NJ Department of Environmental Protection

Division of Science and Research

Do-It-Yourself Air Cleaners

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What was the purpose of the study?

The study aimed to evaluate the performance of different Do-it-Yourself (DIY) air cleaners, including single and multi-filter DIY air cleaner configurations with different filter thicknesses and Minimum Efficiency Reporting Values (MERV) ratings. Single-filter configurations had to cost less than $50, and multi-filter configurations had to cost less than $100. The study also evaluated noise levels, motor temperatures, and power consumption of tested DIY air cleaners.

What was the general approach to the study (methods)?

Single and multi-filter DIY air cleaners were constructed by combining a widely available box fan from Lasko (20 x 20 in; Model# B20201) and various 20 x 20 in furnace air filters. The furnace air filters were selected based on their MERV rating and included filters with MERV ratings of 8, 11, and 13. The filter thicknesses tested were 1, 2, and 4 in. The tested models included single-filter configurations with filters from three companies, a 2-filter configuration, and a Corsi-Rosenthal (C-R box) (Rosenthal 2021) with four 2-inch filters (Figure 1a, b, c, respectively). The DIY air cleaners were challenged with airborne particles of various sizes, and filter performance was determined by measuring particle concentration for 60 minutes with and without operating the DIY air cleaners. DIY air cleaner performance was evaluated in terms of Clean Air Delivery Rate (CADR). Noise levels produced by the DIY air cleaners, their box fan motor temperature, and power consumption were also measured.

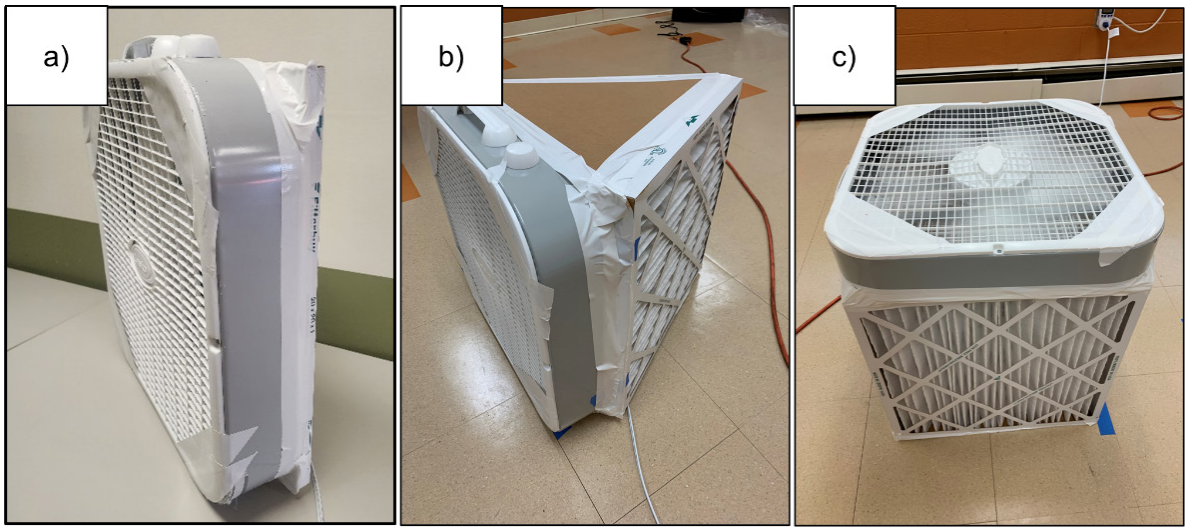

Figure 1. Example of constructed DIY air filters: a) single filter, b) two-filter and four-filter (Corsi-Rosenthal box) air cleaners. Figure reproduced with permission of the American Association for Aerosol Research.

Overall, what did the study show?

CADR for multiple airborne particle fractions, including ultrafine (<100 nm) and 300 nm (most penetrating particle size), was investigated. Typically, among the single-filter configurations, the 4-inch filter performed the best. The multi-filter models, especially the C-R box (four filters attached to a box fan), demonstrated the highest CADR. For $PM_{2.5}$ particles, the CADR of the two-filter model and C-R box exceeded 400 cfm (Figure 2). Such CADR values are comparable to and exceed those of several commercially available portable air cleaners with High Efficiency Portable Air (HEPA) filters. The sound levels ranged from 63 to 73 dB and 60 to 68 dB, measured one and three feet away from the box fan, respectively. The average power draw was 0.080 kW (80 W). Thus, if used non-stop, a box fan with a filter would consume less than 2 kWh per day (24 hrs). This power consumption value applies to a one-filter box fan model operated at maximum fan speed. Even less power would be used at lower settings, but the resulting CADR would be lower.

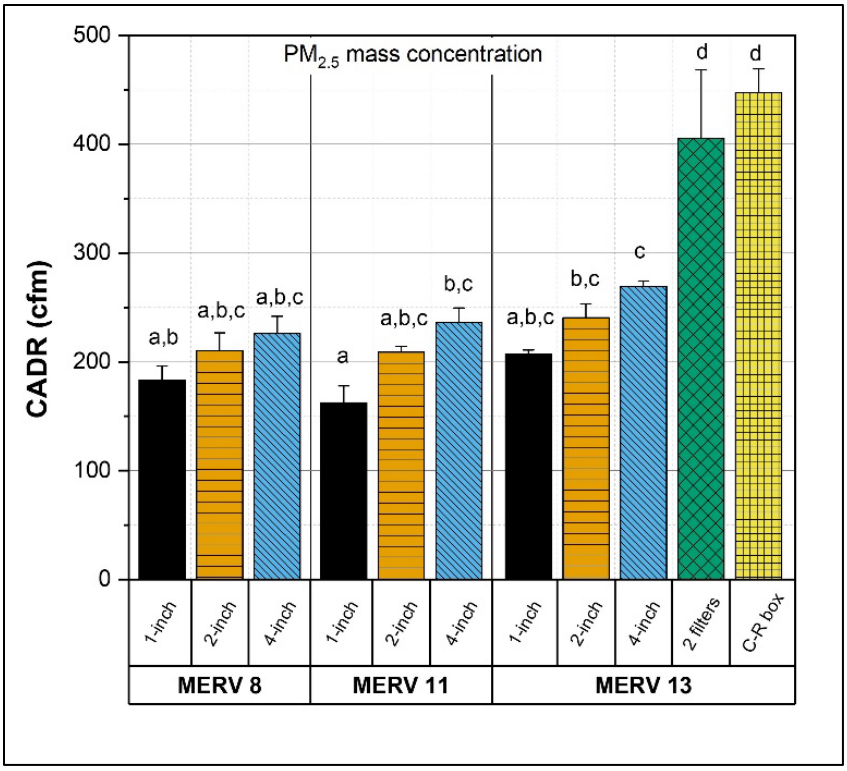

Figure 2. Average CADR of DIY air cleaners when removing $PM_{2.5}$ particles. The x-axis shows filter configurations (MERV rating and thickness), and the y-axis shows their performance in CADR. The matching letters above the bars indicate that the air cleaner performance was not significantly different. All filters in this graph are from the same manufacturer. Figure reproduced with permission of the American Association for Aerosol Research.

How will DEP use the data?

The study clearly demonstrated the utility of DIY air cleaners to remove airborne particles of various sizes, including sizes corresponding to single viruses such as SARS-CoV-2 and virus-carrying droplets. The DEP will be able to advise the public that DIY air cleaners are an affordable and effective option to improve indoor air quality. The study presented strong evidence that DIY air cleaners with higher MERV ratings and filter thickness, as well as with multi-filters, will achieve better performance. The DEP will also be able to provide data on power consumption, noise levels, and costs to build and operate the DIY air cleaners.

Please review the full report for more detailed information

Nirmala T. Myers, Kevin P. Dillon, Taewon T. Han & Gediminas Mainelis. 2023. Performance Evaluation of Different Low-Cost DIY Air Cleaner Configurations, Aerosol Science and

Technology. Available at: https://www.tandfonline.com/doi/full/10.1080/02786826.2023.2249963

Who to contact with further questions.

For more information on this study, feel free to contact Alexander Polissar (Alexander.Polissar@dep.nj.gov).

References:

Rosenthal, J. (2021). IAQ Research-Practice in Action: The Corsi/Rosenthal Box Air Cleaner. *Tex-Air Filters*. Available at https://www.texairfilters.com/iaq-research-practice-in-action-the-corsi-rosenthal-box-air-cleaner/

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