference
South China	Leachate	3 to 25 particles/L	Wan et al., 2022
Suzhou, China	Leachate	235.4 ± 17.1 particles /L	Sun et al., 2021
China	Leachate	0.42 to 24.58 particles/L	He et al., 2019
Shanghai, China	Leachate	4 ± 13 particles/L	Su et al., 2019
Lahti, Finland	Leachate	1.97 particles/L	Praagh et al., 2018
Alfsnes, Iceland	Leachate	4.51 particles/L	Praagh et al., 2018
Kodungaiyur, India	Leachate	0.75 to 16.2 particles/L	Present study
Perungudi, India	Leachate	0.8 to 32 particles/L	Present study
South China	Groundwater	11 to 17 particles/L	Wan et al., 2022
Australia	Groundwater	16 to 97 particles/L	Samandra et al., 2022
Karst, US	Groundwater	15.2 particles/L	Panno et al., 2019
Kodungaiyur, India	Groundwater	0.87 particles/L	Present study
Perungudi, India	Groundwater	2.1 particles/L	Present study

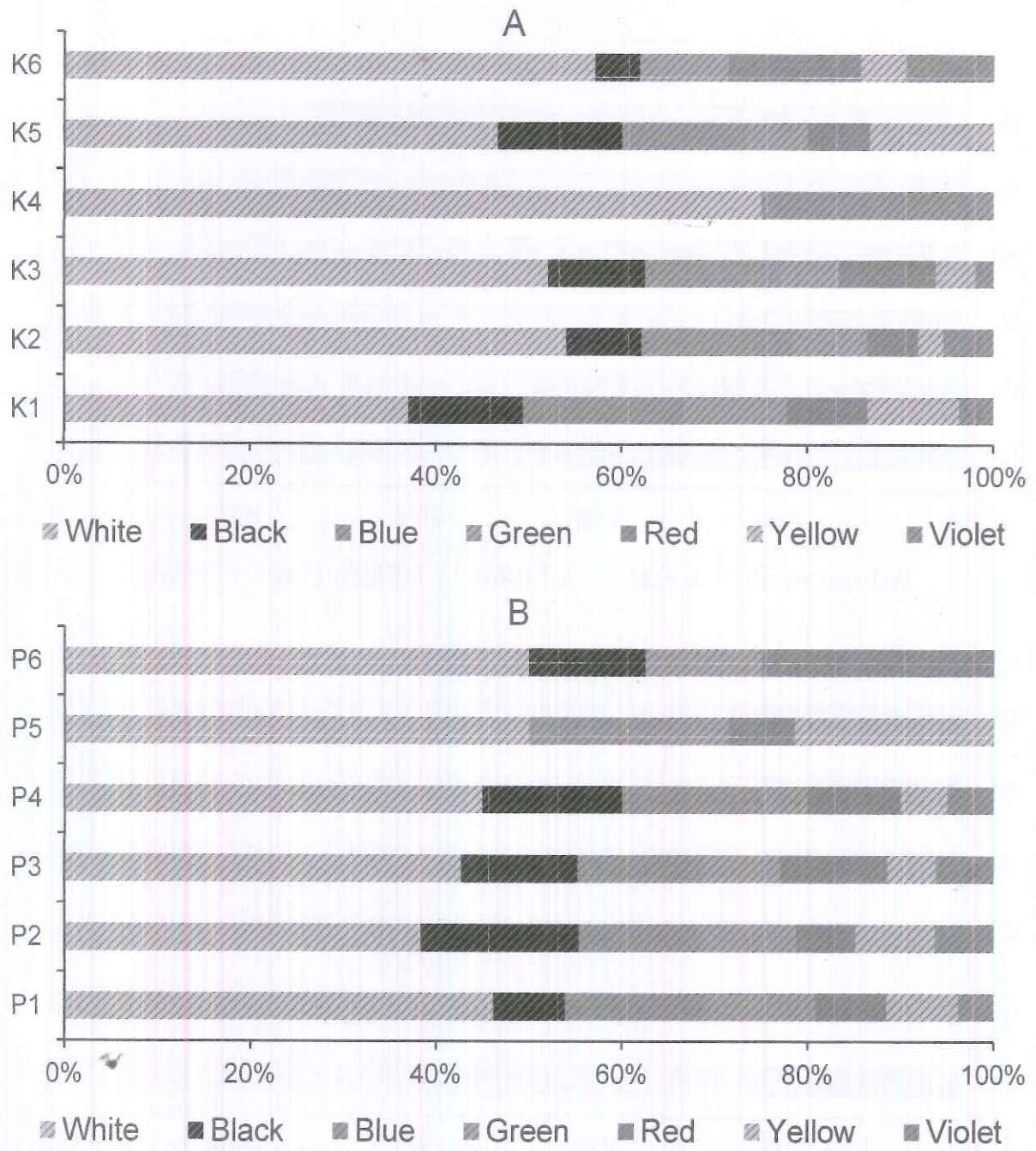
Among the colors detected, white color was predominant in both Kodungaiyur and Perungudi waters that accounted for 47.1% and 44.2% respectively. The abundance was followed by blue (12.3%), black (10.2%), red (12.4%), green (8.7%), red (8.7%), yellow (6.8) and violet (3.9%) in Kodungaiyur (Figure 4). Similar pattern was observed in Perungudi with the abundance of blue (13.6%), black (12.6 %), red (10.2%), green (9.2%), red (8.7%), yellow (7.3) and violet (5.3%) (Figure 4).



*Figure 2: Micrographs showing different types of microplastics: (a & b) fragments, (c & d) fibre/line, (e & f) film (g) form and (h) pellet.*



*Figure 3: Percentage composition of microplastics types found in the waters of (A) Kodungaiyur and (B) Perungudi.*

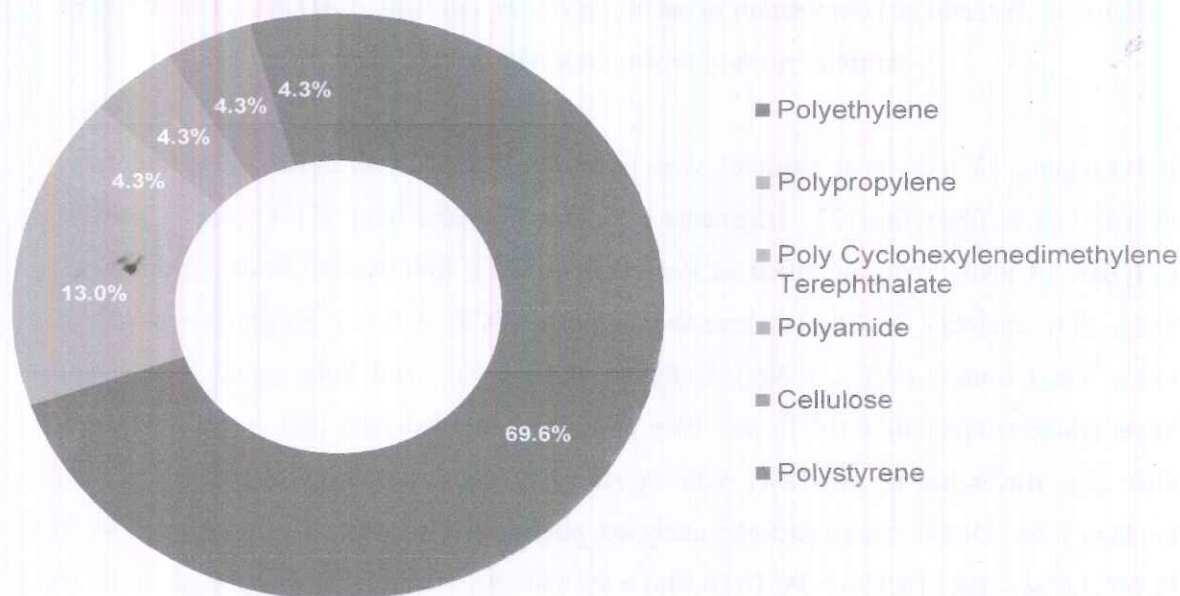


*Figure 4: Percentage composition of microplastics colors found in the waters of (A) Kodungaiyur and (B) Perungudi.*

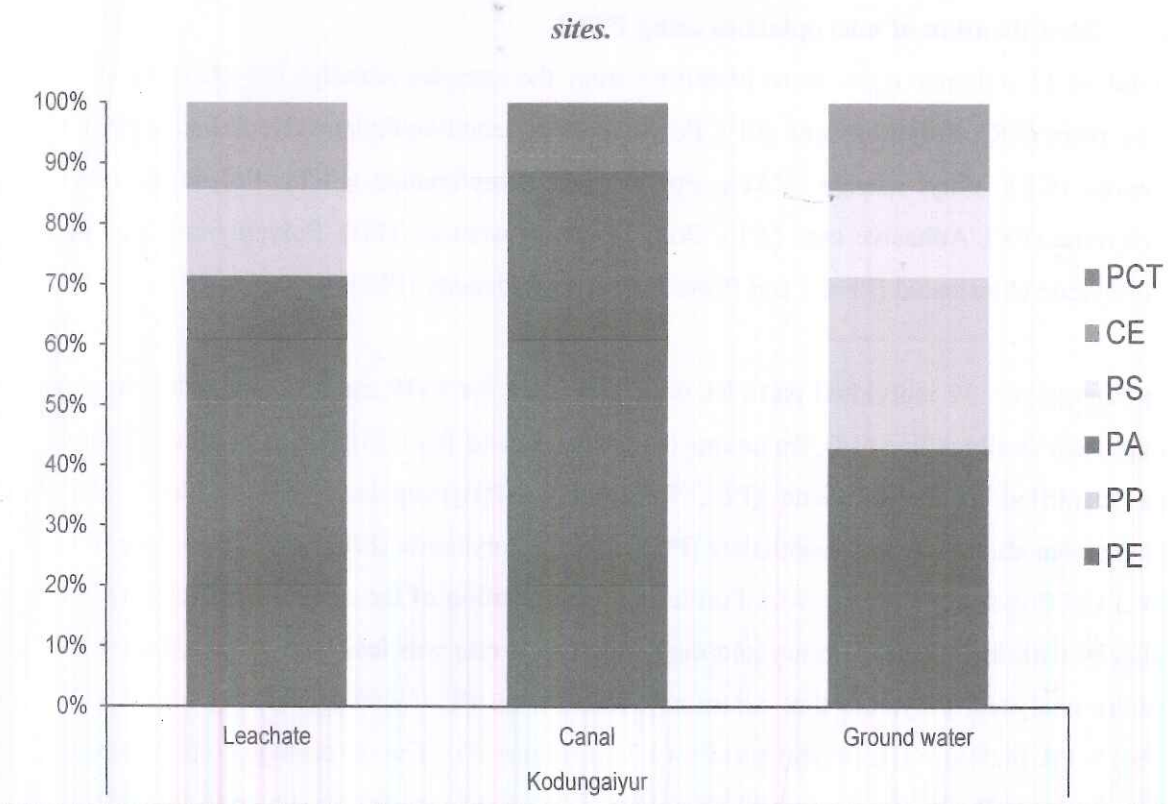
#### 7.4 Identification of microplastics using FTIR

A total of 11 polymer types were identified from the samples namely, Polyethylene (PE), Epoxy resin (ER), Polypropylene (PP), Poly cyclohexylenedimethylene terephthalate (PCT), Cellulose (CE), Vinyl acetate (VAC), Polyethylene terephthalate (PET), Polyamide (PA), Polystyrene (PS), Adhesive tape (AT), Poly(1-butene) isotactic (PB). Polyethylene includes Polyethylene chlorinated (PE-C) and Polyethylene high-density (PEHD).

At Kodungaiyur, 37 individual particles were identified for FTIR analysis under four major classes such as fibres/line (14), fragments (11), film (9) and foam (3). Among them, 16 items were identified as Polyethylene (PE), followed by Polypropylene (PP, 3 Nos.), Poly cyclohexylenedimethylene terephthalate (PCT, 1 No.), Polyamide (PA, 1 No.), Cellulose (CE, 1 No.) and Polystyrene (PS, 1 No.). Further, the composition of the other 14 particles had no similarity with the standard library and the concordance rate was less than 70%. Of the total particles analyzed, polymers that commonly found were PE (69.6%) > PP (13.0%) > PCT (4.3%) > PA (4.3%) > CE (4.3%) and PS (4.3%) (Figure 5). The percentage composition of microplastics in Kodungaiyur dumpsite leachate, canal and groundwater shown in figure 7.



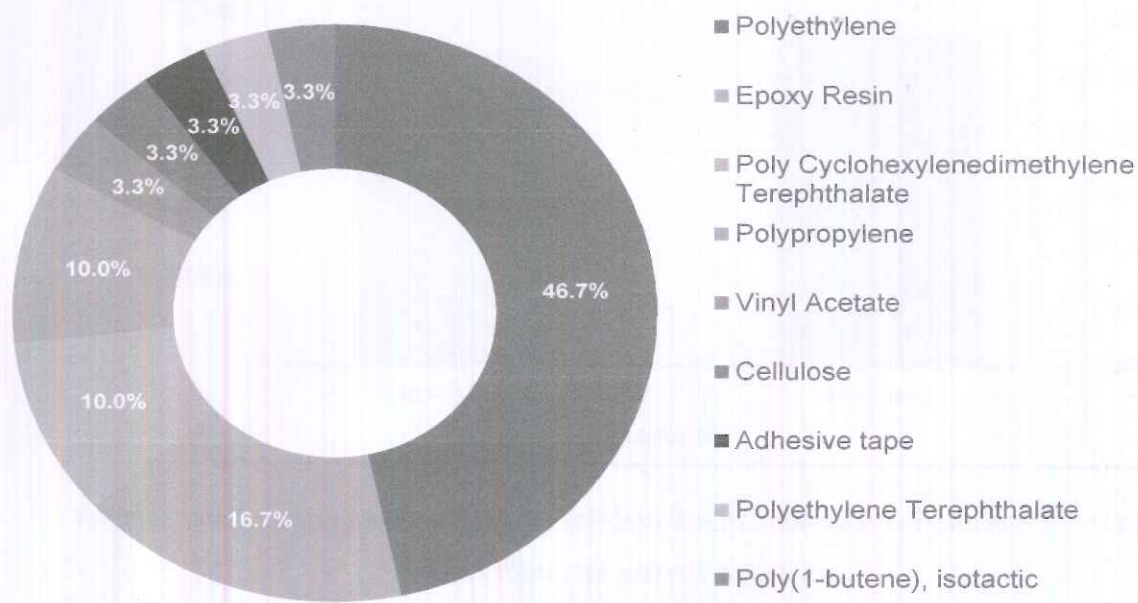
**Figure 5: Chemical composition of microplastics samples collected from Kodungaiyur**



**Figure 6: Percentage composition of microplastics in leachate, canal and groundwater samples around in Kodungaiyur landfill sites.**

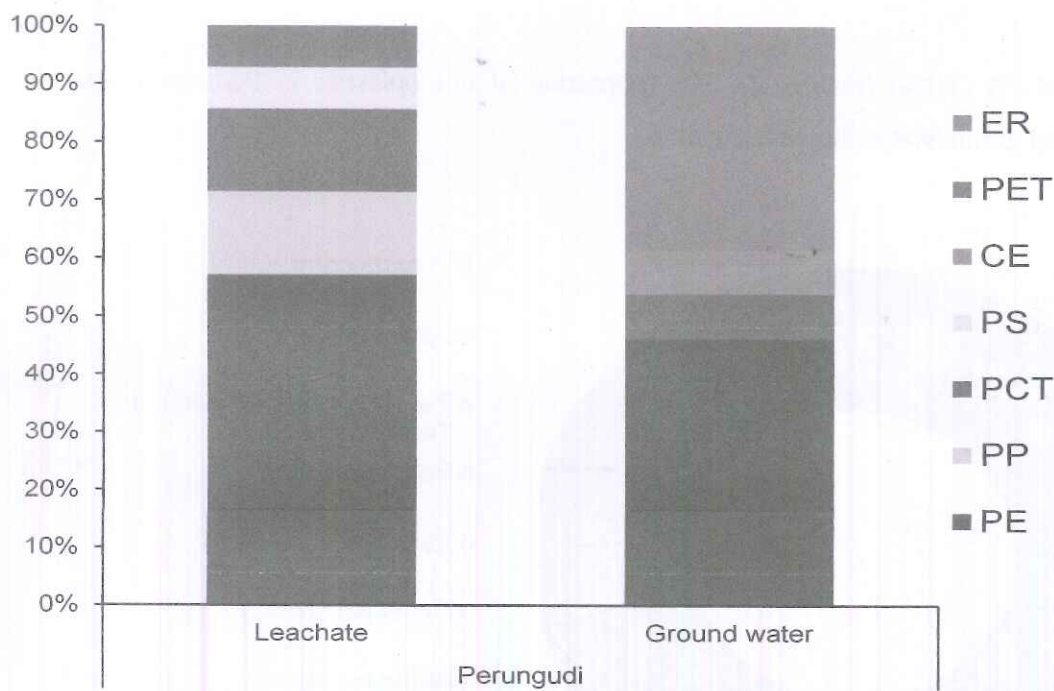
In Perungudi, 51 individual particles were identified for FTIR analysis under four major classes such as fibres/line (23), fragments (12), film (11) and foam (5). Of the 51 particles analyzed, 14 items were identified as Polyethylene (PE), followed by Epoxy resin (ER, 5 Nos.), Poly cyclohexylenedimethylene terephthalate (PCT, 3 Nos.), Polypropylene (PP, 3 Nos.), Vinyl acetate (VAC, 1 No.), Cellulose (CE, 1 No.) and Polystyrene (PS, 1 No.), Polyethylene terephthalate (PET) and Poly (1-butene) and isotactic (PB, 1 No.). Whereas, other 21 particles had no similarity with the standard library and the concordance rate was less than 70%. Of the overall particles analysed, polymers were most frequently found where PE (46.7.6%) > ER (16.7%) > PCT (10.0%) > PP (10.0%) > VAC (3.3%) > CE\_(3.3%) > PS

(3.3%) and PB (3.3%) (Figure. 7). The proportion of microplastics in Perungudi landfill leachate and groundwater shown in figure 8.



**Figure 7: Chemical composition of microplastics samples collected from Perungudi sites.**





*Figure 8: Percentage composition of microplastics in leachate and groundwater samples around in Perungudi landfill sites.*

## 7.5 Microplastics in ambient air

### Spatial distribution of microplastics

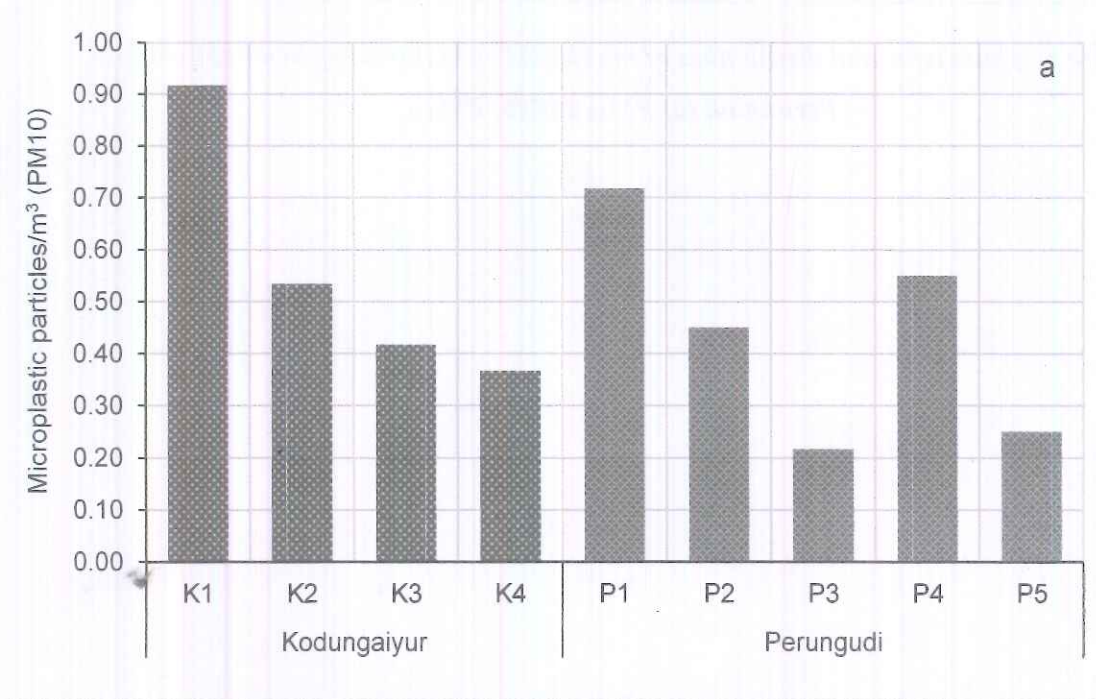
In the Kodungaiyur, microplastics particles in air represented between 0.37 and 0.92 particles/m<sup>3</sup> in PM<sub>10</sub>, while 0.50 and 0.94 particles/m<sup>3</sup> in PM<sub>2.5</sub> with the overall mean of 0.56 particles/m<sup>3</sup> and 0.72 particles/m<sup>3</sup> respectively. The density of microplastics particles in both PM<sub>10</sub> and PM<sub>2.5</sub> was recorded at K1 (AD office TMEB) which is in close proximity to the landfill area, whereas, a considerable reduction in the density of microplastics in air was observed at other locations (Figure 10 a & b).

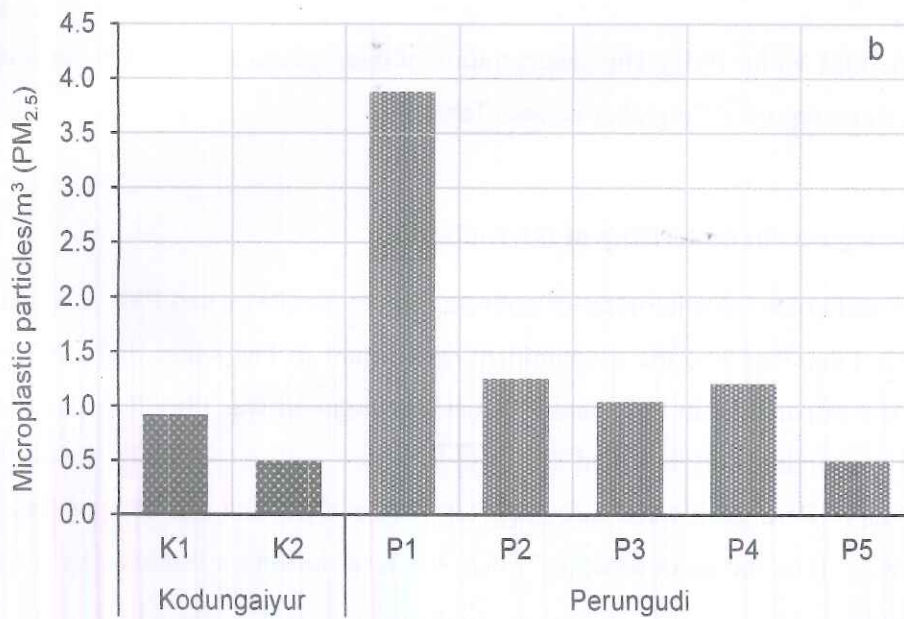
Similarly, the density of microplastics at Perungudi ranged from 0.22 to 0.72 in PM<sub>10</sub> and 0.50 to 3.88 particles/m<sup>3</sup> in PM<sub>2.5</sub> with a mean density of 0.44 particles/m<sup>3</sup> in PM<sub>10</sub> and 1.58 particles/m<sup>3</sup> in PM<sub>2.5</sub> (Figure 10 a & b). The highest level of microplastics was found at P1 (Corp. Admin Office I), whereas the lowest being at P3 (Radial Station III) for PM<sub>10</sub> and P5

(Perungudi CAAQM V) for  $PM_{2.5}$ . The concentration of microplastics in the present study was comparable to those reported for global values (Table 10).

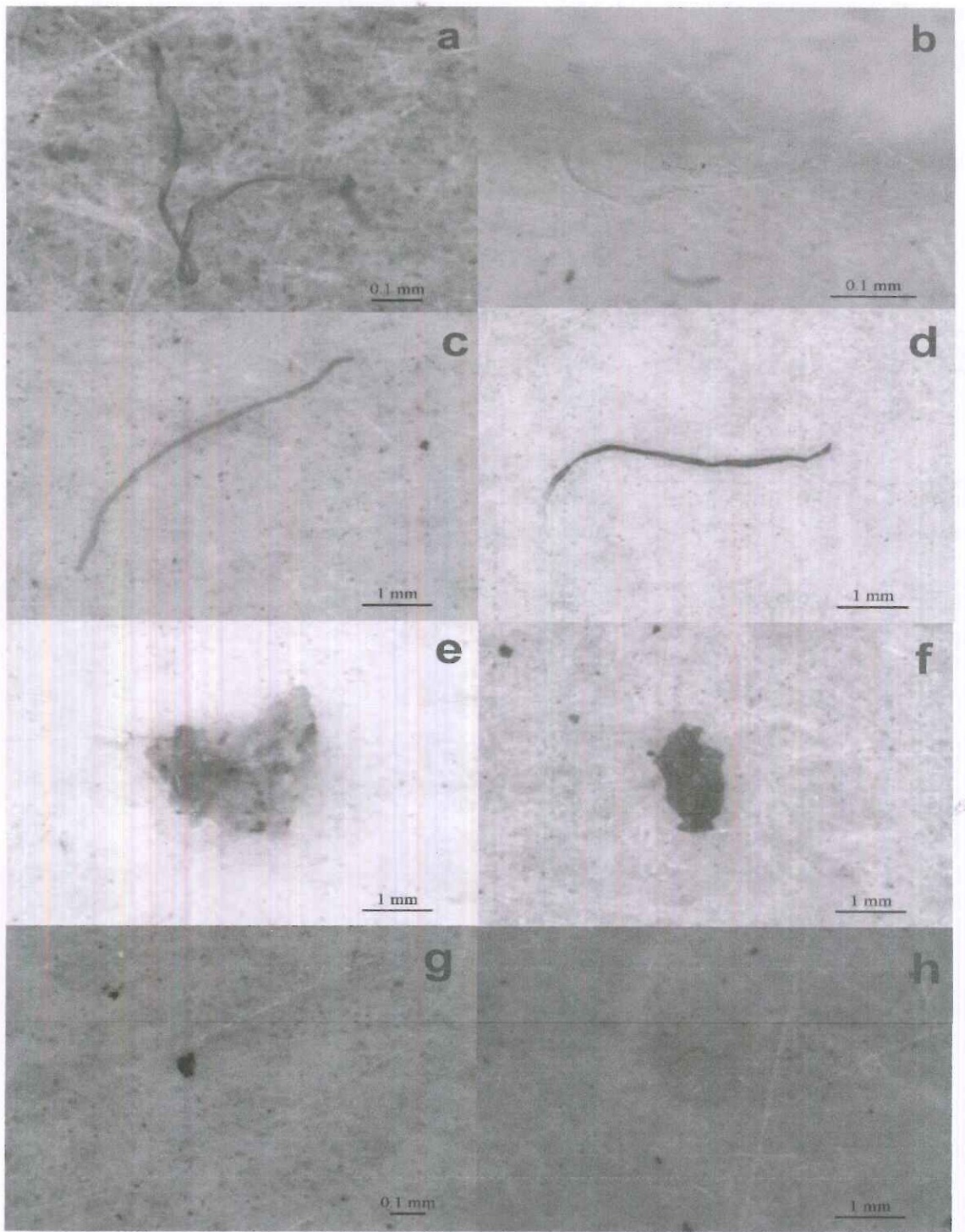
### 7.6. Morphological characteristics of microplastics

Different types and colors of microplastics collected in the air ( $PM_{10}$  and  $PM_{2.5}$ ) is shown in figure 11 & 12. Fiber/line was the predominant type found in  $PM_{10}$  and  $PM_{2.5}$  at both the regions. The type of particles in  $PM_{10}$  and  $PM_{2.5}$  at Kodungaiyur was fiber/line and fragment with the relative abundance of 77% and 23% and 84% and 16% respectively. Similarly, the particles in  $PM_{10}$  of Perungudi were accounted for 72% of fiber/line and 28% of fragments. Whereas in  $PM_{2.5}$ , fibre/line accounted for 71% of the total collection followed by fragments (29%) (Figure 11).





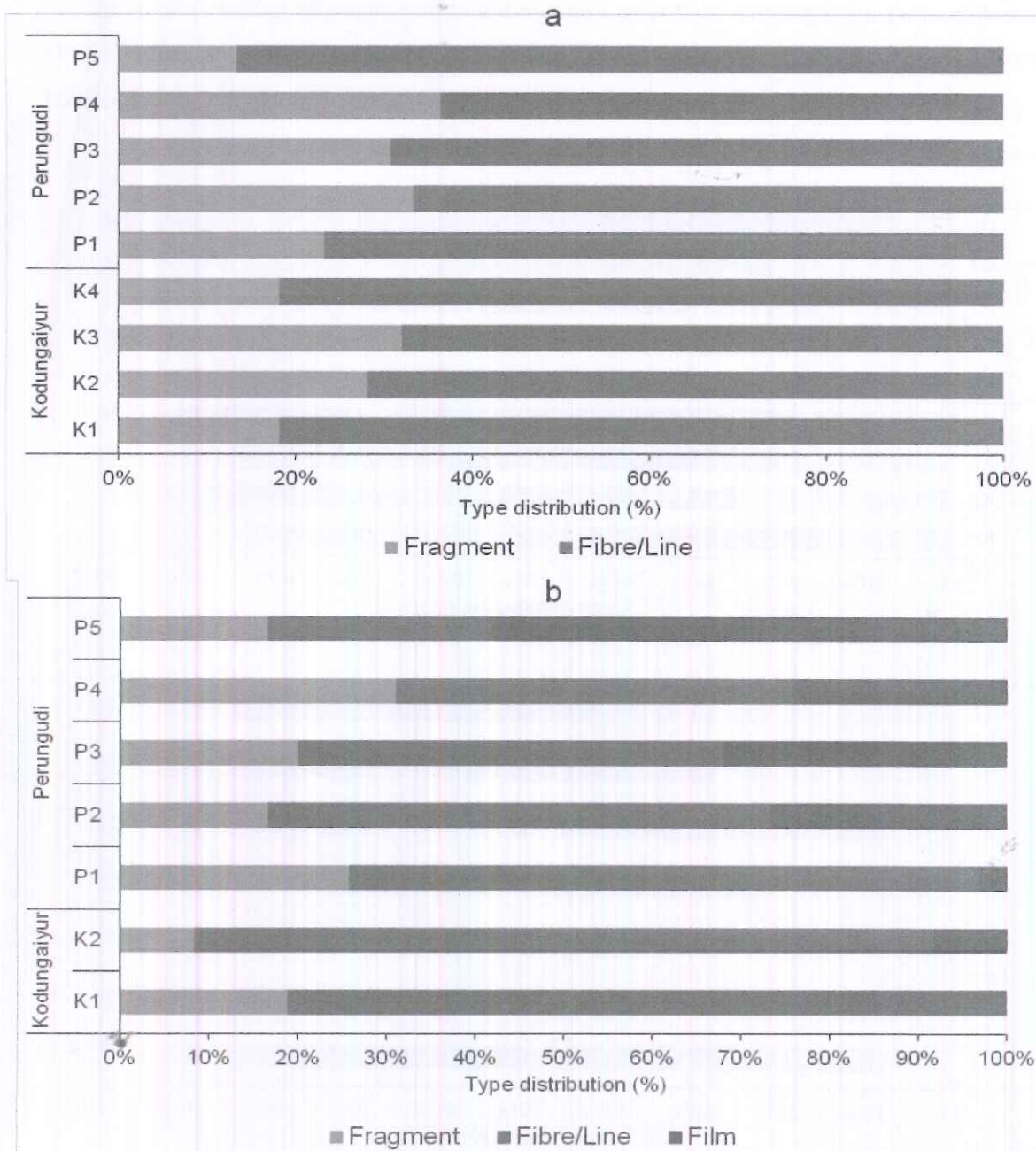
*Figure 9: Abundance and distribution of microplastics in the air of Kodungaiyur and Perungudi (a) PM<sub>10</sub> and (b) PM<sub>2.5</sub>.*



*Figure 10: Micrographs showing different types of microplastics (a-d) fibers/lines and (e-h), fragments.*

**Table 10: Microplastics concentrations detected in the air of Kodungaiyur and Perungudi were compared to global values**

Location	Samples Type	Method	Microplastics conc. (particles/m <sup>3</sup> )	Reference
Shanghai, China	Urban megacity	KB-120F type intelligent middle flow total suspended particulate sampler	0–4.18	Liu et al., 2019a
Paris, France	Indoor and outdoor of Residential area of Paris city	Simple vacuum filtration array	0.3–1.5	Dris et al., 2017
Asaluyeh County, Iran	Industrial area	ECHO PM ambient filter sampler	0.3–1.1	Abbasi et al., 2019
West Pacific Ocean	Coastal area	KB-120F type intelligent middle flow total suspended particulate sampler	0.13 ± 0.24	Liu et al., 2019a
Cal State University, USA	Across 100 km of coastal Southern California, Semi-urbanized landscape	Simple vacuum filtration array	0.7–19.6	Gaston et al., 2020
Kodungaiyur, Chennai, India	Urban area, landfill site	High Volume Air Sampler	0.37–0.92 (PM10) 0.50–0.97 (PM2.5)	Present study
Perungudi, Chennai, India	Urban area, landfill site	High Volume Air Sampler	0.22–0.72 (PM10) 0.50–3.88 (PM2.5)	Present study



**Figure 11: Percentage composition of microplastics types found in the air of Kodungaiyur and Perungudi (a)  $PM_{10}$  and (b)  $PM_{2.5}$ .**

In the case of colored particle, black color was dominant in both  $PM_{10}$  and  $PM_{2.5}$  with the relative contribution of 41% and 37% respectively at Kodungaiyur. The other colors in the order of abundance includes white (18%), yellow (16%), blue (14%), red (10%) and green

(1%) in  $PM_{10}$  and blue (21%), yellow (18%), red (15%) and white (9%) in  $PM_{2.5}$ . Similarly, the colors of air microplastics in  $PM_{10}$  at Perungudi was dominated by yellow, accounting for 31% followed by black (26%), white (24%), blue (12%), red (4%), green (2%) and violet (1) (Fig. 4). Whereas in  $PM_{2.5}$  the dominant colors of microplastics was black (24%) followed by white (23%), yellow (21%), blue (18%), red (7%) and green (7%) (Figure 12).

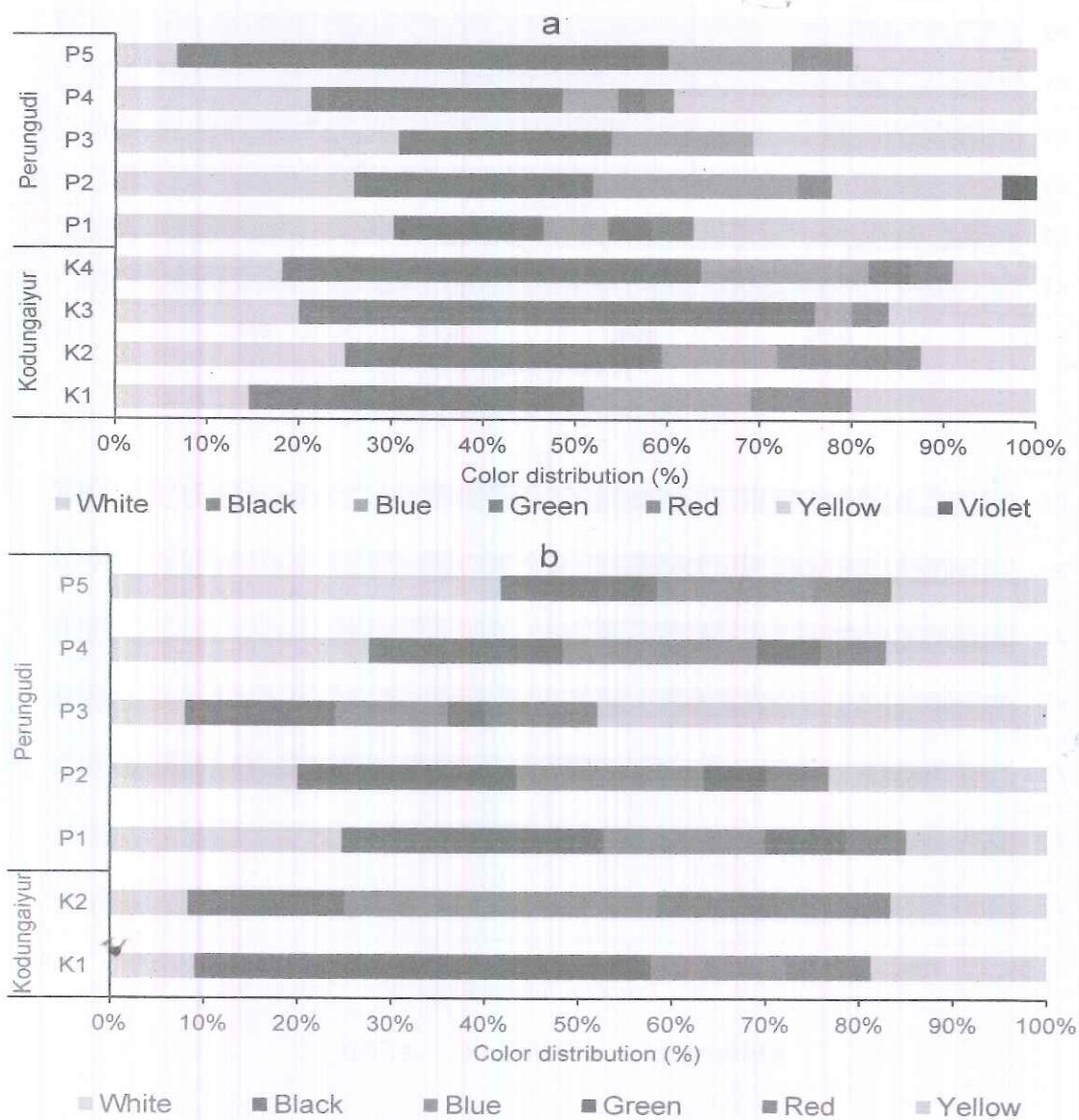


Figure 12. Percentage composition of microplastics colors found in the air of Kodungaiyur and Perungudi (a)  $PM_{10}$  and (b)  $PM_{2.5}$ .

## 9.0 Conclusions

- i. GCC is not complying with the Solid Waste Management Rules, 2016 w.r.t. segregation, processing, disposal, leachate management and bio-remediation of legacy waste.
- ii. Presently 4500-4800 TPD of fresh unsegregated solid waste is being dumped in two dumpsites (Kodungaiyur & Perungudi). GCC has not commenced the bio-mining/remediation of legacy waste at these dumpsites. However, in Perungudi dumpsites, the erection of machineries was under process for bio-mining.
- iii. High value of COD (200-2500 mg/l), BOD (39-800 mg/l) & TDS (5000-25000 mg/l) reported in ground water samples collected from dumpsites confirms the pollution caused by dumpsites and also improper management of leachate generated from these dumpsites.
- iv. Reported values of micro-plastics in leachate, ground water and ambient air are less as compared to those reported in similar samples in other countries (China, Iceland, Finland etc.)
- v. The density of microplastics in the leachate, canal and ground water ranged between 0.75 and 32.0 particles/L. The maximum density was found in the leachates, invariably at both the sites.
- vi. White colored particles were predominant in both Kodungaiyur and Perungudi waters with 47.1% and 44.2% respectively.
- vii. A total of 11 polymer types were identified from the samples. At Kodungaiyur, 16 items were identified as Polyethylene (PE), followed by Polypropylene (PP, 3 Nos.), Poly cyclohexylenedimethylene terephthalate (PCT, 1 No.), Polyamide (PA, 1 No.), Cellulose (CE, 1 No.) and Polystyrene (PS, 1 No.).
- viii. In Perungudi, 14 items were identified as Polyethylene (PE), followed by Epoxy resin (ER, 5 Nos.), Poly cyclohexylenedimethylene terephthalate (PCT, 3 Nos.), Polypropylene (PP, 3 Nos.), Vinyl acetate (VAC, 1 No.), Cellulose (CE, 1 No.) and Polystyrene (PS, 1 No.), Polyethylene terephthalate (PET) and Poly (1-butene) and isotactic (PB, 1 No.).



- ix. An average of 0.56 particles/m<sup>3</sup> and 0.72 particles/m<sup>3</sup> of microplastics were recorded from PM<sub>10</sub> and PM<sub>2.5</sub> at Kodungaiyur. Similarly, a mean density of 0.44 particles/m<sup>3</sup> in PM<sub>10</sub> and 1.58 particles/m<sup>3</sup> in PM<sub>2.5</sub> at Perungudi.
- x. Black color was predominant in both PM<sub>10</sub> and PM<sub>2.5</sub> with the relative contribution of 41% and 37% respectively at Kodungaiyur. Whereas Yellow and black colored particles were dominant in PM<sub>10</sub> and PM<sub>2.5</sub> of Perungudi respectively.
- xi. The assessment of damage to environment in monetary terms and the cost of restoration can be assigned to NEERI or any other expert agencies.

### **10.0 Recommendations**

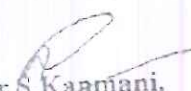
Greater Chennai Corporation may be directed with following points for compliance of Solid Waste Management Rules, 2016:


1. GCC shall comply with Solid Waste Management Rules, 2016 w.r.t segregation, processing, leachate management and bio-mining /bio-remediation of the legacy waste.
2. To stop further dumping of unsegregated fresh solid waste on top of legacy waste and process the entire solid waste generated.
3. To initiate immediate necessary action to collect the leachate generated from the dumpsite and to treat in Leachate treatment plant. To ensure that no treated/untreated leachate reaches the nearby water bodies.
4. GCC shall expedite the process of bio-remediation of legacy waste in both dumpsites as per the CPCB guidelines and complete within shortest possible time (within one year).
5. Since the dumpsites are been operated from past 35 years in unscientific method, assessment of dumpsites w.r.t ground water, soil is required before utilizing the site.
6. Since the analysis results confirms the pollution of ground water and air in both dumpsites and also presence of microplastics in air and ground water around the dumpsites, the committee felt the assessment of damage to environment in monetary

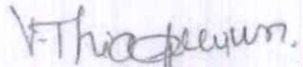
terms and the cost of restoration can be assigned to NEERI or any other expert agencies.

TNPCB shall be directed with following:

1. To ensure that bio-mining/bio-remediation of legacy waste at two dumpsites are carried out as per the CPCB guidelines and to evaluate the works regularly.
2. To initiate necessary action against GCC for non-compliance of Solid Waste Management Rules, 2016.

  
Dr. S. Kanniani,  
Director  
Centre for Environmental  
Studies  
Anna University, Chennai

  
Smt. Poornima B. M  
Scientist 'D'  
CPCB  
Regional Directorate - Chennai

  
Thiru. V. Thyagarajan  
Deputy Director (Labs)  
TNPCB, Chennai

**BEFORE THE NATIONAL GREEN  
TRIBUNAL SOUTHERN BENCH,  
CHENNAI.**

**Original Application No. 99 of  
2021(SZ)**

Suo Motu based on the News item in the Times of India Newspaper Chennai edition dated 5.4.2021 under the caption "Chennai you are breathing micro plastic"

Vs

The Chief Secretary to Government  
Tamil Nadu, Chennai and Ors

...Respondents

**Report of the Joint Committee in the matter of O.A.No.99 of 2021 in Suo Motu registered on the basis of news paper report published in " The Times of India Chennai Edition" dated 05.04.2021 under caption "Chennai you are breathing micro plastic".**

**Advocate for Respondent: TNPCB  
Thiru. S. Sai Sathya Jith,  
Advocate, Chennai.**

**Date:31.03.2022**

**Hearing date on 28.04.2022**