GOA UNIVRESITY

# Analytical studies for analysis of micro plastic in environment

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Analytical Chemistry

Index

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## Introduction

We are now living in a time some refer to as ‘The Plastic Age’ due to the high spread of polymer-based products; varing from single use (Low Density) Polyethylene bags and films for food packaging to PET bottles to PVC pipes; within our daily lives .The plastic is made of polymeric material. [1] .Over the last 50 years the use of plastic allowed a considerable improvement in human everyday lives. Used in simple daily requirements (e.g. Fresh food requirements, transport of shopping goods, aseptic medical products, preparation of meals), plastic may considered as pillar material on a global economy. Plastic permits the use of cheaper, lighter products for wide range of human need. However, the overuse of these materials has become a global environment concern which poses a serious threat to our aquatic and terrestrial ecosystem. Given their regurality, it is difficult to remain unaffected by their undesired potential chemical, mechanical and indirect toxic effect[2]

With their unique properties, plastics have become both necessary in our daily life and an emerging threat to global environmental. Global plastics production has demonstrated an exponential growth which will be continue in the future, the same holds true for plastic litter ending up in the environment. Depending on their stability of the polymer type and the environmental condition, plastic persevere in the environment for years, decades, centuries, or even millennia with many more negative impact.[3]

Despite a solidarity that plastic debris will accumulate in the environment, its presence has extremely increased, reaching almost 360 million tons in 2018. Plastic pollution is now considered one of the main environmental problem and represents an emerging threat for all living species, especially due to the chemical species (additives and other adsorbed elements) that are associated with plastics. Many governments have even classified plastic pollution as a critical problem comparable to climate change.[4]

However, plastic-based materials such as plastic mulches and polytunnels are widely used to produce more agricultural production efficiency or life duration. Sewage sludge products also contribute to the increase of micro plastics into soils. Both inputs, together with many others, such as landfills, lead to the accumulation of plastics in soils, which could represent an even larger pollution pool than that in the ocean. Once plastic waste is present in soil, it mixes and reacts with soil organic matter and mineral and may persist for up to a few hundred years[4]

Research reporting the presence of plastic pollution throughout the planet is constantly progressing. Plastic is present even in the most remote region of the planet, perhaps as a result of atmospheric deposition. The risk plastic pollution poses are debated and largely unknown [5]

Plastic waste has become a menace on a global scale. The environmental concern emanating from this waste stream has generated a great deal of scientific interest. With 8.3 billion metric tons of plastics produced between 1950 and 2015, 75.9% was dumped as waste. By 2050, it is predicted that about 12,000 million metric tons of plastic debris will be present in landfills. Approximately 8.75 million metric tons of plastic enter our ocean each year from land-based sources and comprise 61%-87% of marine litter. The problem is further exacerbated when plastic breaks down into smaller micro plastics (1 µm to 5 mm) and Nano-plastics (< 1 µm) due to biotic and abiotic degradation. Reports suggest that > 5.25 trillion plastic particles sized between 0.33 and 4.75 mm are currently floating in the world's oceans. A more recent assessment by Uddin et al. indicates that globally treated effluent from wastewater treatment plants contributes 1.47 × 1015 MPs per annum, while discharge of untreated wastewater disposal adds another 3.85 × 1016 MPs annually to the aquatic environments. Micro-plastics are found in all environmental matrices of the aquatic and terrestrial environments. The observations are well documented in 6551 published articles up to 3 May 2021.[6]

The use of plastics in food packaging has undoubtable had an enormous positive impact on human life by helping in food preservation, while its low density and weight provide benefits for transport and logistics. The polymers in food packaging materials are generally considered to be chemically inert, and the legal controls of material migration into food products consider mainly low molecular weight compounds (<1 kD), such as unreacted or partially unreacted monomers, processing aids, and additives.[7]

The release of plastic into the environment is universally recognized as a major threat not only for terrestrial and marine ecosystems, but potentially also for human health. This concern is primarily related to the degradation of plastic materials into micro- and nano-size particulates that can more easily bio accumulate. Their growing presence in the environment is raising concerns at the global level about the potential risks for human health via contamination of food, water, soil and air. Typical of emerging research fields, a harmonized classification of environmental nano-, micro- and meso-plastics remains a topic of debate. In recent years, substantial research has been devoted to the study of micro-plastics in the environment

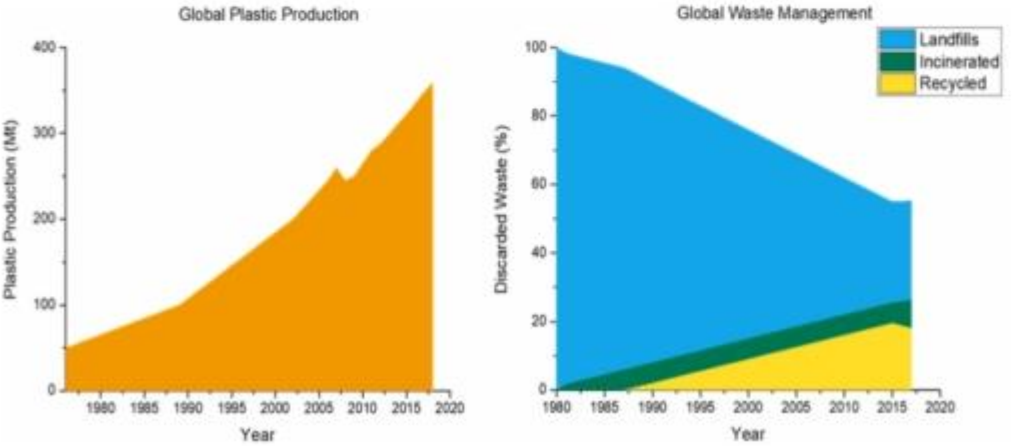

Fig 1 Left: Summarizing plastic product production values in million metric tons (Mt). Right: Summarizing official waste management. Both data are adapted from [1]

Despite their vast application, plastic is an environmental sensitive issue due to their resistance to biological, and chemical degradation, which entail the accumulation of these materials in the environment

Plastic can be classified as thermosets or thermoplastic based on how the polymer utilized to produce them behave during their starting exposure to heat. Thermosets undergo chemical change on heating that result in the formation of a three-dimensional cross-linked matrix which cannot be melted and reformed. Common example include PU or epoxy resins. Thermoplastic are viscous if heated above a specific temperature and solid below that temperature that this property which allows for them to be melted and reformed multiple times. Examples include PE, PP, PS, PVC, and PA.[1] The most of the plastic include polyethylene, polypropylene, polystyrene, polyvinylchloride and polyethylene terephthalate.[8]

**Micro-plastic**

Micro-plastic are defined as plastic particle with size covering the range from 1 µm to 5 mm And with the Brownian motion in the aqueous system. Fragmentation of large plastics produses MP. Larger plastic can fragmented in two mechanism that are abiotic and biotic degradation. Plastic can be breakdown mechanically through external forces, example freezing and thawing of plastic in marine environment.[9]

The term “micro plastic” was first produced by Thompson in 2004. Micro plastic can directly generated by manufacturing cosmetic for divers purpose, there are about 1g micro plastic in the usage of personal care products in each American per year.[8]

There are two main classifications of MPs: primary MPs and secondary MPs. Primary MPs directly enter the environment in the microscopic size (<5mm in diameter). Primary MPs are produced through grinding, either as a feed stock for manufacture of products or for direct use. For example, in cleaning products, micro beads in cosmetics and as air-blasting media. The secondary MPs are derived from fragmentation of larger plastic waste.[10]

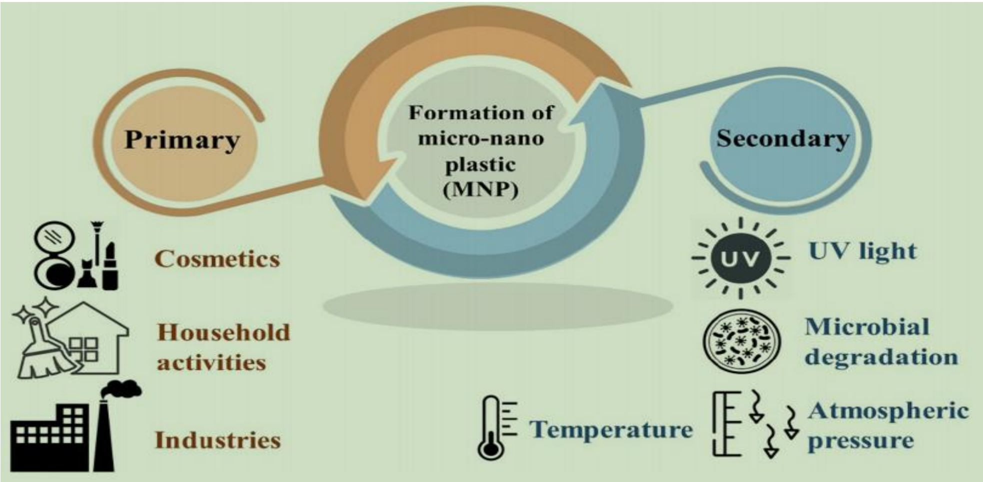

Fig 2. Formation of microplastic [9]

Micro plastic are also used in several products like personal care product (e.g. facial cleanser, tooth paste, shower/bath gel, scrubs, peeling, makeup, insects repellent and sunscreen), abrasives in cleaning products, and biomedical application that have, as end destination, their release into sewage system and/ or environment. Although it is known that the micro-plastic are being released and transported through air, soil and water compartment, the available data concerning its presence, variation of characteristics and impacts on natural system is extremely scarce, largely due to the difficulty of its detection and characterization. Its level are expected to increase consistently over time in environment.[2]

In the past few 39 years, the research interest towards micro plastic (< 5 mm synthetic polymer particle) pollution has been increased drastically. A more recent definition of MPs follows the logical differentiation along standard international (SI) unit nomenclature, that is, size of MPs = 5 mm to 1 µm. MPs are a pervasive and persistent environmental contaminant, impinging on freshwater, terrestrial, and marine ecosystems across the globe.[8]

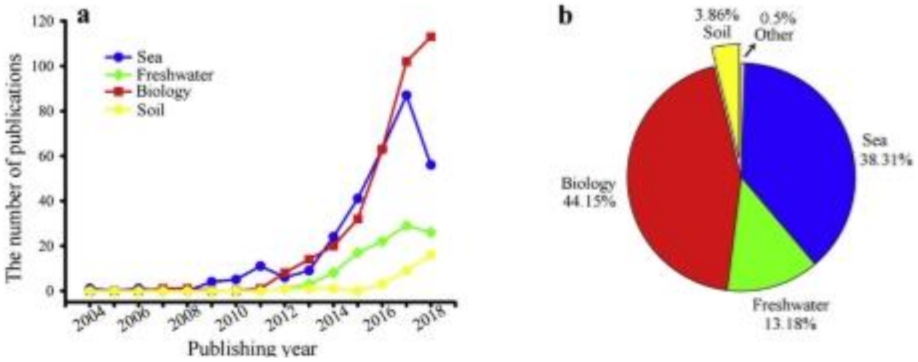

Fig 2. The number of publication about micro plastic pollution in different types of environment matrices. a) Increasing number of publication about micro plastic pollution from 2004 to 2018; (b) The percentage of publication about of micro pollution in sea, fresh water, biology and soil in the total publication.[8]

Micro plastics are globly detected in marine and terrestrial systems in recent decades. The published studies showed that micro plastics could pose threats to the whole ecosystem For instance, micro plastics are considered as vectors for various toxins such as heavy metals, hydrophobic organic pollutants, and pharmaceutical and personal care products. Due to their sizes similar to algae or mineral grain, micro plastics can be easily ingested by organisms with different trophic level, and accumulate along the food webs. After ingestion, the adsorbed pollutants and/or the toxic additives (e.g. plasticizers, organotin compounds, alkylphenols, nonylphenol, bisphenol A) contained in the polymer can be transferred to organisms, and then causing negative effects to organisms. Micro plastic pollution has received increasing attention and become a hotspot in the field of ecological and environmental science research.[11]

In addition, micro plastic can be taken by number of species including small fish, invertebrate, shore crabs, and so on. Micro plastic have been reported to exist in sea food, salt, honey, sugar, beer, and even drinking water.[8]

## RISK ON HUMAN EXPOSURE TO MICROPLASTIC

Increasing studies have suggested that micro plastic can induced negative effect on organism, such as feeding disruption, reproductive reduction, intestinal damage and disturbance in energy metabolism, etc.[8]

Studies on air born MPs were relatively scars and have gained increasing concern recently. Moreover, human being would be exposed to air born MPs via inhalation and dust ingestion, causing potential adverse effect to human health. Air born MPs ingested by human being would cause inflation and secondary genotoxicity. Air born MPs may contain various harmful chemical, such as the unreacted monomer, additives of plastic and other harmful contaminants adsorbed from environment. These harmful chemicals may enhance the toxicity of air born MPs to human beings.[12]

MPs may enter the respiratory system via inhalation. Assuming that the average air volume consumed by an adult was $15m^3/d$, adult exposure to air born MPs via inhalation by Shanghai resident would be 21 particles /d. It should be noted that not all the suspended airborne MPs could reach and finally deposit in the deep lung. For example, fibrous MPs with length-to-diameter ratio greater than 3:1 may stay in the upper airways due to mucociliary clearance.[12] .Dust ingestion is also a significant pathway for human exposure to harmful pollutants, especially for the sensitive population such as infant and toddlers. There are some ways that can lead to human exposure through oral route, via drinking water, through food containing plastic particle. According to Canadian study at McGill

University, a plastic tea bag steeped at a brewing temperature of 95°C release around 11.6 billion MPs into brewed tea.[9] [13]

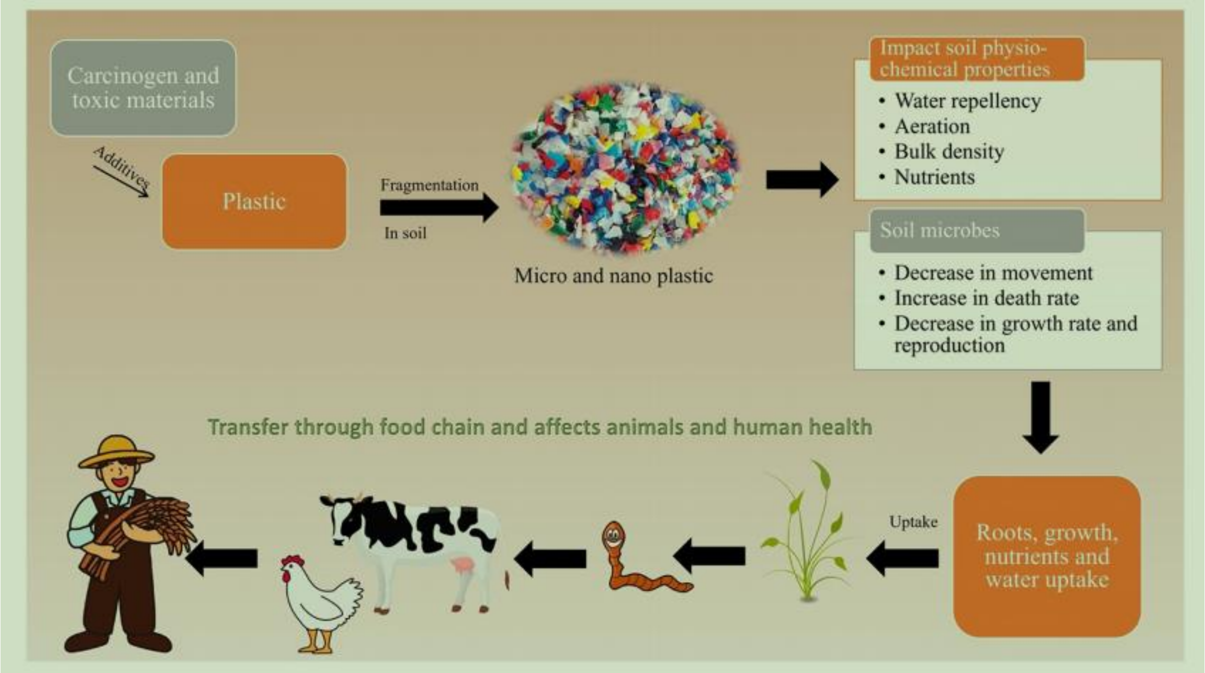

Fig.3 Plastic source identification method.[9]

## ANALYSIS OF MICROPLASTIC

An accurate analytical method is the core interest of research on micro plastics. Analytical method of micro plastic contain four steps that is extraction, clean-up, identification, and quantification. New methods are develop that works without extraction and clean up steps and can detect microplastics[11]

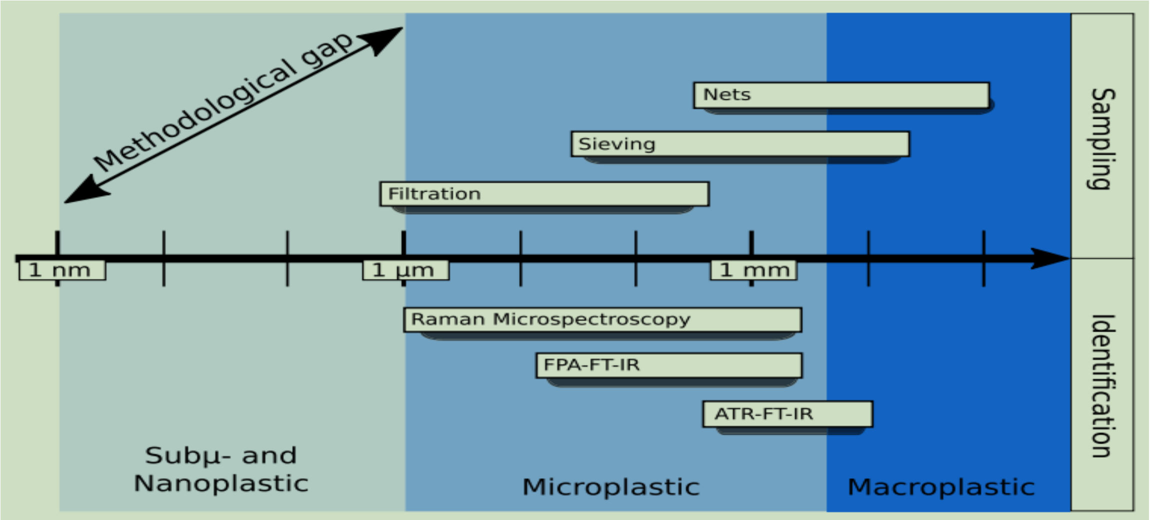

Fig 4. The analysis of MP is established for down to 1 µm.[14]

*Sampling Strategies*

The selection of an adequate sampling strategy is the most crucial step in environmental analysis. The choice of the sampling approach is determined by the research question.[15]

Sample preparation step is the bottleneck which can be time consuming, labour intensive and can considerably affect the accuracy of result of analysis.[16]. The key aspect of sampling is to remove non-plastic, e.g. biofilms, sand or wood.[17]

There are two methods used for sampling air born microplastic: passive atmospheric deposition and active pumped sample.[18]

Larger size MPs can be detected visually and removed with the help of tweezers and the small size are extracted using density separation and filtration method.[10]

For water, large MP can be directly separated using a net in the water or directly filtered by filters or sieves after a known volume is collected. For sediment and soil having a high density (2.6-2.7 g cm$^{-3}$), flotation is popular method, wherein MP is often extracted by higher density salt solution. The higher the solution density, the grater the density range of MP can be collected.[19] [20]

MPs in sediment from beaches and coastal areas were generally collected by placing a metal or wooden frame on the sediment surface, pushing it to a depth of 1-5 cm, scooping out the material and taking the sample using a steel spoon or shovel. The different sizes of frame can be used are 25×25cm, 30×30cm, 50×50cm, 100×100cm and 200×200cm; sampling depth can be varies from 0 to 5 cm, under water sample can be collected using Van veen or Peterson grab sampler.[10]

Fig 4. Schematic diagram in analytical procedure for microplastic in soil samples.[8]

## Identification of microplastic

### Visual identification

Identification of microplastics is usually based on the physical and chemical characterizations of isolated particles in mixtures after the extraction and clean-up steps. Therefore, the commonly used identification methods consist of physical identification (i.e. visual sorting) and chemical identification. Based on the specific properties (e.g. color, shape or surface texture), it is easy to identify microplastics by naked eyes. Visual sorting of relatively larger microplastics (1–5 mm) offers a simple and fast method for both experts and the non-professional volunteers.

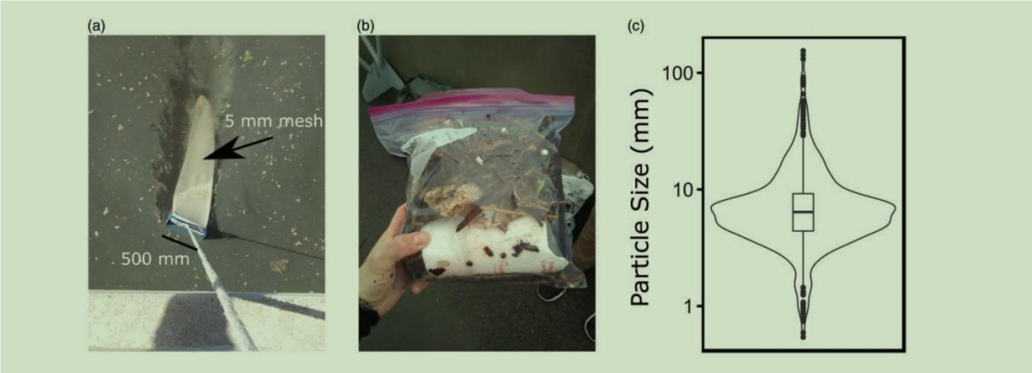

Fig. 5 (a)This sample was collected using a 5 mm mesh with a 500 mm aperture net lowered from a bridge in Southern California. (b) Given the abundance of visible plastic, this sample is a good candidate for naked eye identification. (c) Violin plot (kernel density function) with centered boxplot of particle size observed by the Gray Lab during the full sampling season using this technique. Particle size is a normalized length computed using the square root of the particle's projected surface area.[21]

For the identification of smaller microplastics (i.e. <1 mm) in soils, stereoscopic or dissecting microscopy with professional image software were widely used. However, some smaller particles (<100 µm) with no color or typical shape were difficult to be characterized with confidence as plastics by visual or microscopy identification. According to the changes of physical properties (e.g. shape, transparency) of plastics before and after heating, recently established a simple and cost-saving method which could identify polyethylene (PE) and polypropylene (PP) microplastics from soils. This heating method was not affected by the presence of SOM. With the help of the microscope and image software, particles size, shape, and number of microplastics could be determined visually. More importantly, heating method could be used to identify smaller particles (<100 µm). Currently, heating method is only suitable for PE and PP, and its applicability for other plastics still needs confirming. In addition, Zubris and Richards (2005) used polarized light microscopy to identify synthetic fibers in soils. Indeed, this is also a visual identity method based on the different physical characterizations of synthetic and natural fibers under polarized light. Visual sorting was considered to be questionable because it exhibit error of 20-70%.[11]

[20] [17]

## Fourier Transform Infrared Spectroscopy

FTIR spectroscopy is the most widely used method for identification and quantification of MPs.[10].It is a reliable identification method because it can record the specific chemical bonds of chemicals. Through comparing the obtained spectrums of the targeted polymers with the standard database provided by spectrum library, it enables not only confirmation of plastics, but also identification of plastic types. The mid infra red region (400-4000cm$^{-1}$) is the most used FTIR spectral region in MP research.[11]

With polymer, it is even able to display ageing by observation of surface oxidation via characteristics bands (e.g. carbonyl). FTIR is capable of identifying mixtures, which produces an overlay of the respective spectra of each individual substance.[14]

Compared with visual analysis, FTIR can analyse particle with small size, and the result of identification are more reliable.[18]. FTIR spectroscopy and its optimized technology (i.e. micro-FTIR) have been applied to microplastics identification in soils as well as air born micro plastic, since this technique can detect microplastic down to 20μm . However, it remains a challenge to apply FTIR in analyzing ultra-fine plastic particles (<1 μm).[11]

In addition, attenuated total reflection FTIR spectroscopy (ATR-FTIR) and focal plane array FTIR spectroscopy (FPA-FTIR) have also been used in studies on microplastics. ATR-FTIR is more suitable for identifying irregular microplastic particles larger than 500 mm, while FPAFTIR can identify all microplastic particles on filter paper with screening. However, these two methods have not been used in the identification of atmospheric microplastics, because of the smaller size of airborne microplastics. All the FTIR technologies require expensive instrumentations, and using FTIR to identify microplastics is time-consuming work requiring welltrained operators, which has prevented the use of FTIR to characterize a large number of microplastics in these studies.[18]

The spectra can be measured via two general principles, transmission and reflectance FT-IR. In short, transmission FT-IR analyses the interaction of the IR beam after full penetration of the sample. This has the advantages that the full material spectrum is collected but is prone to total absorption, which either yields the loss of spectral details or blocks the complete beam. In reflectance, the IR beam hits the sample, is reflected, and collected again. This type of measurements mainly investigates the surface of the sample and cannot be hampered by total absorption, but the surface needs to be able to reflect the beam. If applied on reflective surface such as a gold-coated mirror or filter, a measurement in reflectance–absorbance can be performed which yields spectra similar to transmission.[21] [22] [17] [23]

Limitation: (i) FTIR spectra obtained spectra for MPs acquired from different modes are not the same, (ii) it is critical to investigate the effects of chemical degradation on FTIR spectral bands of plastics before MP identification, (iii) a substrate is required to hold the particles in place during spectrum collection and the spectral interference of introducing a substrate filter has not been well addressed, (iv) MPs below 10 µm cannot be analyzed by FTIR technique, (v) irregular-shaped small size MPs would produce non- interpretable FTIR spectra due to refractive error, and (vi) FTIR is strongly active for water content, which produces broad peaks over 3000 cm-1. Thus, the sample preparation is required prior to measurement.[10] [3] [14]

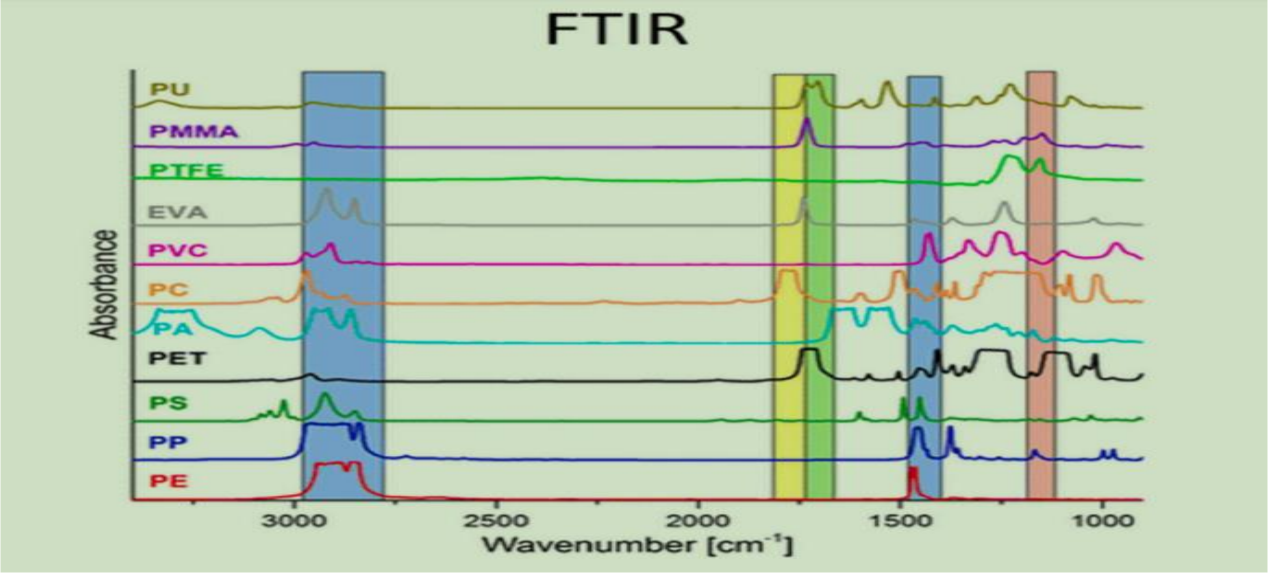

Fig. 6; Reference spectrum of FTIR for common plastic[1]

## RAMAN SPECTROSCOPY

Raman spectroscopy is widely used technique for detecting microplastics in various environments and it is nondestructive technique.[24] In Raman spectroscopy a Single wavelength is directed onto a target sample and induced different types of excitation, and detected due to the reflection, scatter, and absorption produced by a sample. Laser wavelength of 532 nm and 785 nm are widely used. While the Raman shift range varied from 200 ± 150 to 3000 ± 1000 $cm^{-1}$ and is depend on the molecular structure and chemical components of the samples, which is used to identify microplastic polymers. Raman spectroscopy requires only small quantities of microplastics from various environments and produces highly dependable results. For example, Raman spectroscopy was used in the identifification and characterization of types of microplastics collected from atmospheric fallout in the French Pyrenees, and PS, PE, PP, polyethylene terephthalate (PET) were identified. In addition, the optimized technologies of Raman spectroscopy can be applied to the identification of microplastics. The micro-Raman (a combination of Raman spectral imaging equipment and microscopy) can detect smaller microplastics down to 1 mm, and this resolution cannot be achieved by other methods and also provide information on polymer type, particle number, size distribution and morphology[21].The samples should be subjected to organic matter removal to avoid high background fluorescence before using micro-Raman spectroscopy. Compared with IR techniques, the spectrum libraries of polymers created by Raman spectroscopy are not yet well established, and additives could affect the accuracy of the spectral results. Raman spectroscopy is still powerful analytical method in microplastic studies [18] [23]

Analysis of MP can be performed via three approaches: (i) manual measurement of single particles,

(ii) Automated particle identification with ‘‘Particle Finding’’ algorithm, or

(iii) point-by-point mapping with ‘‘Imaging Mode.’’[14] [20] [17] [3] [1]

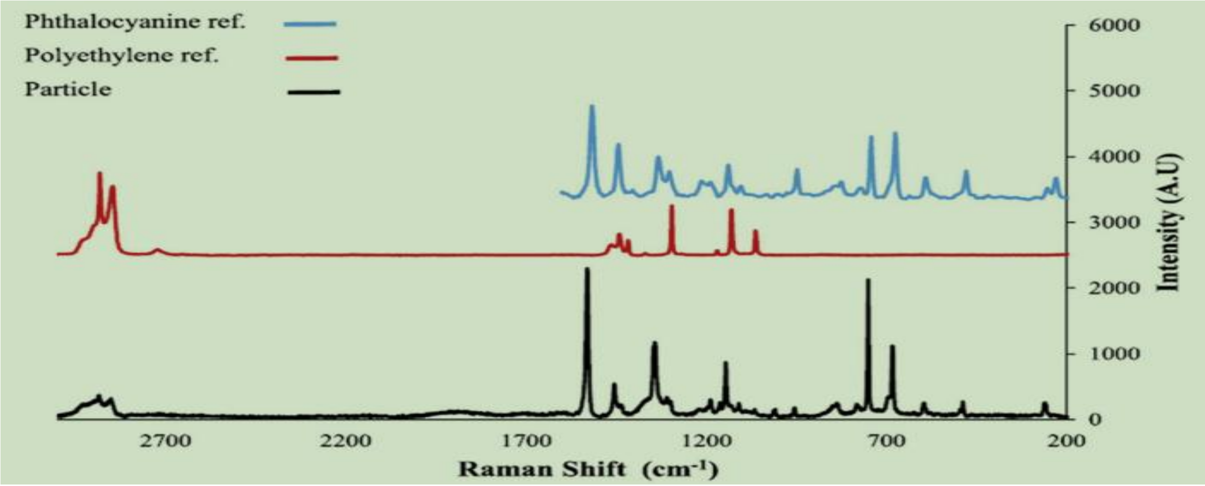

Fig 6. Raman spectrum of a particle, polyethylene, phthalocyanine and spectra of the reference materials [20]

## PROTON NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY ($^1$H NMR)

Qualitative NMR spectroscopy is well known. By contrast, quantitative NMR spectroscopy has only become increasingly popular in the last 10 years and is widely used in fields of metabolite research, drug toxicity, forensic science, and environmental toxicity

A completely new approach for size independent microplastic analysis was recently described by Peez et al. Using quantitative $^1$H NMR spectroscopy, model samples of polyethylene (PE) particles, polystyrene (PS) beads, and polyethylene terephthalate (PET) fibers can successfully be qualitatively and quantitatively analyzed with a calibration curve method. The author discus better sensitivity with size independent LOD in the range of 19-21 µg ml$^{-1}$ and LOQ in the range of 74-85mg/ml**.**[1] Each analyte was separately dissolved in the corresponding deuterated solvent: Deuterated toluene for PE, deuterated chloroform for PS, and deuterated chloroform with triflfluoracetic acid for PET, and subsequently measured with an NMR spectrometer. The signal of solvent should have chemical shift that significantly differs from analyte particle. MP particle should completely dissolve at a temperature 50°C lower than that of boiling point of deuterated solvent.

Quantitative determination by qNMR is based on the proportional relationship of integrated signal area and number of resonant nuclei. This method can be described as a precise quantification method since with this method a high quantitative accuracy of >98% is achieved. It is cost effective, fast (about 1 min per measurement), non-destructive, size-independent, and simple method.

In principle, various determination methods are possible: relative determination, absolute determination by use of internal or external standards, standard addition, and calibration curve method. Bharti et al. described these methods in connection with qNMR and explained their advantages and disadvantage. Analysis of mocroplastic can be done using calibration curve method since the exact composition of analytes does not to be known still it has some disadvantage as systematic error are difficult to detect. Biological sample matrix must be completely cleaned from MP particle because signal overlay make quantification difficult.

A disadvantage of quantitative $^1$H NMR spectroscopy is that, analytes should be dissolved in deuterated solvent which causes loss in size information of analyte.[23] [25]

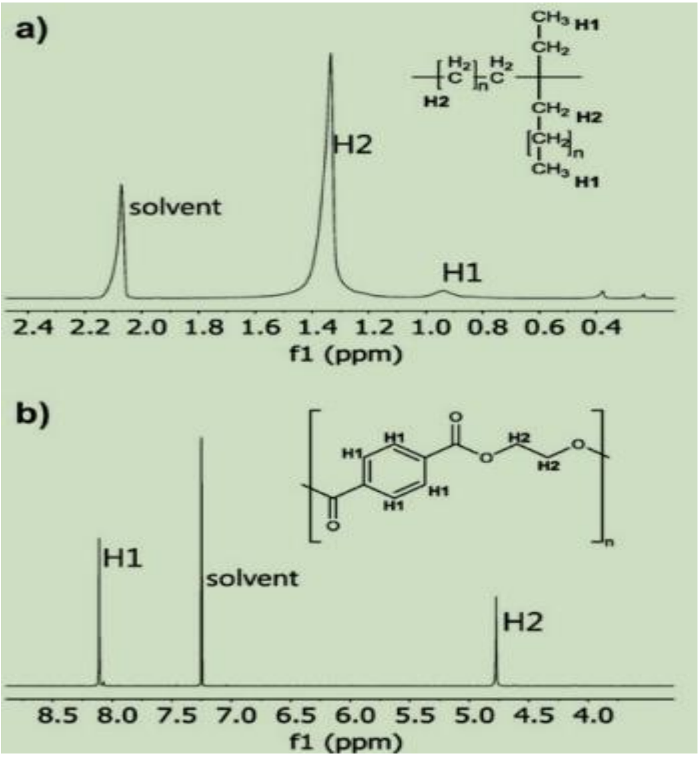

Fig. 7 $^1$H NMR spectra of MP particles and their structural formulas[23]

The fig 7(a) shows the NMR spectra of polyethylene granule measured in toluene-d8 at 60°C and (b) shows HMN spectra for PET fibers measured in CDCL3/TFA 4:1 at 25°C.[23]

## PYROLYSIS-GAS CHROMATOGRAPHY-MASS SPECTROMETRY (Py-GC-MS)

Pyrolysis-Gas Chromatography-Mass Spectrometry (Py-GC-MS) is a destructive technique that has also been described for the characterization of microplastics in terms of identifification of polymer type, by analysing their thermal degradation products. Commonly applicable for non-volatile material**.**[26] This technique eliminates the need of pre-treatment of sample since it directly examines the solid polymer sample; in addition, only a small quantity of sample is analysed in one measurement (200 mg). Fig. 7 shows a typical Py-GC-MS chromatogram (pyrogram) of PE found in the environmental microplastic over layerd by that of a standard PE

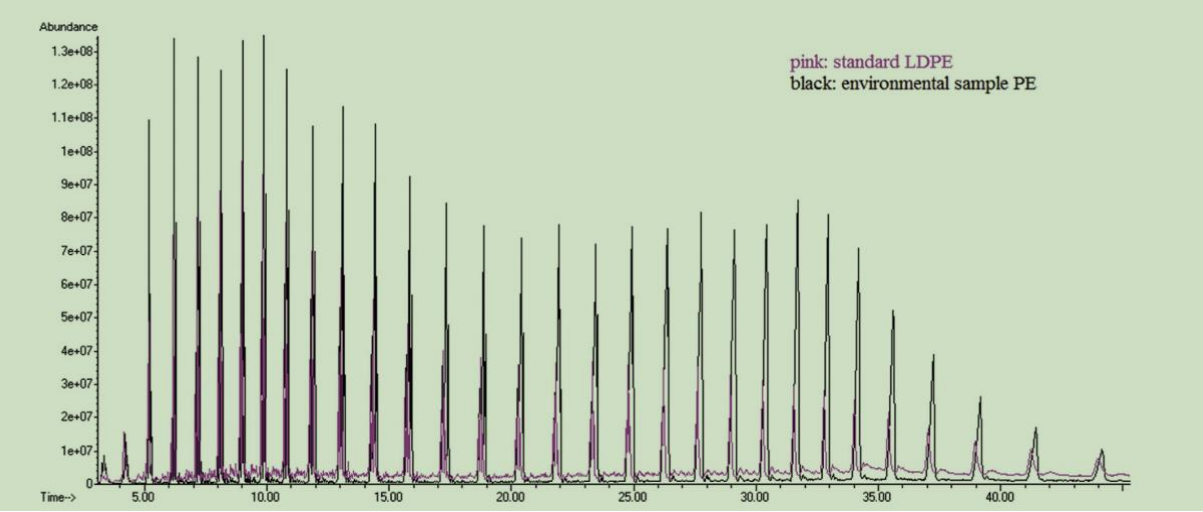

Fig 7. Pyrogram of PE (black) found in the environmental microplastic overlayed by the pyrogram of a PE standard (pink)[20]

Py-GC-MS can also be used to simultaneously identify polymer types and associated organic plastic additives. From marine sediment samples, particles PE,PP, PS, PA, chlorinated PE, and chlorosulfonated PE were identified together with polymers containing diethylhexyl phthalate, dibutyl phthalate, diethyl phthalate, diisobutyl phthalate, dimethyl phthalate, benzaldehyde, and 2,4-ditert-butylphenol

Recently, McCormick et al. examined microplastics collected from wastewater treatment efluent samples, which were retrieved and counted under a stereo microscope and the respective polymer type was assessed by Py-GC-MS. In this case, Py-GC MS served only as a complementary technique to characterize the suspected microplastics sorted by visual techniques. Pellets, fibres, and fragments were the most common microplastic types found and the samples consisted on PE, low-density PP, PS, and ethylene/ propylene rubber (EPDM). When testing the impact of digestion protocols on the integrity of known microplastics, Dehaut et al. verified that Py-GC-MS was reliable for the identifification of the polymer type, although it was not possible to establish differences of polymer subtypes (e.g., low-density PE vs. high-density PE).The use of Py-GC-MS by itself does not allow to determine the number, type or morphology of microplastics, as it only provides the mass of polymer per sample, thus requiring pre-selection of microplastics by optical techniques. This leads to the use of Py-GC-MS solely as a strategy for the verification of the composition of suspected microplastics.[20] Upon pyrolysis, the chemical decomposition occurring at high temperature breaks down large molecule into smaller fragment. The fragment generated are readily separated by gas chromatography and identify by a mass detector(Py-GC-MS)[5] [24]

The thermoextraction and desorption coupled with gas chromatography-mass spectrometry method (TED-GC-MS) relies on quite similar processes. The thermal decomposition, another term for pyrolysis, is carried out in a thermal balance. This provides additional information: mass losses upon heating. Usually, the crucible for TED-GC-MS accommodates a higher volume than that for Py-GC-MS. This allows the introduction of up to a few tens of milligrams, while Py-GC-MS is generally limited to a few milligrams. In the next step of TED-GC-MS, the products are collected onto an adsorber. When thermal extraction is complete, the adsorber is transferred for thermal desorption and gas chromatography-mass detection. All steps can be automated. With TED-GC-MS, the thermal decomposition profile is slightly different from that of Py-GC-MS. The larger fragments are more represented with pyrolysis. This is because the thermal desorption programs typically occur at maximum temperatures of 200°C and under inert gas ($N_2$), and the larger compounds are not desorbed and transferred into the GC-MS. However it is possible to analyse larger sample volumes at a time.[1] [24]

Both techniques allow pyrolysis to proceed under controlled conditions and to generate highly reproducible and consistent compositions of degradation products. It was demonstrated with both techniques that the quantifification of microplastics is possible.[5]

In the study of *Dehaut et al.* and *Fischer et al.* , who used py-GC/MS for identifification. They analysed PE, PP, PS, PA, PVC, PMMA simultaneously and compared pyrograms with a homemade and commercial database. In this context, *Fischer et al.,* pointed out that there is a risk of misinterpretation, because different polymers have similar pyrolysis products. They also studied matrix effects and recommend an extensive cleaning including enzymatic or chemical oxidation. However, one big disadvantage of py-GC/MS is the small sample mass input of 0.5 mg, which impede investigation of heterogeneous or complex samples, e.g. soils, sediments or organisms[17]

## Conclusion

Microplastic becoming new challenges for the environmental plastic analysis. MP have adverse effect on the plant-soil system, human needs to reduce the consumption of plastic, especially single used plastic, in order to decrease their abundance in the environment. In this literature review we discussed different method for the analysis of microplastic, which have been already applied. We discuss method like visual identification, FTIR method, Raman spectroscopy, $^1$H NMR spectroscopy and pyrolysis-GC-MS spectroscopy.

Environmental analysis require cost efficient and fast method, which can handle a large number of sample

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