Filtration Characteristic and Recharge Performance in Electret Filters

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Abstract

Conventional corona electret filters suffer charge decay due to environmental factors. Water electret technology has said high filter quality and potential for washability and reuse. With increasing usage and waste generation in recent years, extending filter life and developing regeneration technologies have become critical issues for sustainable development. This study is under identical filter structures to investigate the filtration characteristics and regeneration of corona and water electret filters.

In this study, filter thickness was measured by laser displacement sensor, packing density by filter's volume, weight, and material density, validated by liquid displacement method, and fiber diameter by SEM images and pressure drop. Isopropanol treatment and single-fiber theory were applied to evaluate the charge density and stability. Collection efficiency was assessed at different face velocities. Through immersing filters in water solutions to observe their recharging performance.

Results show water electret filters achieve >98% efficiency, outperforming corona electret filters at 80% under identical filter structure. Charge density of water electret filter is five times higher than corona electret filter. After isopropanol treatment, both efficiencies drop to 18% (corona) and 23% (water), similar to uncharged filter (18% and 21%), difficult to observe differences in charge stability between them. Surface tension influences the infiltration of water solutions into the filter. When the solution no longer forms droplets on the surface, it allows uncharged filters to become electrostatically charged, achieving 80% efficiency. After removing charges with isopropanol, immersing the filter in the same solution again can still restore it to 80% efficiency.

Keywords: Water electret filter; Corona electret filter; Filter quality; Recharge.