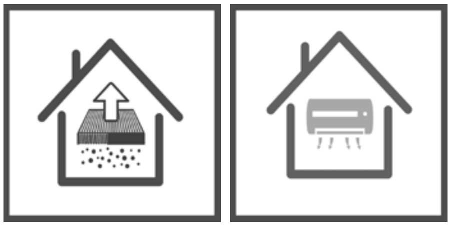

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Tang M, Siegel JA, Corsi RL, Novoselac A. 2023. Impacts of usage conditions on performance of ozone removal devices in ventilation systems. *Building and Environment*, **241**, 110460.
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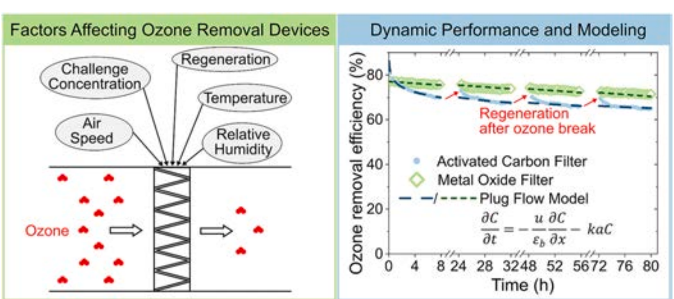
Abstract

Ozone removal devices can be exposed to a wide range of environmental and operating conditions in building ventilation systems, which can affect their ozone removal performance. We evaluated activated carbon and metal oxide filters under varying temperature, relative humidity, ozone concentration, and air speed, as well as after no-ozone periods. Results on new activated carbon filters show that decreasing relative humidity from 50% to 30% decreased single-pass efficiency by 6% relatively at 70 ppb ozone and nearly doubled the degradation rate at 500 ppb ozone; increasing relative humidity to 80% had no effect on efficiency; increasing temperature from 25 to 35 °C increased single-pass efficiency at 70 ppb ozone by 11% relatively and decelerated aging by 22% relatively at 500 ppb ozone. The observed dual effect of water indicates that water can facilitate chemical reactions between ozone and activated carbon, but it can block reactive sites on activated carbon at a high relative humidity. The tested activated carbon and manganese dioxide filters were not sensitive to ozone concentration ranging from 35 to 500 ppb. Activated carbon filters recovered 1%–3% efficiency after 16-h ozone breaks probably due to decomposition of surface oxygen complexes. An air speed increase from 0.6 to 2.7 m/s significantly decreased the single-pass efficiency of all tested devices. A plug flow reactor model proved useful in predicting the impact of air speed on single-pass efficiency as well as the non-linear relationship between single-pass efficiency and time.



Practical Implications

- Impact of various factors on ozone removal performance was quantified.
- Temperature and humidity had a small impact on ozone removal to carbon filters.
- Air speed had largest effect on ozone removal to carbon and metal oxide filters.
- Ozone removal to activated carbon filters was regenerated after a break.
- Dynamic and quasi-steady-state device efficiency was explained by a plug flow model.

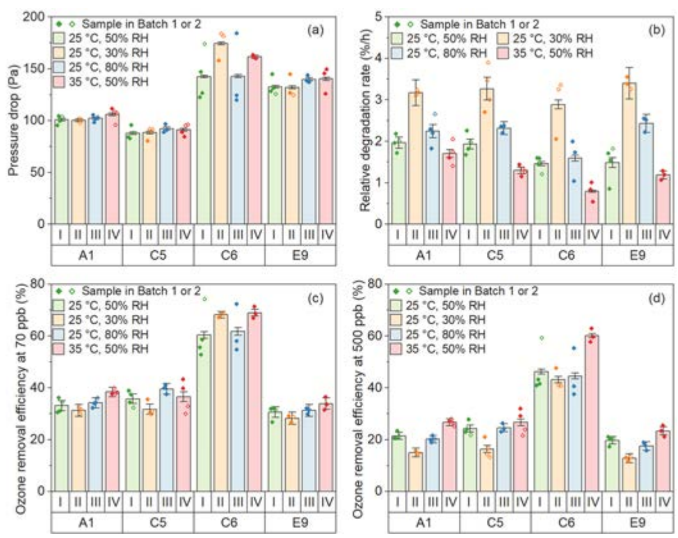


Fig. 2. (a) Pressure drop at 2.5 m/s air speed; (b) Relative degradation rate at 500 ppb; (c) Time-averaged single-pass ozone removal efficiency at 70 ppb; (d) Time-averaged single-pass ozone removal efficiency at 500 ppb. Dots represent each tested sample, and filled and hollow symbols indicate samples in the same batch. Columns represent the mean of samples of the same device type and tested under the same hygrothermal condition, and error bars represent the uncertainty of the mean due to measurement uncertainty. A1, C5, and C6 are 2″ pleated carbon filters; E9 is a 2″ pleated blend filter.

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