Laboratory Evaluation to Reduce Respirable Crystalline Silica Dust When Cutting Concrete Roofing Tiles Using a Masonry Saw

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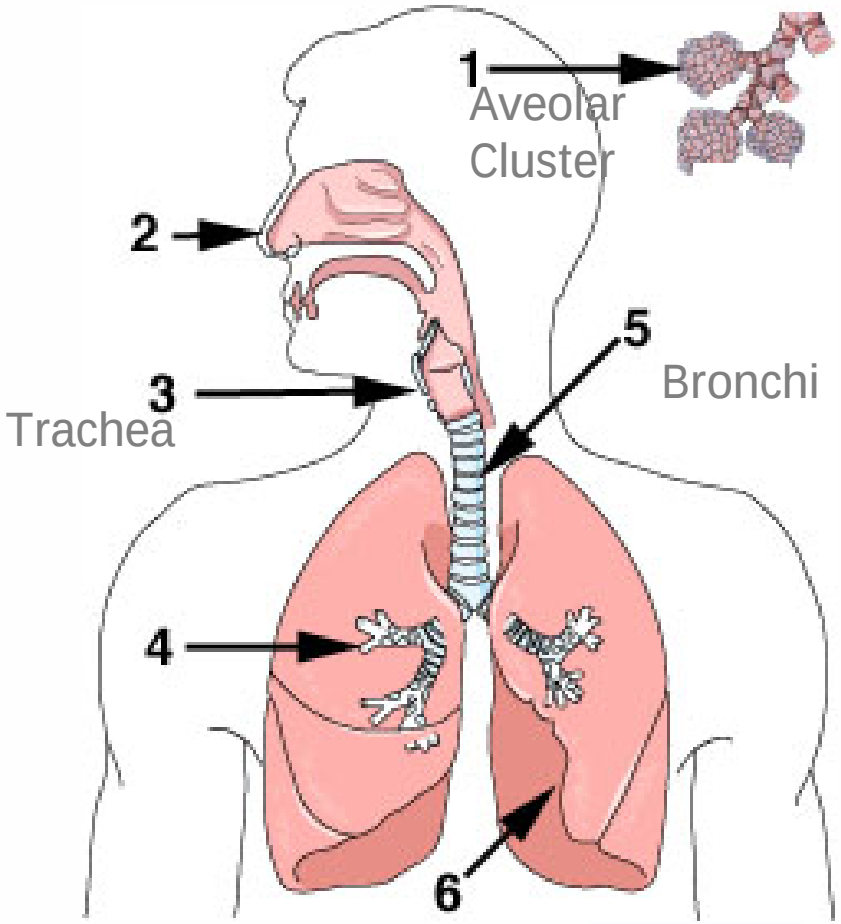
Outline of Presentation

- Silica exposure and project background
- Methodology
- Results
- Conclusions
- Discussion

Silica Exposure Facts

- Crystalline silica is classified as a potential occupational carcinogen by NIOSH and classified as an A2 *Suspected Human Carcinogen* by ACGIH
- An estimated 1.7 million U.S. workers are currently exposed to respirable crystalline silica (NIOSH 1991; Yereb, 2003)
- More than 250 U.S. workers will die from silicosis each year
- Roofers are exposed from 0.03-0.33 mg/m^3 of respirable silica dust while cutting concrete roofing tiles (% silica ranged from 9.5- 21.7%)
- Due to rapid industrial expansion in developing countries, overexposure to respirable crystalline silica is an international problem

Respirable Crystalline Silica Dust Enters and Impacts Your Body



Symptoms Include:

- Shortness of breath
- Lung disease
- Pulmonary problems
- Chronic or severe cough
- Chest pain
- Fatigue
- Fever
- Cyanosis or blue skin

Exposure Criteria

NIOSH (REL)

0.05 mg/m^3 (TWA) for up to a 10-hr workday during a 40-hr workweek

ACGIH (TLV)

0.025 mg/m^3 (TWA) for up to a 8-hr workday during a 40-hr workweek

OSHA General Industry Standard

PEL = $\frac{10 \text{ mg/m}^3}{\% \text{ Silica} + 2}$

OSHA Construction Standard

PEL = $\frac{250 \text{ mppcf}}{\% \text{ Silica} + 5}$

Note: Apply a conversion factor of 0.1 mg/m^3 per mppcf

Summary of 3 Health Hazard Evaluations conducted in Spring `03 and Fall `04

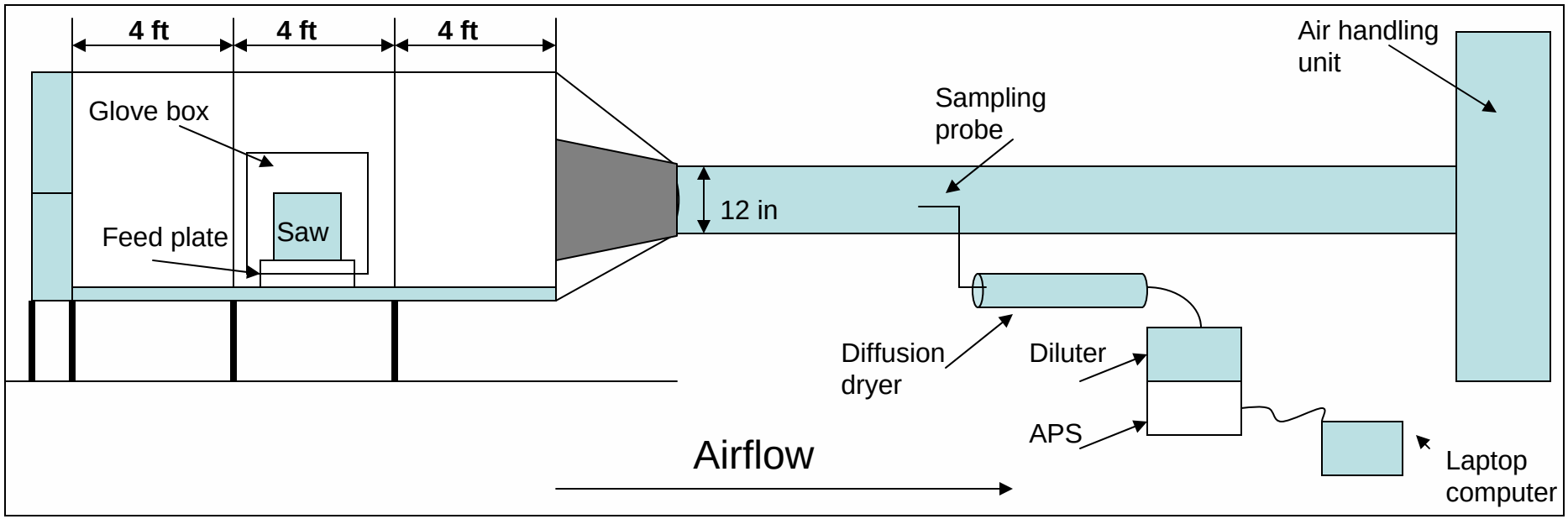
- **General OSHA Standard for Respirable Silica**
  - 74% of the TWA samples exceeded the PEL
- **Construction OSHA Standard for Respirable Silica**
  - 33% of the TWA samples exceeded the PEL
- **NIOSH and ACGIH® Criteria**
  - 87% of the respirable silica TWA's were exceeding the REL and TLV

Case Study

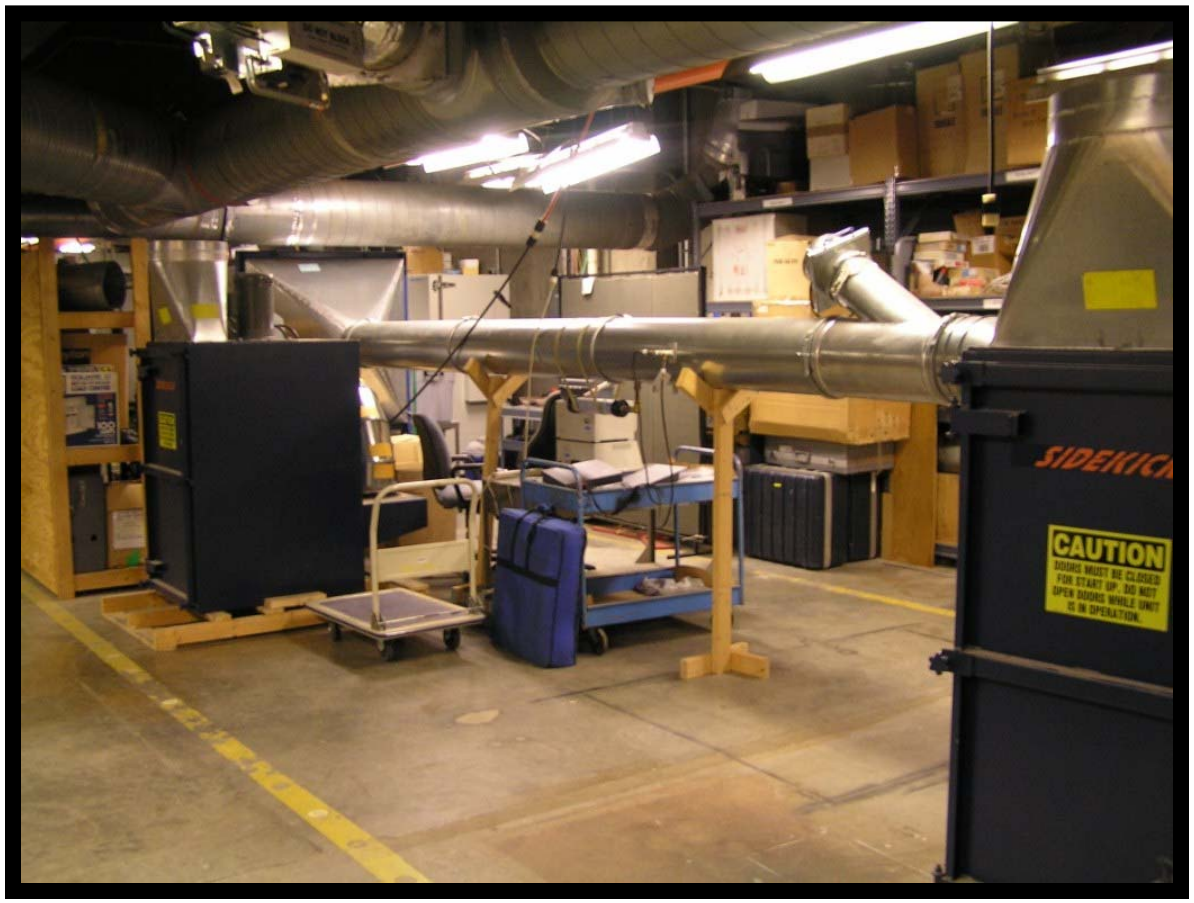
- **Objective:**
  - Report effectiveness of a commercially available local exhaust ventilation system (LEV) and a water suppression system to reduce silica exposures
  - Estimate the impact of reducing air and water flow rates when operating a masonry saw

- **Experimental Design:**
  - LEV exhausted 500, 280, and 250 cfm
  - Water suppression system supplied 2, 1, 0.5, 0.35 gpm
  - No Control

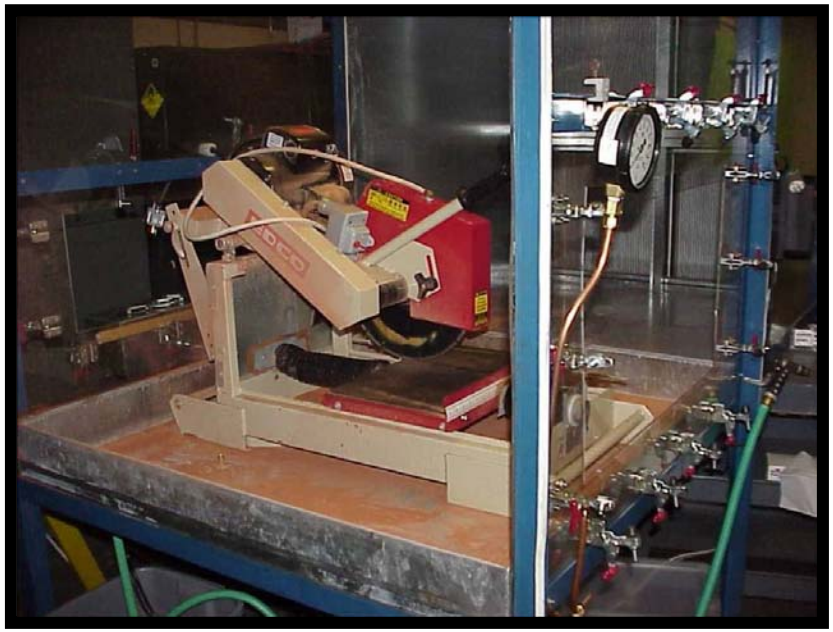
Testing Chamber

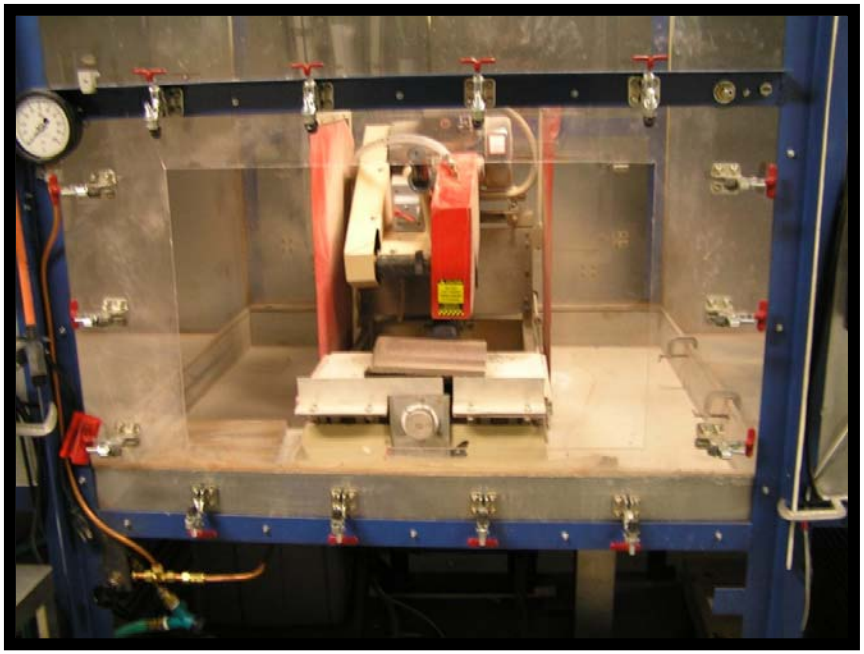


Testing Laboratory

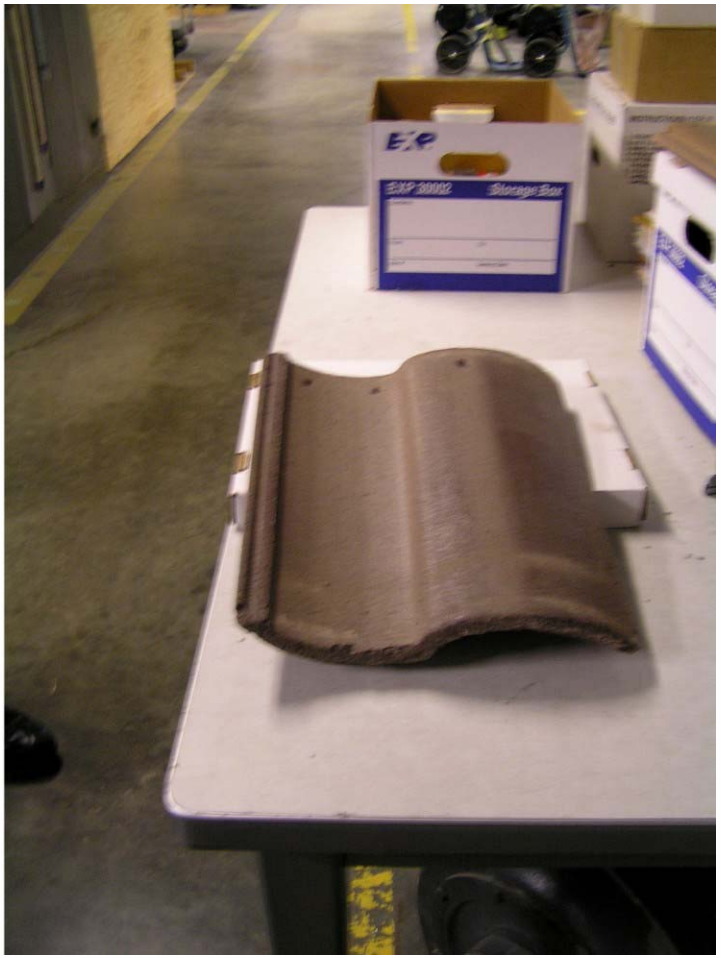


Masonry Saw





Sample Tiles

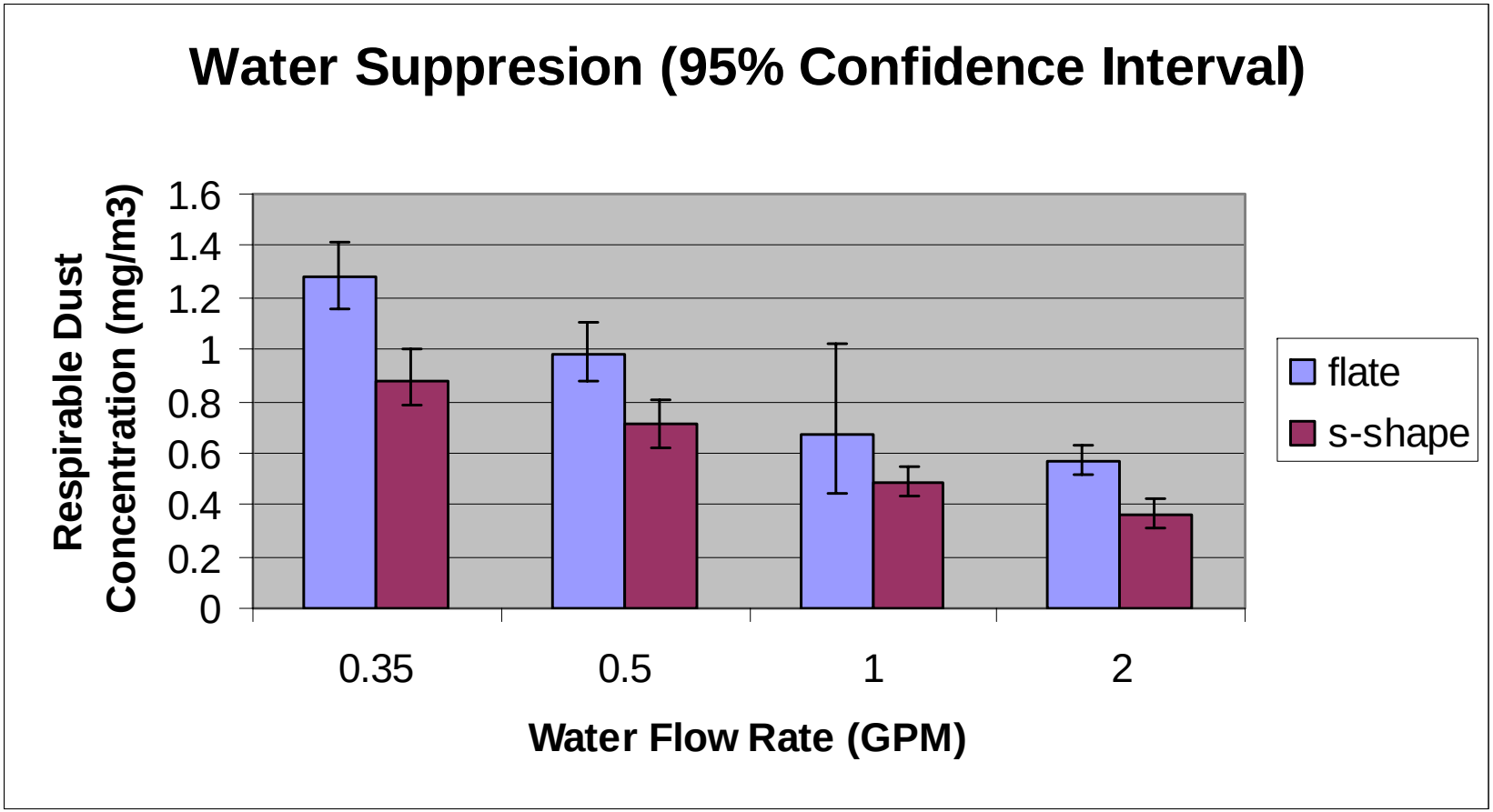


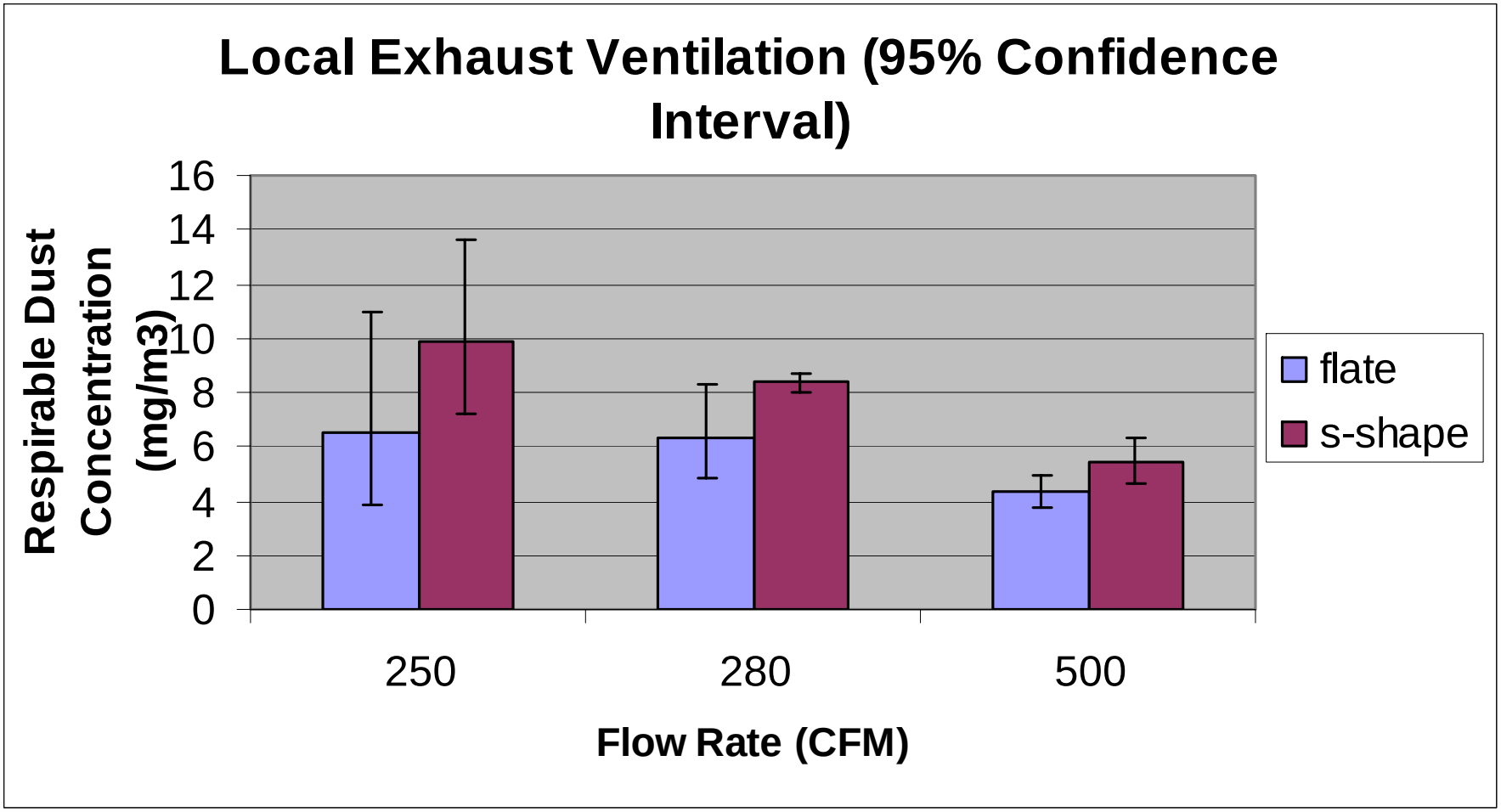
Water Suppression Results

Tile	Water Flow Rate (GPM)	Number of Samples	Geometric Mean Respirable Dust (mg/m^3)	Geo. Std. Dev.	% Reduction
Flat	0	8	49.7	1.04	_
Flat	0.35	4	1.28	1.06	97.4
Flat	0.5	4	0.98	1.07	98
Flat	1	4	0.67	1.30	98.7
Flat	2	8	0.57	1.12	98.9
S-Shape	0	8	39.2	1.04	_
S-Shape	0.35	4	0.88	1.08	97.8
S-Shape	0.5	4	0.71	1.08	98.2
S-Shape	1	4	0.49	1.08	98.8
S-Shape	2	8	0.36	1.20	99.1

Local Exhaust Ventilation Results

Tile	Air Flow Rate (CFM)	Number of Samples	Geometric Mean Respirable Dust (mg/m^3)	Geo Std. Dev.	% Reduction
Flat	0	4	49.7	1.04	_
Flat	250	3	6.48	1.23	87
Flat	280	4	6.32	1.18	87.3
Flat	500	8	4.32	1.17	91.3
S-Shape	0	4	39.2	1.04	_
S-Shape	250	3	9.90	1.14	74.8
S-Shape	280	4	8.37	1.03	78.7
S-Shape	500	8	5.42	1.21	86.2





Variance and Tukey Multiple Comparison Results

- LEV control

  S-shape tile has a significant higher mean concentration than the flat shape tile

  500 CFM has a significantly lower mean concentration than 280 or 250

- Water suppresion

  Flat shape has a higher mean concentration level than s-shape

  Statistically significant differences were found among all water flow rates

Water is better at controlling respirable dust

Caveats for Water Suppression

- Water source and disposal requirements
- Surface discolorations
- Clean-up
- Slips and falls

Summary & Conclusions

- Water control reduced respirable dust by approximately 97.4% for both flat and s-shape tiles
- LEV control reduced respirable dust from 87.0-91.3% for flat tiles and 74.8-86.2% for s-shape tiles
- Engineering controls are available; however precautions must me taken to choose the best one

Acknowledgments

I would like to thank my co-workers who have helped me immensely during this study. They are:

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The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy

Questions???

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