Is There a Relationship Between Indoor and Outdoor Aerosol Concentrations?

Purpose
Aerosols are solid or liquid particles suspended in the air. Dust, dirt, smoke, bacteria and pet dander are examples of solid aerosols. Hair spray, bug spray, cooking oil and water are examples of liquid aerosols. Aerosols are important because we breathe them every day.

Filter samples containing aerosol particles were collected from indoor and outdoor sample locations. The purpose of this project was to determine whether the aerosol concentration of particulate material collected on the filters was greater indoors or outdoors and if there was a proportional relationship between inside and outside aerosol concentrations.

Procedure
   - Outside critical orifice mean flow rate = 10.04 ± 0.05 L/min, n = 10
   - Inside critical orifice mean flow rate = 10.15 ± 0.03 L/min, n = 10
2. Install critical orifice in filter sample vacuum supply lines.
3. Connect filter sample lines to filter holders and vacuum pump.
5. Record filter tare weights.
6. Load filters into filter holders.
7. Place outside filter holder in sample location.
8. Place inside filter holder in sample location.
9. Start vacuum pump.
10. Record sample start time.
11. Record weather outside.
12. Record indoor conditions, e.g. dusting, door open, etc.
13. Stop vacuum pump.
14. Record sample stop time.
15. Record weather outside.
16. Record indoor conditions, e.g. dusting, door open, etc.
17. Weigh filters – filter final weight.
18. Calculate filter net weight (μg):
   - Filter final weight – filter tare weight
19. Calculate filter sample collection time (min.):
   - Sample stop time – sample start time
20. Calculate filter sample volume (L):
   - Filter sample flow rate, L/min * filter sample collection time, min
21. Calculate mass per unit volume aerosol concentration (μg/L):
   - Filter net weight (μg) / filter sample volume (L)
22. Calculate statistics: mean, standard deviation, and coefficient of variation.
23. Record data.
24. Graph data.

Results
The outside aerosol concentration was always higher than the inside aerosol concentration except when the carpet was vacuumed or the heater was on. The inside aerosol concentration was higher than the outside aerosol concentration even when the lawn was mowed.

See Table 1. All Filter Data

Inside aerosol concentrations and outside aerosol concentrations varied proportionally regardless of which was higher.

See Figure 1. All Filter Data Graph

Conclusions and Discussion
Multiple filter samples were collected simultaneously from the same indoor and outdoor sample locations to see if there was a relationship between inside and outside aerosol concentrations. The hypothesis was that outdoor concentrations would be higher than indoor aerosol concentrations and that as outside aerosol concentration increased or decreased, inside aerosol concentration would vary proportionally. The hypothesis was correct with the exception of the inside aerosol concentration being higher than the outside when the carpet was vacuumed and when the heater was on at night. Of particular interest was how high the indoor aerosol concentration increased when the carpet was vacuumed and the possible implications to public health, especially for people with asthma or compromised immune systems.

References

Materials
- 47 mm filters, Pallflex Fiberfilm, T60A20, Lot T71032 (Pall Gelman Corp., Ann Arbor, MI)
- Vacuum pump (Gast Manufacturing Corp., Benton Harbor, MI)
- 47 mm filter open-face filter holders (in-Tox Products, LLC, Mortarly, NM)
- Critical orifice, 10 L/min nominal flow rate (in-Tox Products, LLC, Mortarly, NM)
- DryCal DC-Lite primary airflow calibrator, DCL-H rev.1.08, 5/N 7064 (BIOS, Butler, NJ)