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Experimental Studies of Short Term Resuspension Factor Following Particulate Release

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Introduction

- The **internal dose** from inhalation of radionuclides from a contaminated surface depends on airborne fraction [1]:

$$D_{inh} = C_{D,inh} \times f_B \times \mathbf{KP}$$

- A **resuspension parameter** is used to predict time-integrated suspended fraction, but current models of the **resuspension factor** (Bq m-3/Bq m-2) are semi-empirical and less applicable at early timeframes [2, 3].

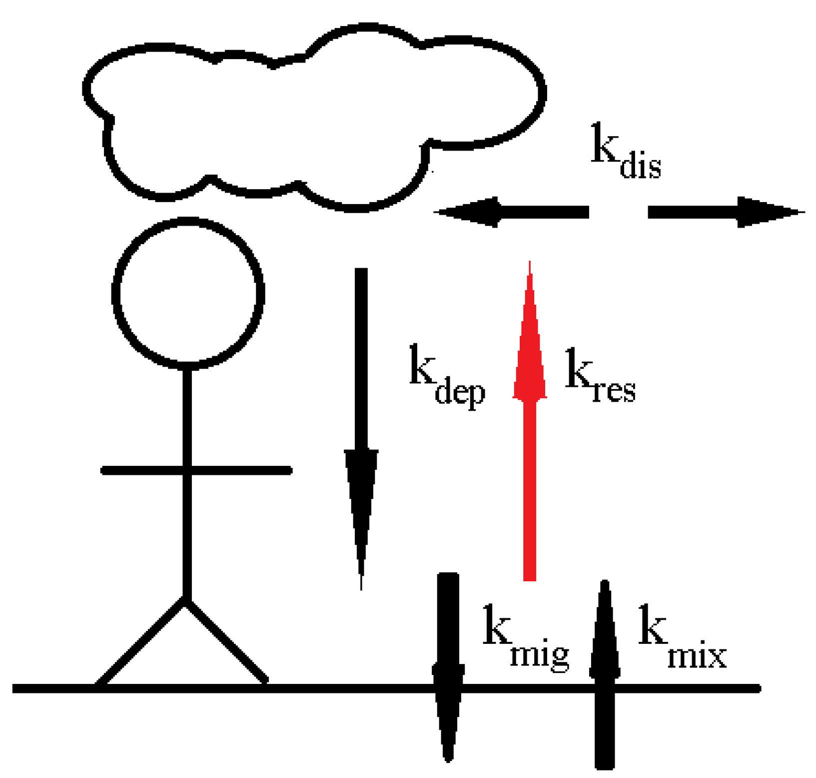

Fig 1: Sketch of kinetic parameters of outdoor particulate transport.

- Kinetic compartment models were explored as a physical basis for transport, and three-compartment models (airborne, surface, and in-ground) were used to fit historic data [4]:

$$\mathbf{K(t)} = X_1 e^{w_1 t} + X_2 e^{w_2 t} + X_3 e^{w_3 t}$$

- Indoor "resuspension chambers" and neutron activation analysis were used to validate models and obtain kinetic parameters.

Methodology

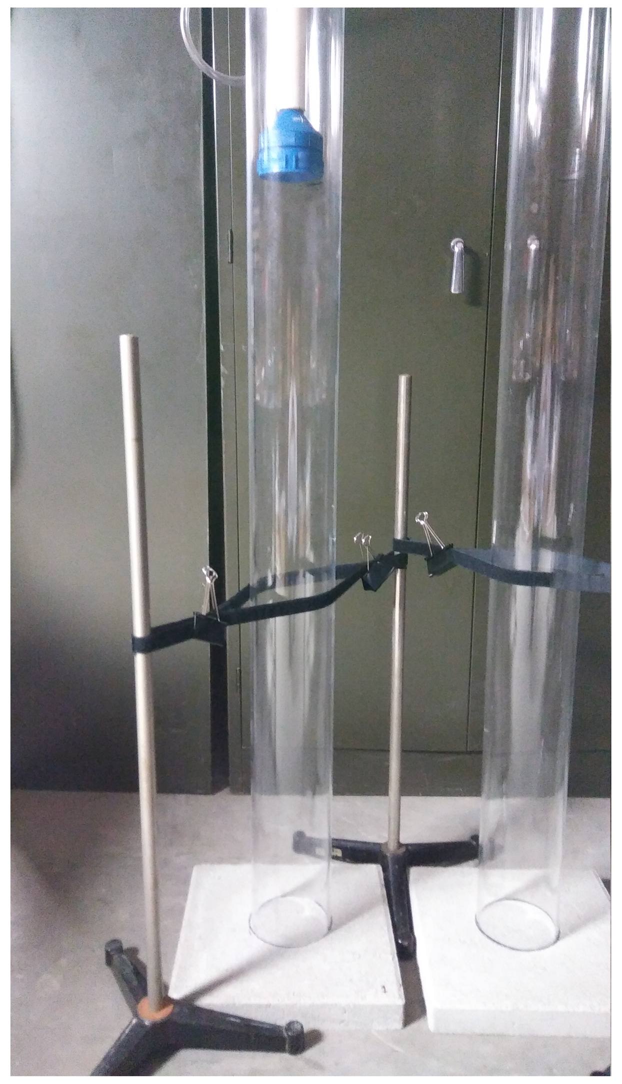

Fig 2: In-house resuspension chamber used to experimentally probe resuspended concentrations of powder atop concrete within an acrylic tube.

- Deposit 1 g Eu_2O_3 powder directly upon concrete surface or drop from above.
- Sample air concentration at height of 1 m with low volume rate (2 Lpm) daily or weekly.
- Activate air sampler filters with thermal neutrons.
- Perform gamma spectroscopy on activated filters with Ge(Li) detector to quantify Eu content.

Fig 3: DD110M neutron generator (Adelphi Technology, Inc.) uses a DD reaction moderated by aluminum and shielded with borated polypropylene to irradiate air sampler filters for activation analysis.

Preliminary Results

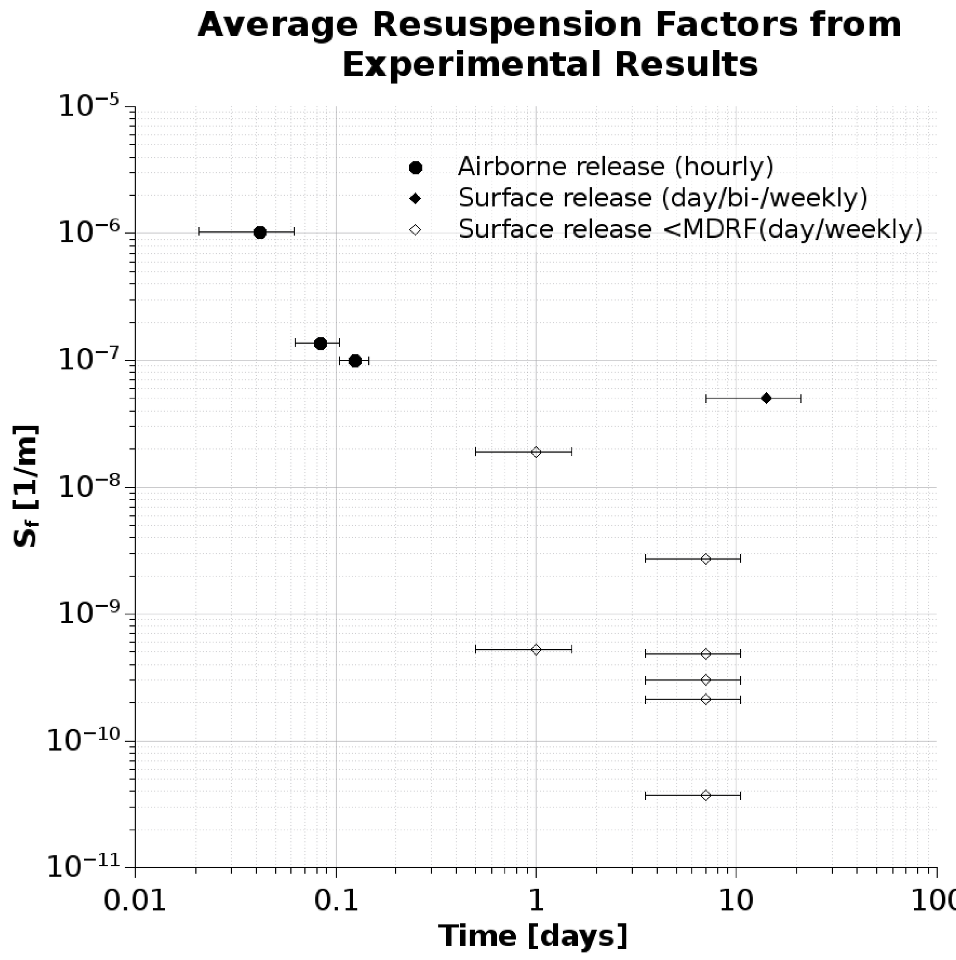

Fig 4: Experimental resuspension factors with null points shown by minimum detectable resuspension factor.

- Particulates from airborne release were immediately found directly on surface in large fraction.
- Minimum detectable resuspension factor ranged from 10^{-11}-10^{-8} m^{-1} based on detection limits of neutron flux and Ge detector efficiency.
- Surface release particulates were not detected until a biweekly sampling period was used.

Discussion

- Air and surface release resuspension factor observations are **10-100x** lower than previous estimates.
- Air release results are indicative of initially **suspended** particulates, which questions *initial resuspension* quantity **K(t=0)** in current models.
- Additional observations are necessary to fit model equation and extract micro-rate parameters.
- Future work includes probing the effects of particle size distribution and surface composition, and using a large-scale experimental chamber to remove any confinement effects.

References

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