

Microplastics in air: Are we breathing it in?

Johnny Gasperi^{1,a}, Stephanie L. Wright^{2,a}, Rachid Dris¹, France Collard¹,
Corinne Mandin³, Mohamed Guerrouache⁴, Valérie Langlois⁴,
Frank J. Kelly² and Bruno Tassin¹

Abstract

The annual production of plastic textile fibers has increased by more than 6% per year, reaching 60 million metric tons, about 16% of world plastic production. The degradation of these fibers produces fibrous microplastics (MPs). Such MPs have been observed in atmospheric fallouts, as well as in indoor and outdoor environments. Some fibrous MPs may be inhaled. Most of them are likely to be subjected to mucociliary clearance; however, some may persist in the lung causing localized biological responses, including inflammation, especially in individuals with compromised clearance mechanisms. Associated contaminants such as Polycyclic Aromatic Hydrocarbons (PAHs) could desorb and lead to genotoxicity while the plastic itself and its additives (dyes, plasticizers) could lead to health effects including reproductive toxicity, carcinogenicity and mutagenicity.

Addresses

¹ Université Paris-Est, LEESU, 61 avenue du Général de Gaulle, 94010, Créteil Cedex, France

² MRC-PHE Centre for Environment and Health, Analytical and Environmental Sciences, King's College London, London, SE1 9NH, United Kingdom

³ Université Paris-Est, Centre Scientifique et Technique du Bâtiment (CSTB), 77447, Marne-La-Vallée, France

⁴ Institut de Chimie et des Matériaux Paris Est, CNRS-UPEC-UMR7182, 2-8, rue Henri Dunant, 94320, Thiais, France

Corresponding authors: Gasperi, Johnny (gasperi@u-pec.fr); Wright, Stephanie L (stephanie.wright@kcl.ac.uk)

^a shared first authorship.

Current Opinion in Environmental Science & Health 2018, 1:1–5

This review comes from a themed issue on **Micro and Nano-plastics**

Edited by **Dr. Teresa Rocha-Santos**

For a complete overview see the [Issue](#) and the [Editorial](#)

<https://doi.org/10.1016/j.coesh.2017.10.002>

2468-5844/© 2017 Elsevier B.V. All rights reserved.

Keywords

Fibers, Microplastics, Air pollution, Health risk, Inhalation, Micropollutants.

Introduction

Plastic pollution is an emerging concern worldwide, with the majority of studies focusing on microplastics (MPs; plastic particles with a longest dimension < 5 mm) in

marine, and more recently, continental environments. Worldwide plastic production increases annually by approximately 3%, and, excluding plastic fiber production, reached 322 million metric tons in 2016 [1]. Whilst the ubiquity of MPs, and especially of fibrous MPs in both marine and freshwater ecosystems has been demonstrated, the dynamics of their sources, pathways and reservoirs are not well documented. Among the sources of microplastics, urban inputs such as wastewater treatment plant effluents are increasingly studied while the atmospheric compartment is mostly neglected. If present in sufficient quantity, the question of their inhalation and associated health risks will be an important issue. Focusing on fibrous MPs, this paper addresses both issues by reviewing work undertaken on the occurrence of MPs in the atmospheric compartment as well as discussing human exposure and the potential for subsequent health risks.

Occurrence of microplastics in the atmospheric compartment

Airborne MPs: is there an issue?

In air, different kinds of fibers can be found. A general classification of fibers is given in [Table 1](#). Fibers can be either natural or man-made. Man-made fibers can also be classified as inorganic (carbon, ceramic, glass) or organic. In this latter category, organic fibers are produced by transformation of natural products (artificial fibers) or from synthetic polymers ([Table 1](#)).

Worldwide, more than 90 million metric tons of textile fibers were produced in 2016. Two thirds of this production are synthetic, plastic fibers and production rates have grown yearly at a rate of approximately 6.6% over the last decade. Other fibers include cellulosic fibers (6%) and natural fibers (27%, mainly cotton) [2]. The commercial use of fine-diameter (1–5 µm) plastic fibers has also increased, such as in the sports clothing industry [3]. These small fibers may be shed and directly or indirectly released as the clothing wears or during washing [4,5] and drying. Furthermore, the industrial chopping or grinding of synthetic material can result in the formation of fine particles. Fibrous MPs may also undergo photo-oxidative degradation in the environment, along with wind shear and/or abrasion against other ambient particulates, eventually fragmenting into fine particles. The risk of inhaling fibrous MPs following

Table 1

General classification of textile fibers.

Textile fibers					
Natural fibers			Man-made fibers		
Animal fibers	Vegetal fibers	Mineral fibers	From organic chemistry		From inorganic chemistry
			Artificial fibers	Synthetic fibers	
Wool, silk	Cotton, jute	Asbestos	Viscose/rayon, acetate, etc.	Polypropylene, acrylic, polyamide, polyester, polyethylene	Glass, ceramic, carbon, etc.

widespread contamination within different environmental compartments deserves special attention owing to both the scale of their worldwide production and their potential to fragment into smaller, more bioavailable fibers. Human exposure to MPs could also occur through ingestion, for example fibrous MPs can settle on the floor; children — owing to crawling and frequent hand-to-mouth contact — ingest settled dust, daily.

Can we find fibrous microplastics in the atmosphere?

To date, and to the best of our knowledge, only two studies have demonstrated the presence of fibrous MPs in the atmospheric compartment [6,7], thereby suggesting potential human exposure. An earlier study [8] highlighted the existence of respirable organic fibers in the indoor and outdoor environment but did not discriminate between natural and synthetic materials. Whilst other studies have suggested the occurrence of atmospheric MPs, no direct evidence was provided [9,10].

Dris et al. (2016) evaluated the presence of fibrous MPs in total atmospheric fallout (TAF - including dry and wet deposition) at one urban site and one suburban site in the Paris Megacity [6]. TAF was collected continuously on the roofs of buildings. Fibrous material accounted for almost all of the material collected (Fig. 1), the remaining being rare small plastic fragments (smaller than 100 μm). Based on a 1-year and a 6-month monitoring period, respectively on two sites, atmospheric fallout of between 2 and 355 fibers·m²·day was

calculated. TAF fluxes were systematically higher at the urban site than at the suburban one, probably linked to the density of the surrounding population. Rainfall also appears to be an important factor influencing the fallout flux. Despite no significant quantitative correlation between the concentrations of fibers and the characteristic of the rain events (rainfall depth, intensity, etc.), TAF during wet weather periods are always substantially larger than during dry weather periods.

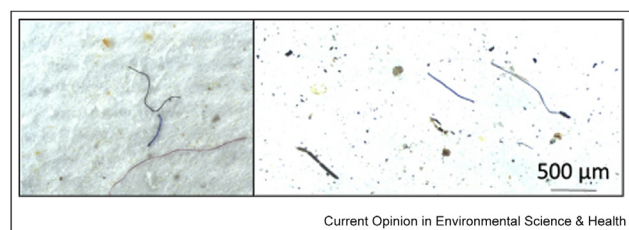
What are the characteristics of atmospheric fibrous microplastics?

After chemical characterization, it appeared that 29% of the fibers evaluated in TAF are plastic, with the majority constituting cellulosic or natural origin [5]. The length distribution of fibers collected larger than 50 μm was assessed. On measuring fiber length, smaller size classes [200–400 μm] and [400–600 μm] were predominant whilst fibers in the larger size ranges were rare. Few fibers measuring between 50 μm (observation limit) and 200 μm in length have been detected. The diameter of the fibers varied mainly between 7 and 15 μm .

Are we exposed to airborne fibrous microplastics?

Dris et al. (2017) investigated fibers in indoor and outdoor air, as well as indoor settled dust [7]. Three indoor sites comprising two apartments and one office were selected within a dense urban area of Paris. Outdoor air was sampled in close proximity to the office site, which was also where TAF monitoring took place. A pump sampled 8 L/min of indoor air onto quartz fiber filters (1.6 μm). Sampled volumes varied depending on occupants' presence. The same method was used for the assessment of outdoor air. Overall, indoor concentrations ranged from 1.0 to 60 fibers·m⁻³. Outdoor concentrations were significantly lower, ranging between 0.3 and 1.5 fibers·m⁻³. The deposition rate of the fibers in the indoor environments ranged between 1,586 and 11,130 fibers·m²·day. Settled dust was collected using a conventional vacuum cleaner and analysis revealed a concentration of fibers ranging from 190 to 670 fibers/mg.

Fig. 1



Fibrous microplastic observed in atmospheric fallout.
Source: @LEESU.

Download English Version:

<https://daneshyari.com/en/article/8940617>

Download Persian Version:

<https://daneshyari.com/article/8940617>

[Daneshyari.com](https://daneshyari.com)