Enhancing Air Quality: Investigating Filter Lifespan and Byproducts in Air Purification Solutions

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Air purifiers have become widely implemented in a wide range of settings, including households, schools, institutions, and hospitals, as they tackle the pressing issue of indoor air pollution. With their ability to enhance indoor air quality and create healthier environments, air purifiers are particularly vital when ventilation options are limited. These devices incorporate a diverse array of technologies, including HEPA filters, active carbon filters, UV-C light, photocatalytic oxidation, and ionizers, each designed to combat specific pollutants and improve air quality within enclosed spaces. However, the safety of air purifiers has not been investigated thoroughly and many questions and concerns still arise when applying them.

The goal of this study is to investigate the lifespan of filters as well as investigate the potentially harmful effects of air purifiers. Understanding the lifespan of filters used in air purifiers and the potential formation of harmful byproducts is essential for ensuring their optimal performance, guiding consumers in their purchasing decisions, and establishing industry standards for safer and more effective air purification solutions.

Certain air purification technologies, such as UV-C light or ionization, can unintentionally generate undesirable byproducts that can negatively affect indoor air quality and health. It is well-established that these technologies can inadvertently generate nanoparticles or convert common gaseous compounds into harmful ones, thus exacerbating air pollution. However, the formation of byproducts can vary across products, necessitating further investigation. There is a particular concern about the formation of the carcinogenic substance formaldehyde from common gases like acetone.

Many air purifiers use mechanical filtration to remove particles, dust, and pollen from the air. Filters need to be replaced periodically for optimal efficiency, resulting in an additional cost for end-users. Currently, there are no guidelines for filter lifespan, and therefore, replacement recommendations solely rely on manufacturers. Our market screening revealed that manufacturers' recommended lifespans vary greatly (from 1 month to 10 years), hence, there is a need for general recommendations to guide consumers.

Activated carbon filters are used to adsorb various types of chemicals that can pose health risks or cause unwanted odors. These filters have a certain capacity before becoming saturated. If not replaced in a timely manner, the adsorbed substances are likely to be released from the filter through off-gassing or losing adsorption efficiency. We will present results from around 20 air purifiers representative of the current market. Results will show how the lifespan varies across products and will contribute to establishing recommendations for standardization and regulations.