

# Evidences of Microplastic in Air and Street Dust: A Case Study of Varanasi City, India

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## Research Article

**Keywords:** Air pollution, FTIR, Microplastics, Particulate matter, Polymer, Street dust

**Posted Date:** January 12th, 2022

**DOI:** <https://doi.org/10.21203/rs.3.rs-1151250/v1>

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# Abstract

Microplastics (MPs) are ubiquitous in our environment. Its presence in air, water and soil makes it a serious threat to living organisms. The present study aimed to assess the availability of MPs in air and street dust of a metropolitan city Varanasi, India. Suspended dust samples and street dust samples were collected from various sampling sites. The assessment of MPs was conducted by for physical identification binocular microscopy, fluorescence microscopy and Scanning Electron Microscopy (SEM), while elemental analysis done by Energy Dispersive X-Ray Analysis (EDX). and finally, Fourier-transform infrared spectroscopy (FTIR) was used for functional group analysis. the presence of MPs in both suspended dust and street dust samples of all selected sampling sites was confirmed by results. MPs of different color with the shape of Fragments, Films, Spherules and Fibers were observed in the study. However, most of the MPs were less than 1mm in size. The MPs identified in our study were majorly polypropylene, polystyrene, polyethylene, polyethylene terephthalate, polyester, and polyvinyl chloride. EDX analysis showed presence of trace elements like aluminum, cadmium, magnesium, sodium, and silicon apart from carbon and oxygen, which indicates the presence of additives or adsorption capacity of MPs. Confirmation of MPs in the air of a locality of Varanasi explains the need of deep research in this concerned field to protect our future from negative impacts of breathing MPs.

## Introduction

Microplastics (MPs) are the emerging contaminant of the environment, ubiquitous in air, water and soil. Since last decade, the research in the field of MPs has gained momentum. Mostly the studies are conducted for the availability of MPs in the water but rarely for the air medium(Dris et al. 2016). Few studies have documented the existence of MPs in the both indoor and outdoor air (Abbasi et al. 2019, Akhbarizadeh et al. 2021, Cai et al. 2017, Dris et al. 2016, Enyoh et al. 2019, Liu et al. 2019). Synthetic fabrics, abrasion from synthetic rubber tires, erosion, and dust from city and household areas are the most common sources of MPs in the air (Prata 2018). According to estimates, a single item of clothing might release up to 2000 fibers per wash(Browne et al. 2011). Other major sources of airborne MPs may include construction and waste incineration sites, roadway particles, landfilling areas and industrial outflows, particle re-suspension, synthetic particles such as polystyrene peat (used in horticultural soils), sewage sludge (used as a fertilizer), and exhaust from tumble dryer (Dris et al. 2016, Prata 2018). Anthropogenic activities always influence the abundance of MPs in air (Abbasi et al. 2019). The study conducted by Dris et al. (Dris et al. 2016) at urban and suburban site of the Paris Megacity, observed fibers in the most of atmospheric fallout. Another study by Zhou et al. (Zhou et al. 2017) detected airborne MPs including fibers, fragments, films, and foams of different colors in a coastal city Yantai, of Shandong Province (Zhou et al. 2017). Similarly, Liu et al. (2019) studied the airborne MPs in Shanghai city and the analysis showed fibers (67%) as the dominating shape, followed by fragments (30%) and granules (3%), respectively (Liu et al. 2019). Another study by Catarino et al. (2018) studied household fibers fallout during a meal in Edinburg, UK. They found Fiber sizes of < 500 µm made of PET and PUR in

their study(Catarino et al. 2018). Studies clearly shows that the problem of presence of MPs in our surrounding is a big issue.

Many researches also tried to quantify the reach and impacts of MPs. Fine MPs present in air can easily pass through our respiratory system and reach deep in the bronchioles. Pauly et al. (1998) got fibers of up to 250µm in the deep part of the lung in their study(Pauly et al. 1998). But still potential risk of ingested airborne MPs to human organ is not known completely till date but it is assumed that the risk associated with it depends on many factors like particle size, adsorbed chemical, concentration, deposition and clearance rate (Teuten et al. 2007, Teuten et al. 2009). Mainly, ability of MPs to absorb toxic chemicals on their surface because of their large surface area and hydrophobic property make them chemical toxic. Pollutants like heavy metals(Kumari et al. 2021, Li et al. 2013, Mohanraj et al. 2004) and polycyclic aromatic hydrocarbons (Akhbarizadeh et al. 2021) got detected in atmospheric particulate matters. Microplastics can also act as a medium to carry pathogens or microorganisms to lungs and possibly result in an infection to the humans (Prata 2018). Adsorbed microbial biofilm on MPs could also be responsible to adsorb and transport heavy metals with it as it assists as chelating agents for metals (Verla et al. 2019). Considering all the reviews, our study was designed with the objective to identify and classify microplastic in atmospheric air and dust over Varanasi region.

## Material And Methods

### Study area

Atmospheric suspended particulate matter and street dust samples were collected from some selected sites of Varanasi city, India (Fig. 1). The city of Varanasi is situated on the Indo-Gangetic plains of North India and has a population of 1,198,491 and an area of 112.26 km<sup>2</sup>. The present study was conducted in June, 2019 and September, 2019.

For suspended dust samples, Site (S1), Banaras Hindu University (Institute of Environment and Sustainable Development, 25.2677°N, 82.9913°E), was chosen. It is an institutional setting surrounded by a typical mixed urban environment characterized by congested roads and a variety of commercial and residential activities. For street dust samples, six specific sites (S2, S3, S4, S5, S6, and S7). were selected representing the urban environment within Varanasi (25°19'0.05"N, 83°0'3748"E). The details of the sampling sites are given below in the Fig. 1 **and** Table 1 respectively.

Table 1  
Details of the sampling sites for MPs study.

Site no.	Sampling sites	Latitude	Longitude
S1	Institute of environment and sustainable development (BHU)	25°15'44"N	82°59'41"E
S2	Swatantrata Bhawan (BHU)	25°15'39"N	82°59'38"E
S3	Sear Govardhan, Dafi	25°15'27"N	82°59'48"E
S4	School of Biochemical engineering (BHU)	25°15'29"N	82°59'40"E
S5	Sir Sunderlal hospital (BHU)	25°16'41"N	82°59'52"E
S6	Lanka	25°16'51"N	83°00'10"E
S7	Durgakund	25°17'14"N	82°59'58"E

## Sampling

All the samples were collected during the dry season, June and September, 2019 from the selected sites. Different methodology was opted to conduct sampling for street dust and suspended particles.

### Street dust samples

Approximately 50g of street dust was collected from all the six selected urban sites (S2 to S7) within Varanasi from the road surface neighboring to the kerb of the two sides of the road. Many authors have used this method for street dust sampling (Abbasi et al. 2017, Abbasi et al. 2019). To minimize plastic contamination, a local anti-static wooden brush and a metal pan was used to gently sweep the material straight into an airtight bag made of low-density polyethylene (PE) which was rinsed with Milli-Q water and dried between subsequent samplings. All collected samples of street dust were then brought to the laboratory and unnecessary material such as gravels, leaves, small pieces of bricks and concrete etc., were removed from the samples. Then each sample was sieved using a 5-mm sieve and all particles collected on 5mm sieve also discarded. To remove mistakes caused by lingering particles on the road surface and particle disruption in the ambient air during the sweeping process, the MPs concentration was given as the number of MPs debris per 15g mass of dust rather than the number of MPs per sq. meter of street dust (Dehghani et al. 2017).

### Atmospheric suspended dust

Over the roof of IESD-BHU, particulate matter (PM<sub>10</sub>) samples were collected on 10x8 inch glass fiber filters (GF/A Whatman) with the help of respirable dust sampler (APM-BL 460, Envirotech) that isolates aerodynamic dust particles of desired aerodynamic diameters ( $\leq 10$  micron) at an average flow rate of 1.2 m<sup>3</sup>/minute. Before and after sampling, all filters were desiccated for 24 hours. To avoid local disturbances like, from automobiles, the high-volume sampler was installed at a height of 7.5 meter.

Following filtering, filters were carefully removed from the sampler and quickly transferred to clean air-tight, LDPE bags using stainless steel tweezers and were brought to the laboratory for MPs extraction. The desiccated filter papers were weighted using electronic microbalance with 0.01 mg resolution. The difference among the initial weight and final weight of the filters was used to compute the aerosol mass ( $\text{g}/\text{m}^3$ ), and then the concentration was estimated by dividing the aerosol mass by the total volume of air ( $\text{m}^3$ ).

## **Extraction of MPs from street dust and air-suspended dust**

The reagents used for this study were- 30% hydrogen peroxide and  $\text{ZnCl}_2$  provided from thermo fisher scientific India Pvt. Ltd., and de-ionized water (Milli-Q) were used throughout all the experiments.

### **For street dust samples:**

Each sample taken from different sites was air-dried for 7 days and then filtered using a stainless steel 5mm sieve to separate larger size debris such as rocks and other biological materials or vegetation. To eliminate organic matter, 15 g sample of street dust was treated with 35 ml of hydrogen peroxide (30%) for 810 days (until no bubbles were formed)(Abbasi et al. 2017, Abbasi et al. 2019). To avoid MPs loss because of the intense reaction that occurs after 20 min of adding hydrogen peroxide, 500 ml glass beaker was used. After digestion process, the content was filtered through Whatman filter paper (Whatman grade 42, diameter 42.5 mm, pore size 2.5 micron) and has been washed using Milli-Q water to collect all particles which has been stucked to the beaker wall and to eliminate remaining hydrogen peroxide on the dust particles. After that, the samples were dried for 24 hours in an oven at 50 degrees (Dehghani et al. 2017).

### **For Suspended dusts:**

Each sample collected on the filter paper was carefully removed and kept in the air-tight low density PE bag and brought to the laboratory for further experiment. The contents of the filter paper were washed with filtered deionized water afterwards cautiously transferred to a clean beaker as much as possible using a clean metal spatula. Then, the content was kept in the oven at 70-80 degree Celsius for drying completely. After the content was completely dried, it was transferred to another beaker and then 35 ml of  $\text{H}_2\text{O}_2$  was added and is kept for approximately 8-10 days until the air bubbles coming out from the beaker stops (Abbasi et al. 2017, Abbasi et al. 2019). This was done to remove all the organic matter or biogenic matter present in the samples. Then, the content was filtered out on Whatman filter paper (Whatman 42, 2.5 $\mu\text{m}$  pore size). After filtration washed with Milli-Q water to remove the remaining hydrogen peroxide adhered to the sample and to transfer all the MPs from the beaker and again kept at 50 degree for 24 hours for drying.

## **Microplastic separation**

A Zinc chloride ( $\text{ZnCl}_2$ ) solution of density  $1.6 \text{ g}/\text{cm}^3$  was prepared and 100 ml of this solution was mixed with each sample and the content was shaken at 350 rpm for 5 min and left to settle approx. 1 to 2

hours. The supernatant was then centrifuged at 4000 rpm for 4 minutes and then vacuum filtered through a cellulose nitrate filter (Axiva SicheM Pvt. Ltd., pore size 0.45 µm). The filtered contents were then washed with Milli-Q water to restrict the formation of ZnCl<sub>2</sub> crystals. Density separation, centrifugation, and filtration processes were repeated three times on the same filter paper to capture all MP. These filter papers were dried for few days at room temperature until it completely dried and then transferred to a petri dish.

## **Microplastics identification**

For identification of MPs on the filters from the street dust samples and suspended particulate matter, fluorescence microscopy, binocular microscopy, SEM, EDX and FTIR analysis were performed.

### **Binocular Microscopy**

MPs were observed and identified on the basis of visual characteristics mainly shape, color and size using Binocular microscope. Apart from this, particles were identified as MPs considering certain criteria described by (Chubarenko et al. 2018) like:

1. There should be no evidence of cellular or biological structure.
2. Fibers should be uniformly thick along their length and not tapering at the end.
3. Colored particles must be uniform in color.
4. Fibers should not be segmented and should not look as twisted flat ribbons.

In this study, a binocular microscope (Catscope) was used to identify and separate MPs on filter paper from road and aerial dust samples, and images were taken with a digital camera (Catymage) equipped with a microscope.

### **Fluorescence microscopy**

During the different process of synthetic textile and plastic industries a wide range of dyes, fluorescent pigments, optical brightening and whitening chemicals are used (Christie 1994). Hence, fluorescence microscopy was used for identification of the extracted MPs using fluorescence microscope (Nikon eclipse 90i) with x100 magnification under ultra violet filter. The corresponding images were taken with the Nikon digital camera which was equipped with the fluorescence microscopy (Dehghani et al. 2017).

### **SEM-EDX analysis**

The morphological characteristics and elemental content of MPs were investigated using SEM-EDX. The selected samples were prepared on double sided carbon conductive tape and were fixed on a 10mm diameter SEM stub and were analyzed under an accelerating voltage(Dehghani et al. 2017). These samples were also examined for their compositional characteristics using an EDX detector. In this study,

ZEISS EVO 18 scanning electron microscope was used for better and clearer morphological characteristics.

## **FTIR analysis**

FTIR is widely used analytical approach to identify MPs samples. We have also used FTIR for the analysis of our desired samples. FTIR spectroscopy method has a long history of use in the investigation and characterization of synthetic polymers and their products. The vibrations of a sample's molecules are stimulated and detected by vibrational spectroscopy, resulting in unique spectrum fingerprints in the FTIR. Which helps in characterization on the basis of comparison of polymeric chemical structure with known reference spectra. Here, in our study, PerkinElmer Spectrum version 10.4.3 was used for sample analysis and a free software named essential FTIR software was used for comparison of the unknown FTIR spectra. During FTIR spectroscopy the sample was treated with Infrared light (wavenumber range 400-4000  $\text{cm}^{-1}$  for Mid-IR). A part of this Infrared radiation is absorbed by the sample and finally measured in transmission or reflection mode.

## **Quality control and assurance of experiment**

All equipment and glassware were pre-cleaned with milli-Q and distilled water to prevent the contamination of external plastic/fiber with the required test setup throughout the test. All the chemicals and the reagents used were also filtered through the Whatman 42. Working areas were carefully wiped with ethanol, and closed environment was maintained by closing windows and door shut, as much as possible. Single use non-latex nitrile gloves were used and samples or the containers were also covered with aluminum foil to avoid any contamination. Also, blank was run throughout the experimental period to observe any contamination of MPs presence from surrounding environment or from the apparatus used, and the same procedure of double filtration was followed as for the samples analyzed. The resulting filter paper obtained after was also observed under the microscope revealed that there was no detectable MPs contamination during the analysis.

## **Results And Discussion**

### **Presence of Microplastics in Varanasi**

MPs were found in the samples of street dust at all the sites of Varanasi and also in all the replicates of suspended dust samples at IESD-BHU. These MPs were of different size, shape and color. The observed color of the Microplastics were Pink, yellow, green and red etc., and very few transparent MPs were observed. At all sites the presence of MPs was observed indicating the contamination of lower atmospheric environment with MPs.

### **Visual Identification of Microplastics**

#### ***Binocular microscopy***

From the experimental observation, varieties of MPs in the atmosphere were found which were of different size, shapes and colors. This study recorded fibers and fragments as the dominant type of MPs. Fig. 2 and Fig. 3 exemplifies the types of few MPs that were commonly observed in the present study by Binocular Microscopy. Fragmented MPs were the dominant type of MPs followed by the fiber in the overall study. Another study from India found that fibers were the most common form in roadside suspended dust from Nagpur's urban and rural environments(Narmadha et al. 2020). Contrary to our results, Dris et al.,2016 reported fibers as the major component of atmospheric fallout in Paris metropolis at two different urban and suburban sites(Dris et al. 2016). Similar observation was also noticed by Cai et al., 2017 while analyzing MPs in the atmospheric fallout from Dongguan city(Cai et al. 2017).

On analyzing the suspended dust samples at IESD-BHU, commonly observed particles were fragmented, film & fibers (Fig. 2). Such results were also noticed by Akhbarizadeh et al., 2021, while analyzing the dust of an urban area of Bushehr port, in the northern part of the Persian Gulf(Akhbarizadeh et al. 2021). Similarly, Liu et al.,2019 found microfibers, fragments and granules type of MPs in the suspended atmospheric air of Shanghai(Liu et al. 2019).

In the samples of MPs extracted from the street dust from the different locations of Varanasi, fibers of different color and different shapes, i.e., fibrous, fragmented and Film-like MPs were observed (Fig. 3). In another study from Chennai, India, mostly fragments and fibers were resulted from the street dust samples (Patchaiyappan et al. 2021). Similarly in Iran the street dust samples of city and county of Asaluyeh, MPs of fibers, fragments, spherules and films were noticed (Abbasi et al. 2019). The source of MPs in the atmosphere and street dust maybe indicated based on the morphological characteristics of MPs. The major source of fibers is clothes and textiles, while films/fragments results from disposable plastic bags and thicker plastic products(Browne et al. 2011). Dust emission from the land surface might be the probable source of MPs in the suspended atmosphere. Thus, dust emission and deposition between land surface, atmosphere and aquatic environment were related with the transportation of MPs(Cai et al. 2017).

### ***Fluorescence Microscopy***

Fluorescence Microscopy confirmed the presence of MPs. In fluorescence, the MPs mainly absorb UV light at 300-400 nm and radiate Blue (450-480 nm) or Purple (400-450 nm) fluorescence(Lei et al. 2006). Most of the visible particles include fragments and fibers which give fluorescence, followed by rare films, spherules, and pellets as shown in the pictures of various MPs shown in Fig. 4 and Fig. 5 In Fig. 4, MPs from the atmospheric fallout has been shown while, Fig. 5 shows the MPs obtained from the street dust. Fluorescence particles were detected in all samples but the number varies sample by sample and also according to the area of selection of samples. Abbasi et al.,2017 also used technique of fluorescence microscopy to identify the presence of MPs in the street dust samples of Bushehr city, Iran (Abbasi et al. 2017).

### **Morphology and elemental analysis**

SEM-EDS is considered as a significant technique for assessment of the surface morphology and composition of MPs (Rocha-Santos & Duarte 2015). Therefore, this technique is better for obtaining a high-resolution image of the surface properties of the selected MP, with qualitative information and results of the elemental composition shown in Fig. 6.

The image shows a fairly smooth surface without cracks. It also shows the mark of mechanical and chemical weathering as flaking, pits, grooves and jagged edges. The elemental result is that MP is composed primarily of carbon and oxygen (and Nitrogen for Spherules), the presence of other elements may reflect the contamination by foreign solids, chemicals, dust and soil (Al, Ca, Si and Mg) or materials used for sample preparation (Zn & Cl). These elements are indicating additives used in plastic polymers or adsorbed content on the MPs surface. Various types of complex combinations of elements are used to provide special feature to polymers. For example, antioxidants like Ca, Al, Mg, Na & Si are used in most of the hydrocarbon polymers (eg. PE, PP, and PS etc.) to weigh down the oxidation cycle. The results of SEM-EDX spectra indicated the presence of elements like C, O, Si, Ca, Mg, Al, S, Na, Fe & K. In EDX report Si-rich large particles indicate their geologic origin, while rough surfaced particles could be associated to originate from vehicular emission.

In present study, major particles were weathered in street dust samples and Al and Si were the most common elements identified which may be possibly originate from nearby soil ground. However, Ca and Mg majorly found to attached with rough surfaced tiny particles shown in (Fig. 6(e)), due to presence of MRs & anthropogenic particles sticking to dust. Presence of MRs in street dust samples indicate that street dusts are mostly affected by release of MRs from abrasion of automobiles while suspended dust is not.

## Chemical composition

The chemical composition suspected MPs collected from atmospheric fallout in the samples taken, were recognized by  $\mu$ -FTIR. The polymers which are reported from  $\mu$ -FTIR are generally Polypropylene, Polystyrene (PS), PE, Polyethylene Terephthalate or polyester and polyvinylchloride etc. The spectrum range for these polymers of MPs ranges from  $400\text{ cm}^{-1}$  to  $4000\text{ cm}^{-1}$ . Narmadha et al., 2020 investigated roadside suspended dust from urban and rural areas in Nagpur, India, and found low-density polyethylene (LDPE), rubber fiber, rayon, PS, polyolefin, polyaniline, and chlorinated polyvinyl chloride in the region (Narmadha et al. 2020). Likewise, polypropylene, PS, and PE were the major MPs analyzed in Dongguan City Air Fallout (Cai et al. 2017). Liu et al., reported that in Shanghai, suspended atmospheric microplastics included PET, PE, PS, rayon, polyacrylonitrile, ethylene vinyl acetate, poly(N-methylacrylamide), alkyd and epoxy resin (Liu et al. 2019).

The spectra of the selected samples are shown in the given Fig. 7. Using IR spectrum, (Fig. 7a, b, and c) sample 1, 2 & 3 obtained from street dust of Sir Sunderlal hospital backyard, chemical engineering department and Durgakund respectively, could be classified as a synthetic of a common PE. The function PE absorbance bands are positioned at  $2914$ ,  $2847$ ,  $1470$  &  $718\text{ cm}^{-1}$ . The wide band around  $1000\text{ cm}^{-1}$

possibly detected because of inorganic impurity (presumably a silicate) on the particle surface. The typical PE bands at 1034, 1100, 1449, 2852 & 2920 $\text{cm}^{-1}$  were clearly seen. Further bands especially at 530, 690, 1385 & 1460 $\text{cm}^{-1}$ , not existing in pure PE, were also visible. Also, in the atmospheric suspended dust (Fig. 8), spectra of the sample show almost the same trend and peaks, thus it is also classified as PE.

## **Conclusion And Future Insight**

Plastic particles became commonly found in abundance in our surroundings still less understood and investigated in urban suspended and settled dust. In the current study, presence of MPs in Street and suspended dust of Varanasi was investigated. It is clear that MPs deposited and in the air are potentially important pollutants in urban environments. This study shows that road dust and airborne dust from all sampling points contain MPs of numerous shapes and colors, and most MPs are less than 1 mm in size. Mostly found particles were particles of fibers, spherules, fragments, and films of different color and size that may come from domestic, vehicular and other commercial sources. The MPs found were dominated by fragmented and fibrous shape MPs followed by spherules and films. The observed color of the MPs was Pink, yellow, green and red etc., and very few transparent MPs was observed, this may be due to the reason that transparent MPs are not easily visible or identified. It has also been observed that MPs gives fluorescence under blue filter. SEM images showed that grooves, pits and fractures were the common pattern of degradation in MPs particles. The EDX analysis has proved that all the MPs are made up of carbon and oxygen majorly and in trace amount Al, Ca, Mg, Na and Si. These elements indicate presence of additives or adsorbed debris on the MPs surface. The identification of MPs using FTIR has been performed for some samples and their spectra reveals the presence of PE with the characteristic peak resemblance with the PE. Majorly detected PE, could be due to the widespread use various PE made items such as toys, milk and shampoo bottles, pipes, packaging films, grocery bags and other bags in our day-to-day life. A better and accurate result can be found on more analysis of samples with pyrolysis GC-MS technique for their more accurate quantification and identification of types of MPs is in progress. Zinc Chloride was used throughout the experiment for MPs extraction since its high density helped to obtain maximum MPs from samples. A further detailed study is required of the street dust and atmospheric suspended dust for a long duration in Varanasi city. Identification and quantification of atmospheric and street dust contaminants adsorbed on MPs are needed to further investigation in detail. Also, standardized or reliable methods for the analysis of airborne MPs is required to develop.

## **Declarations**

### **Funding**

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

### **Competing Interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### **Ethical Approval**

Not applicable.

### **Consent to Participate**

Not applicable.

### **Consent to Publish**

Not applicable.

### **Authors Contributions**

Tirthankar Banerjee and Jaspal Singh Chauhan designed the work. Dipika Pandey conducted the research and analysis. Dipika Pandey and Neha Badola wrote the manuscript. Tirthankar Banerjee, Jaspal Singh Chauhan, Dipika Pandey and Neha Badola participated in the interpretation of results, review and editing of the paper.

### **Availability of data and materials**

All data generated or analyzed during this study are included in this published article.

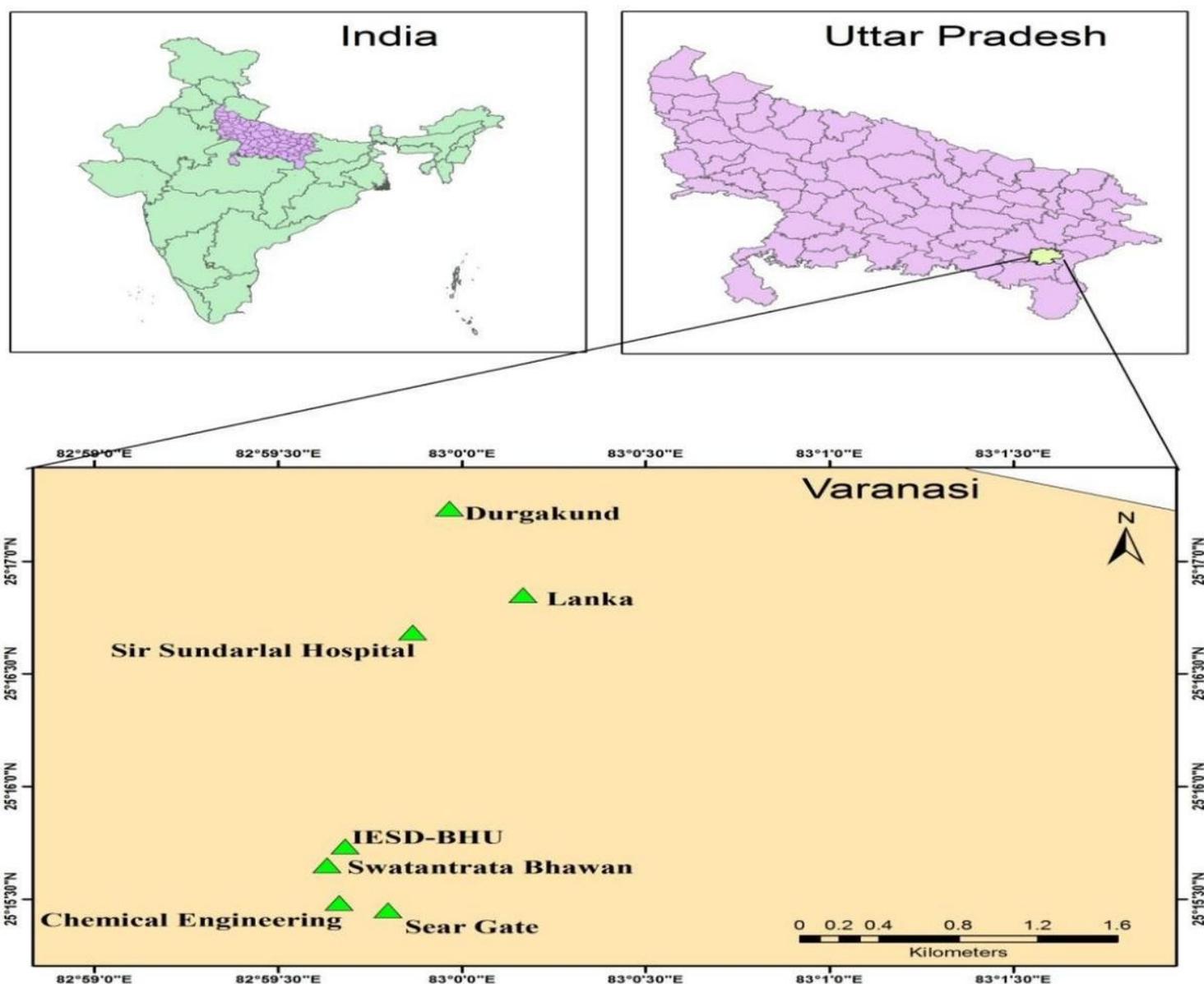
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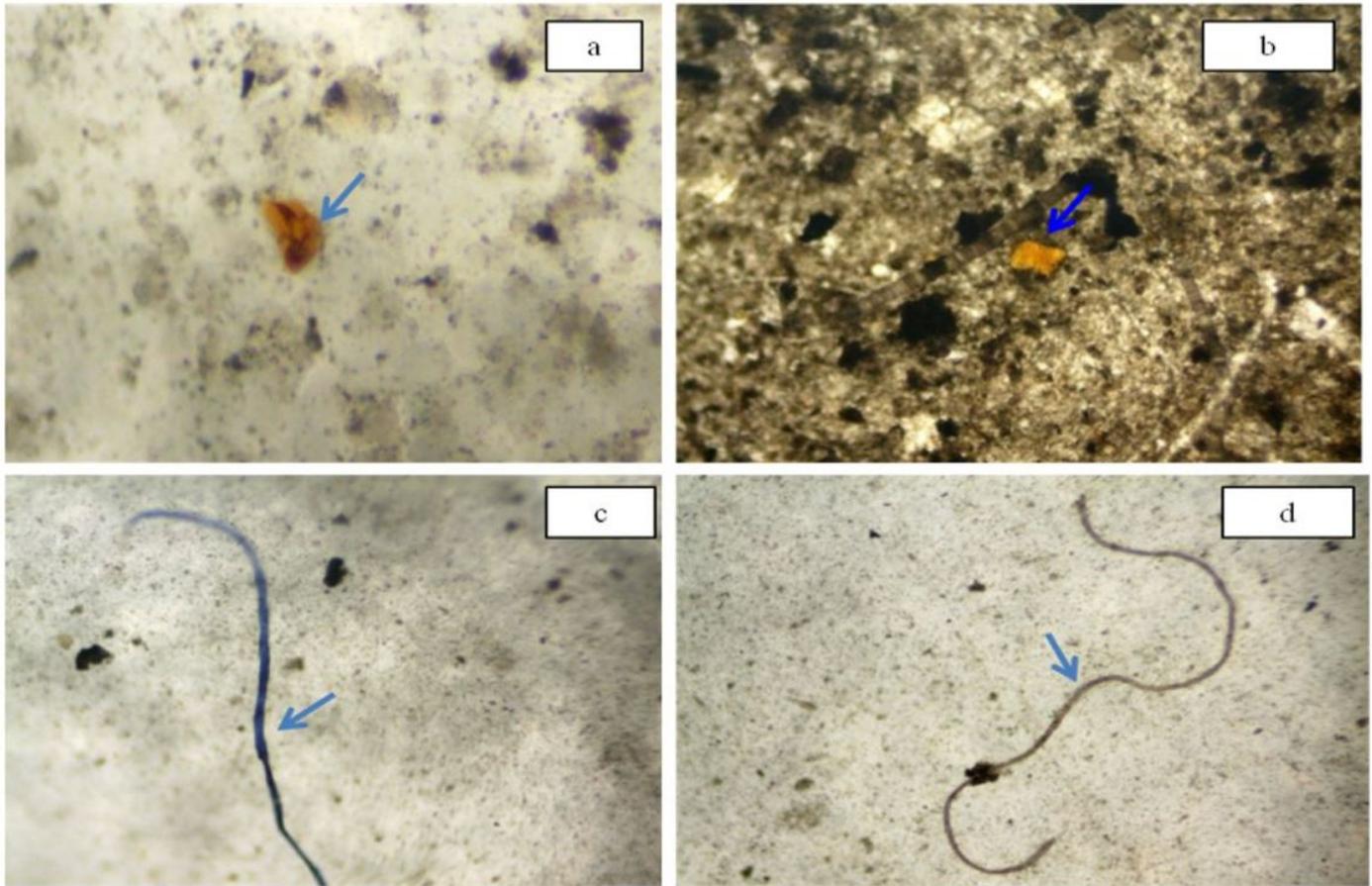
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## Figures



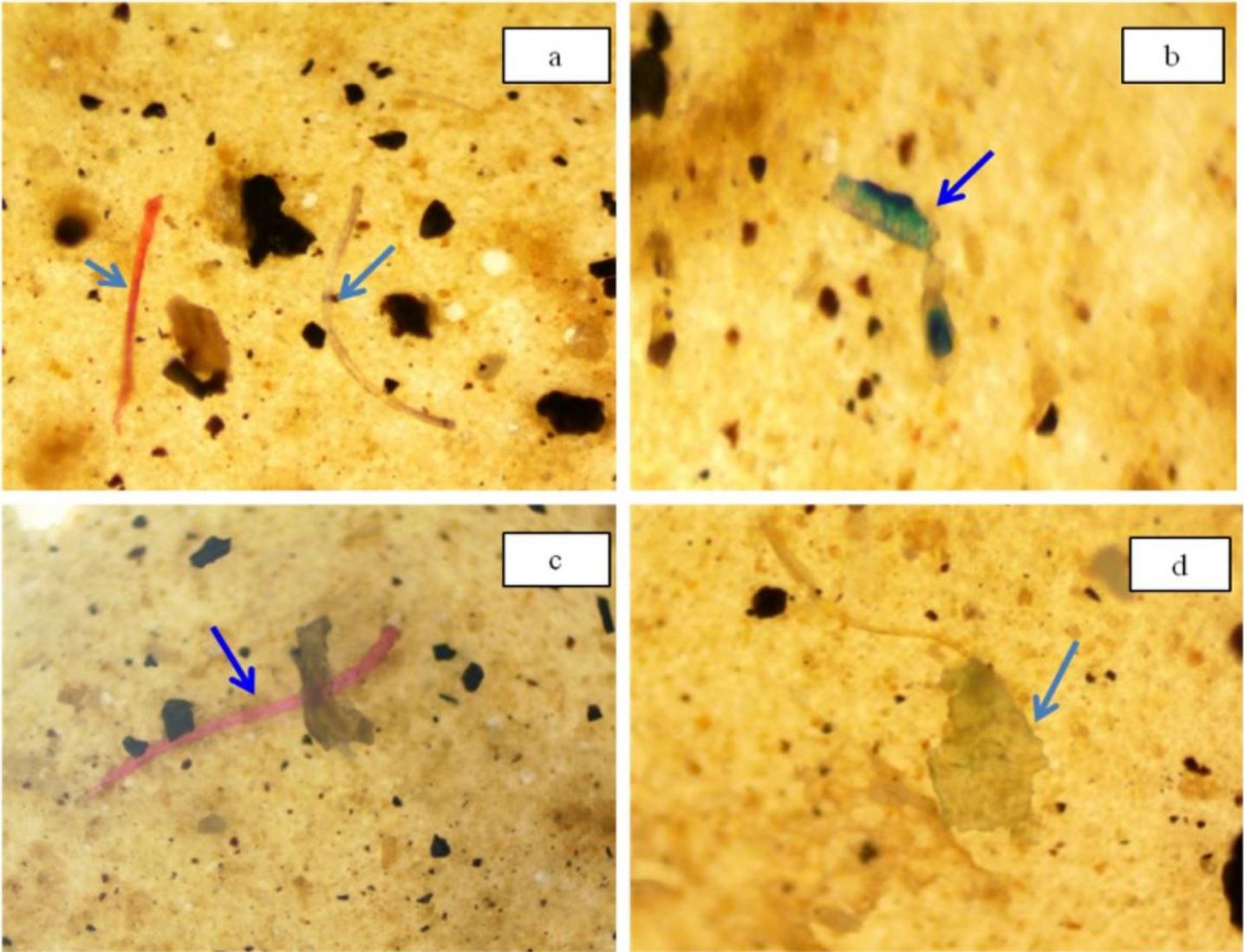
## Figure 1

Geographic Map of the study area and respective sampling sites.



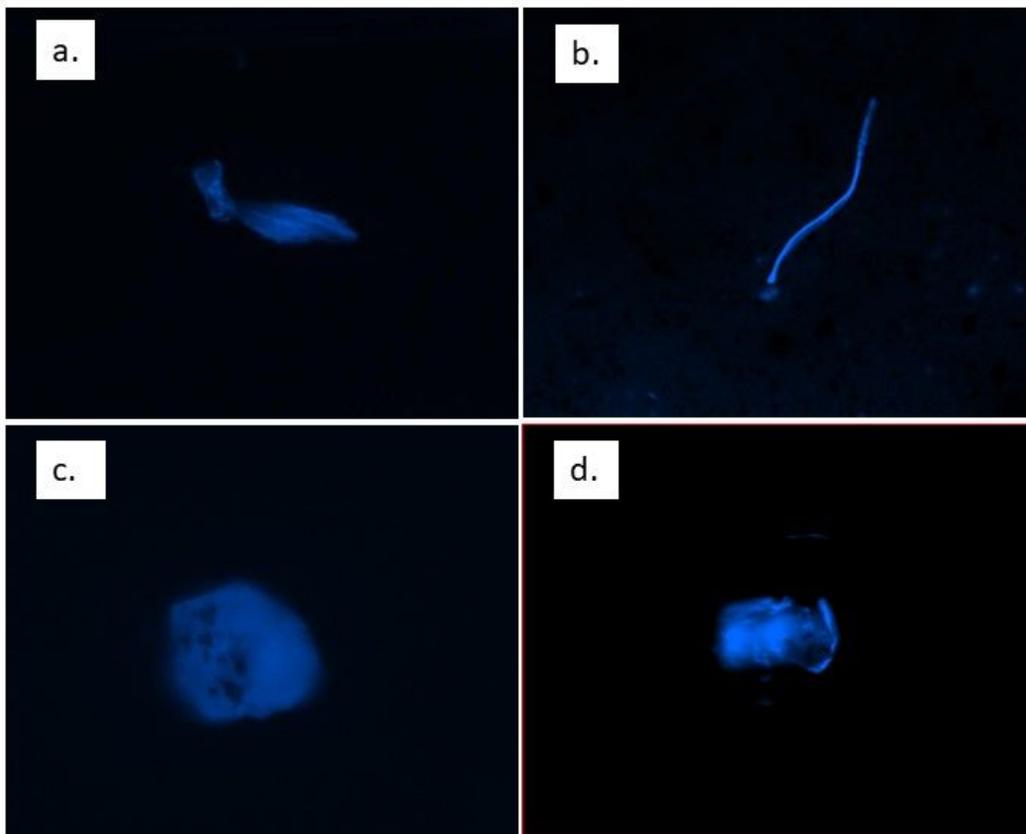
## Figure 2

Binocular microscopic images (at 20X), of different types of MPs in suspended air samples at IESD-BHU. (a) Fragmented, (b) Film-like, (c) & (d) Fibers.



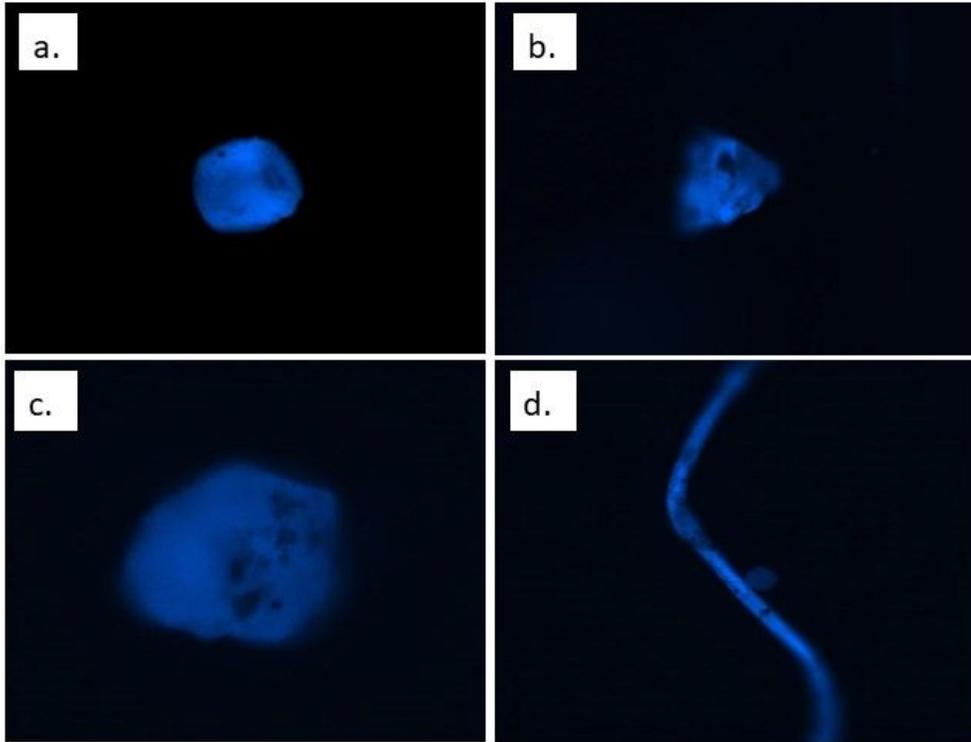
**Figure 3**

Binocular microscopic images of different types of MPs (at 20X), in street dust at certain locations of Varanasi. Fibers (a & c) of different color and different shapes, (b) Fragmented MP and (d) Film- like MP.



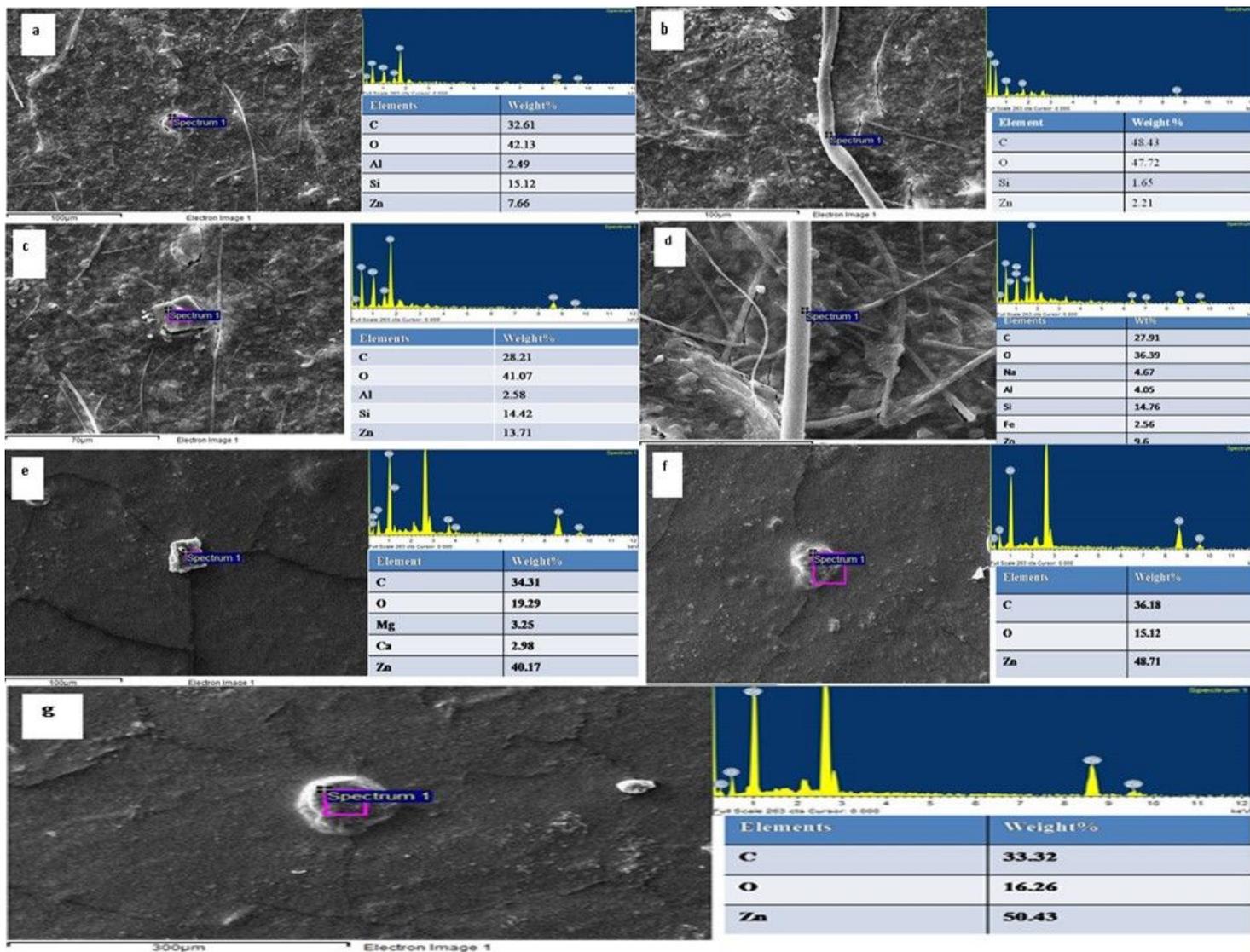
**Figure 4**

Fluorescence microscopic images of MP particles obtained from atmospheric fallout. (a) thin film MP, (b) fiber, and (c) & (d) fragmented MPs



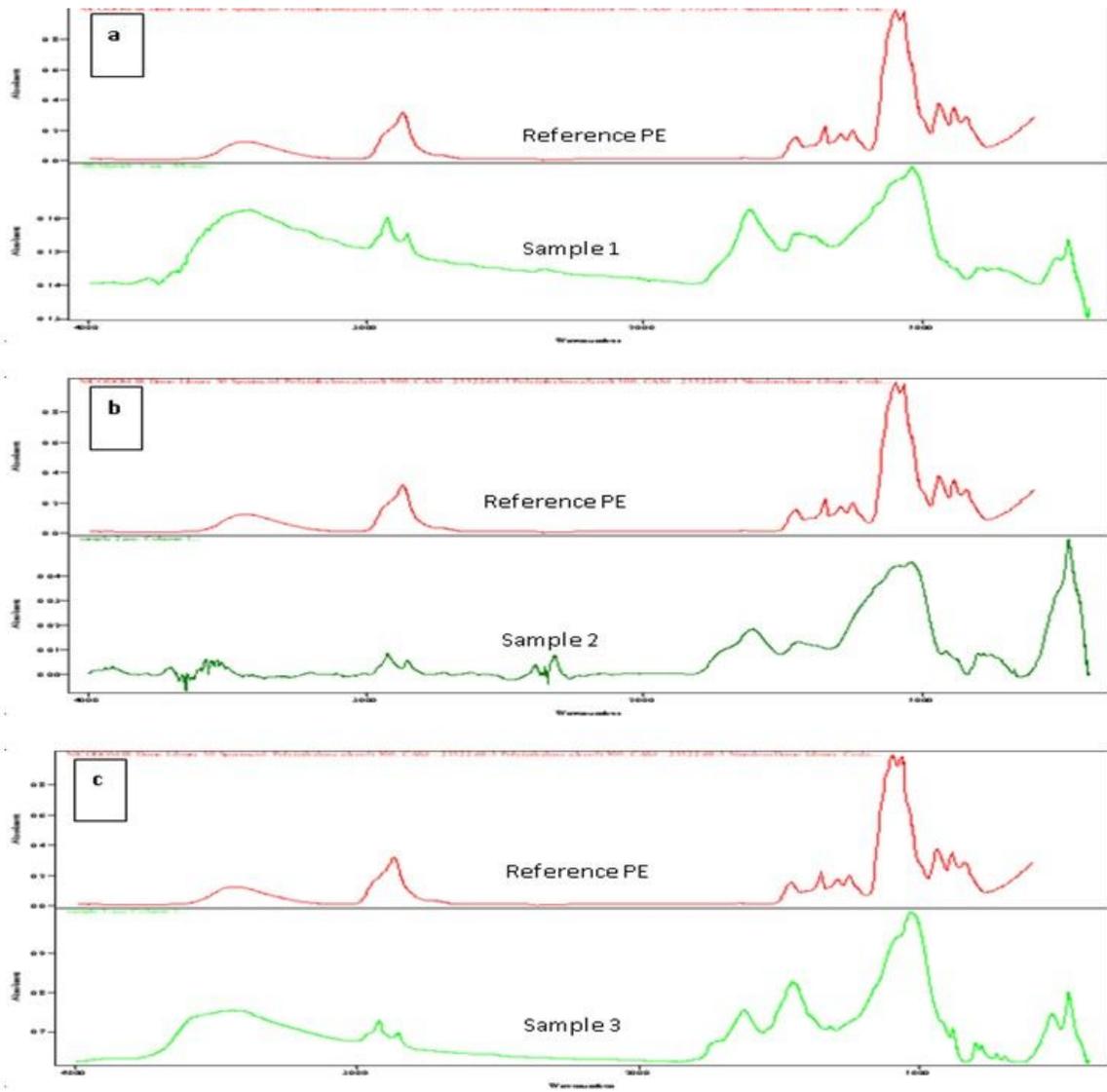
**Figure 5**

Fluorescence microscopic images of different MPs from the street dust. a) Fragment b) Pellet c) film d) Fiber



**Figure 6**

SEM images and EDX analysis result of selected MPs. (a) & (e)-fragments, and (b) & (d)-Fibers, (c)-film like and (f) & (g)-spherule.



**Figure 7**

FTIR spectrum of selected Microplastics from street dusts (a,b,c).

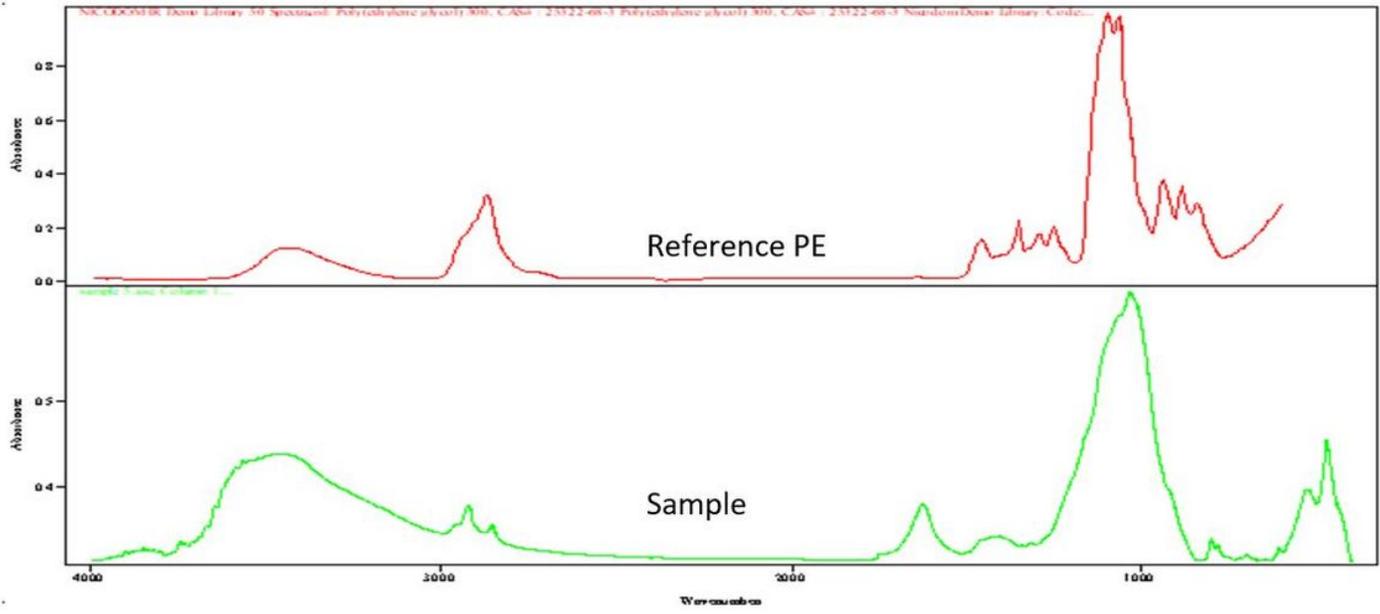


Figure 8

FTIR spectrum of Atmospheric suspended dust.