Chapter 9
Filters and Life:
A Glimpse Into the Future for the Generation of Healthier Homes and Architectural Constructions

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ABSTRACT

Particle pollution, such as PM2.5 and PM10, poses a growing threat to human health and the environment. These particles come from natural sources like plant pollen, as well as human activities such as industry, traffic, and the wear and tear of materials like clothing or artificial turf. These microenvironmental components can cause respiratory problems such as cardiovascular diseases and allergies. Pollen is a significant example as it can trigger allergic rhinitis, conjunctivitis, and asthma. Moreover, pollen allergies can exacerbate other conditions such as atopic dermatitis. Radioactive microparticles, such as those released in the Fukushima nuclear accident, are also a major concern. These particles can persist in the environment for a long time and can cause severe health issues.

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INTRODUCTION

The issue of microparticle pollution in the air is a significant concern due to its potential toxicity and adverse effects on human health and the environment. Microparticles, including PM2.5 and PM10, are known to be components of air pollution and have been associated with various health issues, including cardiovascular diseases (Al-Kindi et al., 2020). They originate from both natural and anthropogenic sources and contaminate various environmental settings, including marine ecosystems and rivers, posing risks to wildlife and human health (Cozzolino et al., 2021; Girard et al., 2021; Rotjan et al., 2019). Of the origins, the most concerning one is anthropogenic, as it is the one we can control by reducing activities that generate microparticles. One of the clearest examples is the presence of microplastics and fibers in various freshwater and saltwater bodies (Bottari et al., 2022; González-Pleiter et al., 2020; Tanentzap et al., 2021), as well as inside animals such as fish in the Great Lakes (Munno et al., 2022). Research has shown that microparticles mix and appear together regardless of their origin (Kholodov & Golokhvast, 2020).

A natural microparticle we all encounter daily is pollen emitted by plants into the environment to ensure their survival in successive generations. Pollen is an allergen that can trigger allergic reactions in susceptible individuals, potentially inducing severe acute or chronic pathological processes. Pollen allergies are caused by the immune system's response to pollen particles (Li et al., 2022). Pollen from trees (deciduous and evergreen), grasses, and weeds is the most clinically important and abundant allergen source, which can induce allergic rhinitis, conjunctivitis, and bronchial asthma (Li et al., 2022). It's worth noting that sensitized individuals commonly have allergies to multiple types of plant pollens (Saha et al., 2021). Additionally, it's important to know that allergic processes are triggered by allergen exposure, so avoiding contact also prevents the allergy from being triggered.

Among other symptoms and syndromes, it's important to highlight Pollen-Food Allergy Syndrome (PFAS). This is described as a type I IgE-dependent allergy caused by prior sensitization to pollen and sensitivity to various types of fruits and vegetables with cross-reactivity to pollen (Kawauchi et al., 2022). Cross-reactivity between food and pollen allergens is what triggers the syndrome's symptoms (Kamei et al., 2022).

The impact of pollen allergies extends beyond respiratory symptoms, as studies have shown associations between airborne pollen allergy and other conditions such as atopic dermatitis (Ebisawa & Eigenmann, 2022). Furthermore, changes in pollen calendars and increased pollen counts due to climate change can influence the allergenicity of pollen grains, potentially altering the risk of pollen-related allergies in the future (Park, 2020). This makes it an important target for developing systems,