Evaluation of the Validity of the Inhalable and "Total" Dust Performance Ratio

Benjamin J. Getschman and T. Renée Anthony

Department of Occupational and Environmental Health, The College of Public Health, The University of Iowa

Background

Inhalable aerosol personal samplers were created to accurately sample the fraction of aerosol that penetrates the nose and mouth airways. The inhalable fraction is defined as having a 50% collection efficiency at 100 µm.

Traditional aerosol sampling is performed with 37-mm closed-face cassettes (CFC), which have lower sampling efficiencies than inhalable samplers, particularly for particle diameters greater than 30 µm. The fraction of aerosol collected by the CFC is considered "total" dust.

Performance ratios (S) have been determined to relate "total" to inhalable dust concentrations. **The most commonly used performance ratio for dusts is 2.5.**

Objectives

The objective of this study was to evaluate this performance ratio (S) during bulk material dispensing operations. Three specific research questions were examined: Does S vary by:

- Dust type
- Inhalable sampler type
- Distance from the dust source

Methods

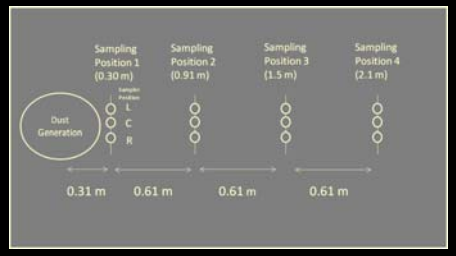
A bulk dust dispensing unit was placed inside a calm air chamber. Airborne dust was generated by dispensing sawdust, flour, and glass microbeads.

An IOM sampler, Button sampler, and CFC sampler were each placed at four locations, increasing in distance from the dust source. Concentration was measured for each sampler at each location.

Performance ratios (S) were computed for each location, dust and repeat test. The mean ratio used linear regression with the origin forced through zero. To assess the effects of distance from the dust source on S, another linear regression model including distance was used.

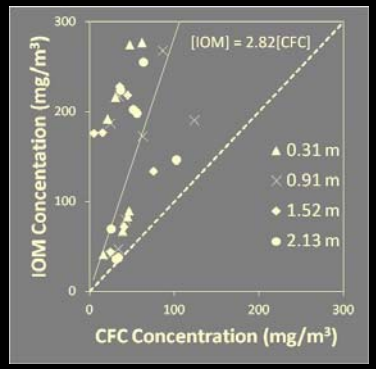
Experimental Set-up

Locations of Samplers and Dust Source



Inhalable Aerosol Samplers
(Located 1.5 m above the Floor)

Paired Mass Concentrations
(Flour Dust)



Results

Computed Performance Ratios by Dust Type and Sampler Type

[Inhalable] = S × ["Total"]

Dust Type	S	95% C.I.	R^2
Sawdust			
IOM/CFC	**1.62**	**(1.37, 1.87)**	**0.85**
Button/CFC	0.82	(0.71, 0.93)	0.88
Button/IOM	0.46	(0.38, 0.54)	0.81
Flour			
IOM/CFC	**2.82**	**(2.15, 3.49)**	**0.71**
Button/CFC	1.04	(0.98, 1.10)	0.77
Button/IOM	0.32	(0.11, 0.53)	0.81
Glass Beads			
IOM/CFC	**2.97**	**(1.59, 4.35)**	**0.38**
Button/CFC	0.57	(0.41, 0.73)	0.64
Button/IOM	0.11	(0.08, 0.14)	0.62

Performance ratio (S) differed by dust type and sampler type.

A significant difference (p=0.049) was found between IOM and Button personal samplers.

The Button sampler performance more closely resembled CFC performance than IOM performance.

Conclusions

Performance ratio differed according to dust type and inhalable sampler type.

While distance did not account for the variability in between-sampler differences, a single performance ratio for all dust types is not advised.

Future Research

Further research into performance ratios calculated for different dust substances is needed.

This research was funded by CDC/NIOSH Education and Research Center Training Grant, T420H00849

UI COLLEGE OF PUBLIC HEALTH
DEPT OF OCCUPATIONAL & ENVIRONMENTAL HEALTH