Author's Accepted Manuscript

www.elsevier.com/locate/jaerosci

A novel electrostatic precipitator-type small air purifier with a carbon fiber ionizer and an activated carbon fiber filter

Myungjoon Kim, Gi-Taek Lim, Yong-Jin Kim, Bangwoo Han, Chang Gyu Woo, Hak-Joon Kim

PII: S0021-8502(17)30374-9
DOI: https://doi.org/10.1016/j.jaerosci.2017.12.014
Reference: AS5240

To appear in: *Journal of Aerosol Science*

Received date: 19 September 2017
Revised date: 24 December 2017
Accepted date: 29 December 2017

Cite this article as: Myungjoon Kim, Gi-Taek Lim, Yong-Jin Kim, Bangwoo Han, Chang Gyu Woo and Hak-Joon Kim, A novel electrostatic precipitator-type small air purifier with a carbon fiber ionizer and an activated carbon fiber filter, *Journal of Aerosol Science,* https://doi.org/10.1016/j.jaerosci.2017.12.014

A novel electrostatic precipitator-type small air purifier with a carbon fiber ionizer and an activated carbon fiber filter

Myungjoon Kim[a], Gi-Taek Lim[a,b], Yong-Jin Kim[a], Bangwoo Han[a], Chang Gyu Woo[a], Hak-Joon Kim[a,*]

[a]Department of Environmental Machinery, Korea Institute of Machinery & Materials, 156, Gajeongbuk-ro, Yuseong-gu, Daejeon 34103, Republic of Korea

[b]Department of Mechanical Engineering, Chungnam National University, 99, Daehak-ro, Yuseong-gu, Daejeon 34134, Republic of Korea

*diayolk@kimm.re.kr

Abstract

We developed and investigated the air cleaning performance of a novel electrostatic precipitator (ESP)-type small air purifier with a carbon brush ionizer and *an activated carbon fiber (ACF) filter.* This version had a high particle charging rate and a low ozone emission rate. Applying a negative voltage of 10 kV to the carbon brush ionizer increased the single-pass particle collection efficiency of 0.3-μm particles from 17.8% to 47.1%. The flow rate was maintained at 362 L/min, and the efficiency increased to 64.2% as we applied a negative voltage to the collection stage and increased the voltage to 10 kV. This was relatively low when compared to a market-leading commercial HEPA filter-type small air purifier (80.7%). However, our novel purifier showed a particle clean air delivery rate (CADR) of 0.31 m^3/min, approximately a 1.7 times higher than that for the commercial purifier (0.18 m^3/min) due to its high flow rate and low pressure drop. We measured the gas removal efficiency in a 1-m^3 test chamber with acetic acid, acetaldehyde, and ammonia; after 30 min of operation, the results were 97.9%, 92.4%, and 87.8% for the novel purifier and 95.2%, 65.4%, and 57.9% for the commercial purifier, respectively. The ozone concentration was measured in a closed test chamber (30.4 m^3) over 15 hrs of continuous operation, and it showed a maximum value of 2.5 ppb, much lower than the current standard for ESPs (50 ppb).

Keywords: Small air purifier; electrostatic precipitator; activated carbon fiber filter; carbon brush ionizer; clean air delivery rate; gas adsorption

1. Introduction

Accelerated increases in both population and industry have deteriorated air quality in east and south Asia. For example, the annual average volume of fine particles (PM 2.5) in the air over east and south Asia was >50 μg/m^3, more than five times the World Health