OMSHR

Office of Mine Safety and Health Research

Dust Suppression Hoppers Reduce Airborne Respirable Dust During Bulk Loading

Jay Colinet, Andy Cecala, Jim Noll - NIOSH

Jamie Robinson – Unimin Corporation

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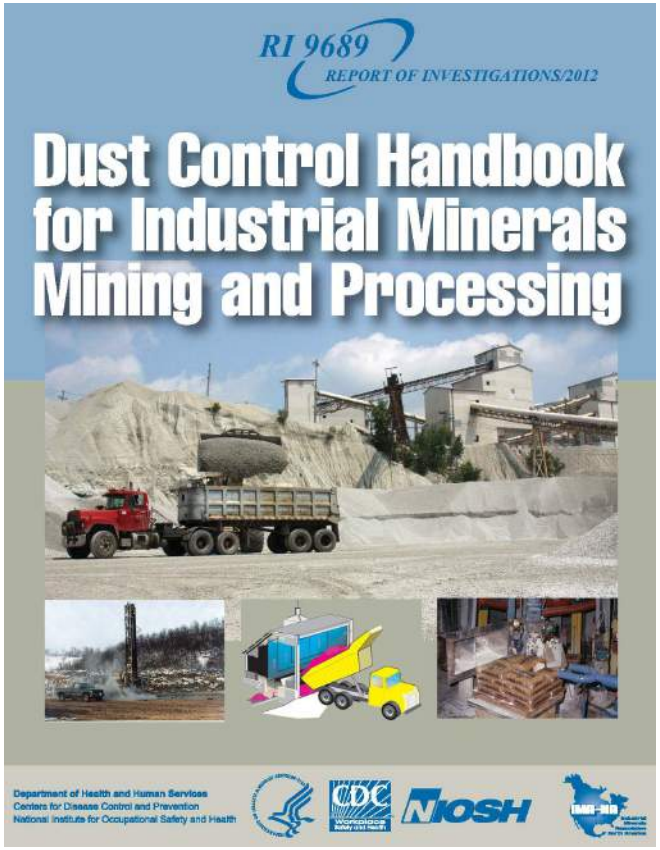
Presentation outline

- background
- dust suppression hopper (DSH)
- case study #1 - NIOSH
  - test conditions
  - sampling protocol
  - results
- case study #2 – Jamie Robinson
- conclusions

Background

- preparing handbook with IMA-NA
- Chapter 7 – Bulk Loading
- DSH identified in literature search as potential control
  - New Zealand company
  - limited data from Australia
- US sand companies installed units
- conducted case studies to evaluate effectiveness



Dust suppression hopper

- designed to load product in a solid column
  - reduces air in product
  - minimize entrainment of dust
  - eliminates need to raise/lower loading spout
- hopper equipped with plug that prevents discharge until predefined quantity has accumulated
- springs or PLC used to control clearance for discharge

Load-Out Rates

DSH MODEL	Bushels Per Hour	Tons Per Hour (48 PCF)	Tons Per Hour (100 PCF)
DSH MINI	800 - 3,200	25 - 95	50-200
DSH 1	3,200 -5,000	95 - 150	200 - 310
DSH 2	5,000 - 8,200	150 - 245	310 - 510
DSH 3	7,300 - 12,800	220 - 380	450 - 790
DSH 4	12,800 - 20,000	380 - 600	790 - 1,200
DSH 5	20,000 - 29,000	600 - 860	1,200 - 1,800
DSH 6	29,000 - 39,000	860 - 1,175	1,800 - 2,400
DSH 7	39,000 - 52,000	1,175- 1,530	2,400 - 3,200
DSH 8	52,000 - 65,000	1,530 - 1,940	3,200 - 4,100
DSH 9	65,000 - 80,000	1,940 - 2,400	4,100 - 5,000

GUIDELINES ONLY

Case study # 1

- plant loads open-bed truck on an intermittent basis
- 2013 – sampled baseline conditions
- DSH and associated equipment then installed
- 2014 – sampled DSH on two occasions
- only fully loaded trucks were included in analysis

Sampling methodology

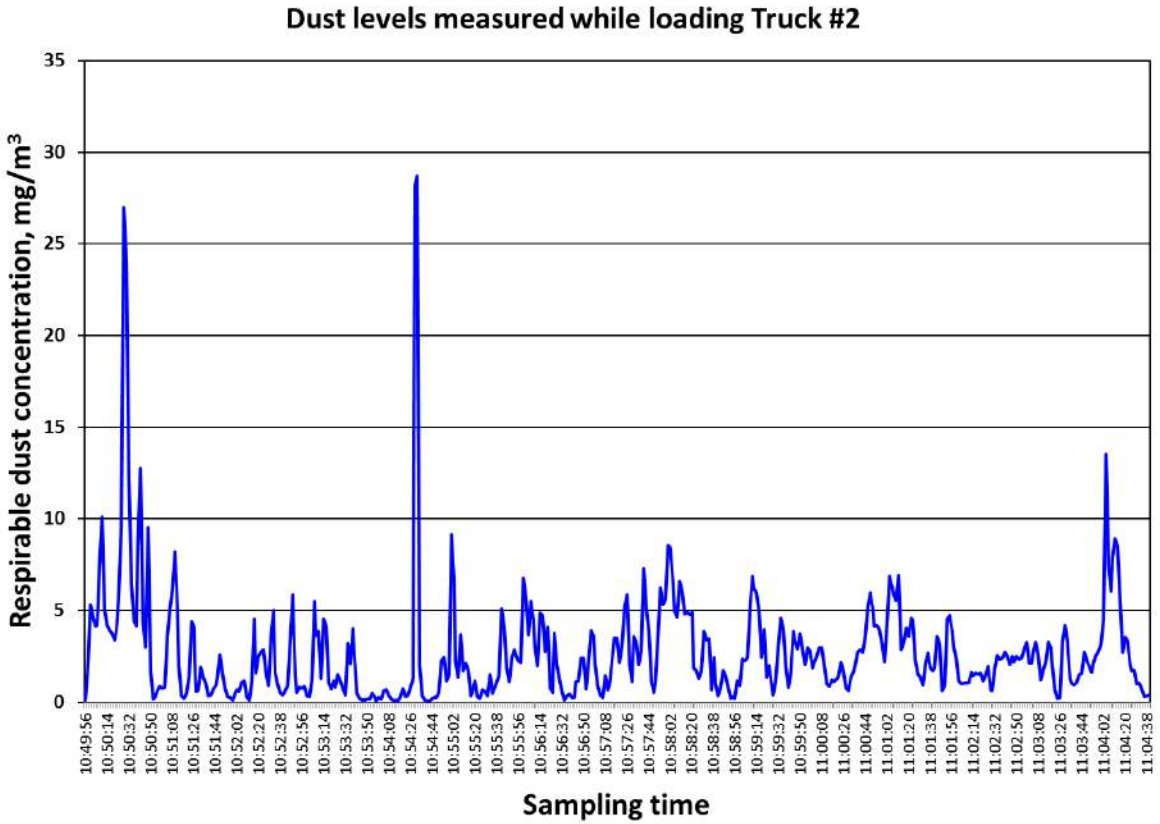
- quantify respirable dust generation; not exposures
- sampling packages located at four inside corners of bed
- gravimetric and instantaneous, light-scattering samplers
- samplers started just prior to loading and removed/stopped after each truck was loaded
- four locations combined to get average truck concentration

Sampling methodology

- short term sampling – 4 to 16 minutes to load a truck
- utilized one set of gravimetric filters per sampling day
- close proximity to loading resulted in elevated dust concentrations
- zeroed personal Data Ram (pDR) periodically

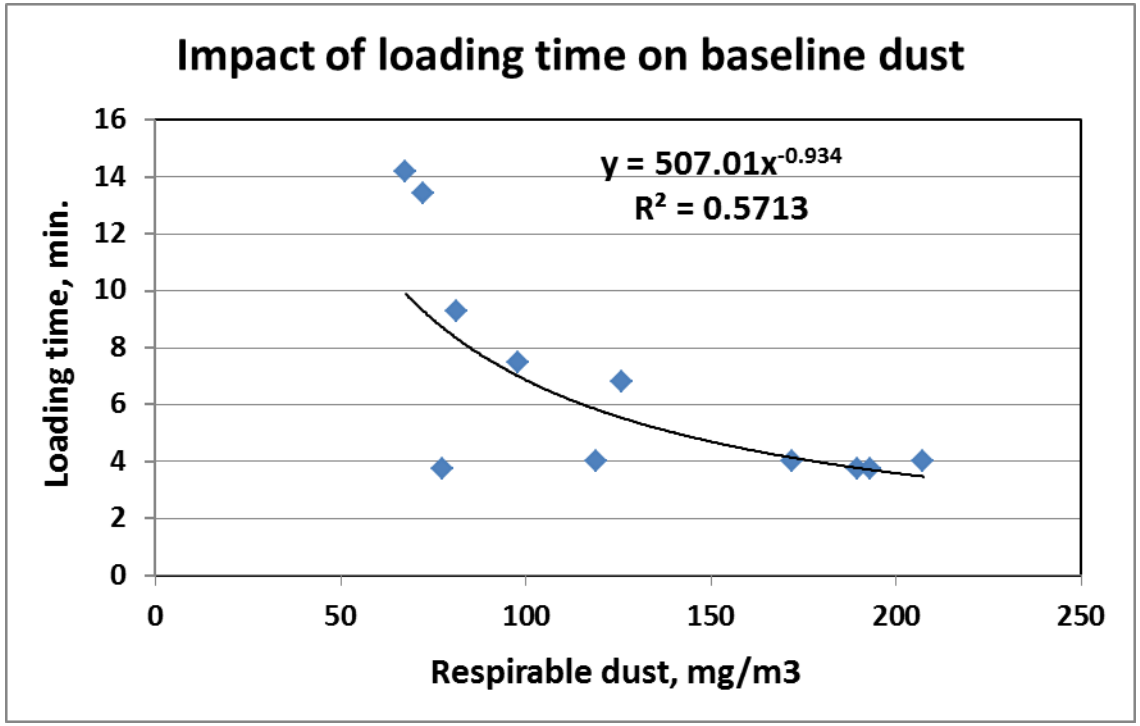
Data analysis

- pDR data adjusted with gravimetric/pDR ratio
  - ratio = (avg grav conc) ÷ pDR conc
  - ratio calculated for each sampling location for each day of sampling
- pDR data from 4 locations used to calculate average concentration for each truck loaded

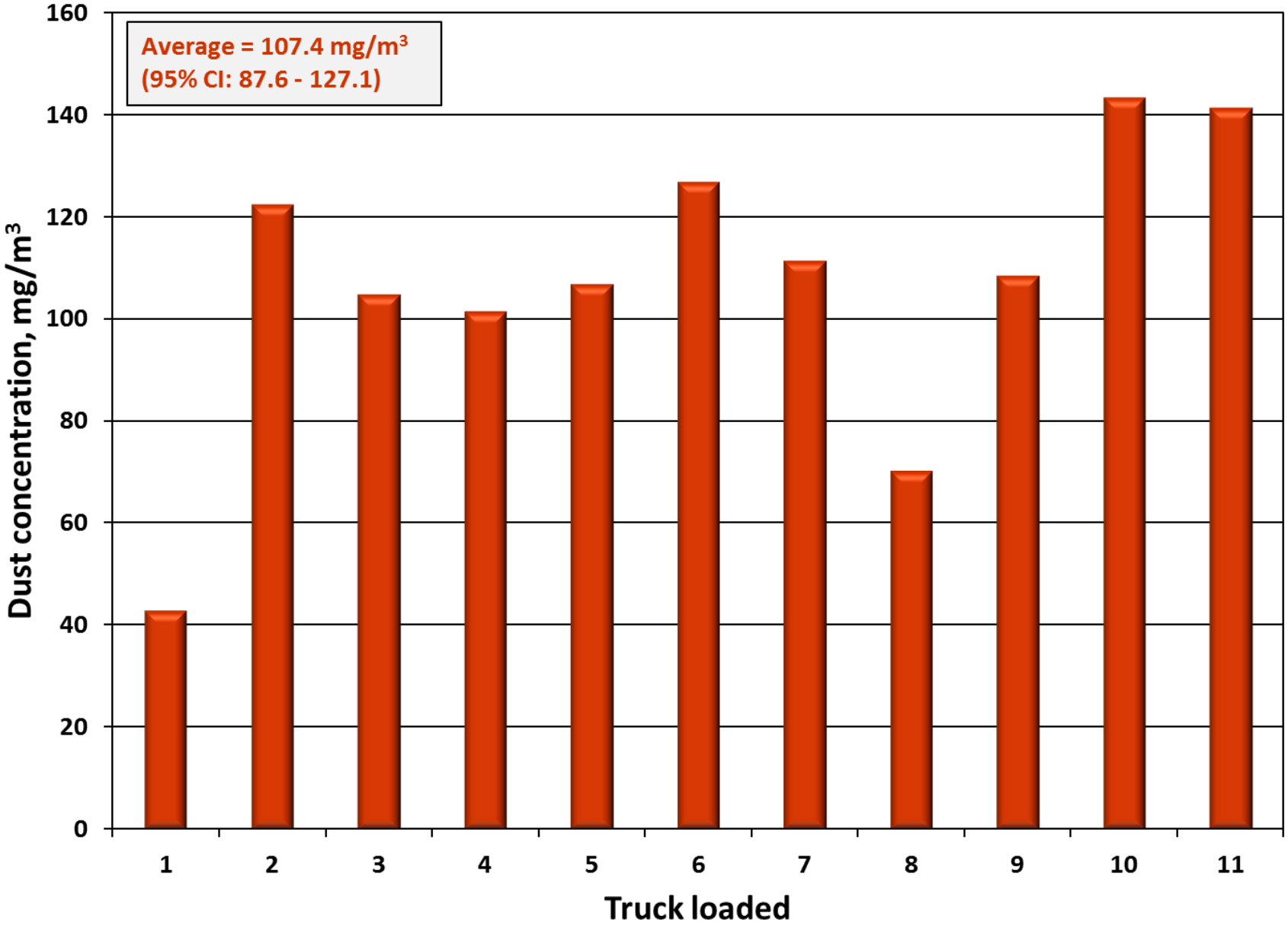


Data analysis - baseline

- average loading time (alt) = 6.8 minutes
- truck loading times (tlt) varied from 3.8 to 14.2 minutes
- relationship between loading time and dust
- normalized dust concentrations = (tlt/alt) x truck concentration



Normalized dust levels from baseline sampling



DSH installation

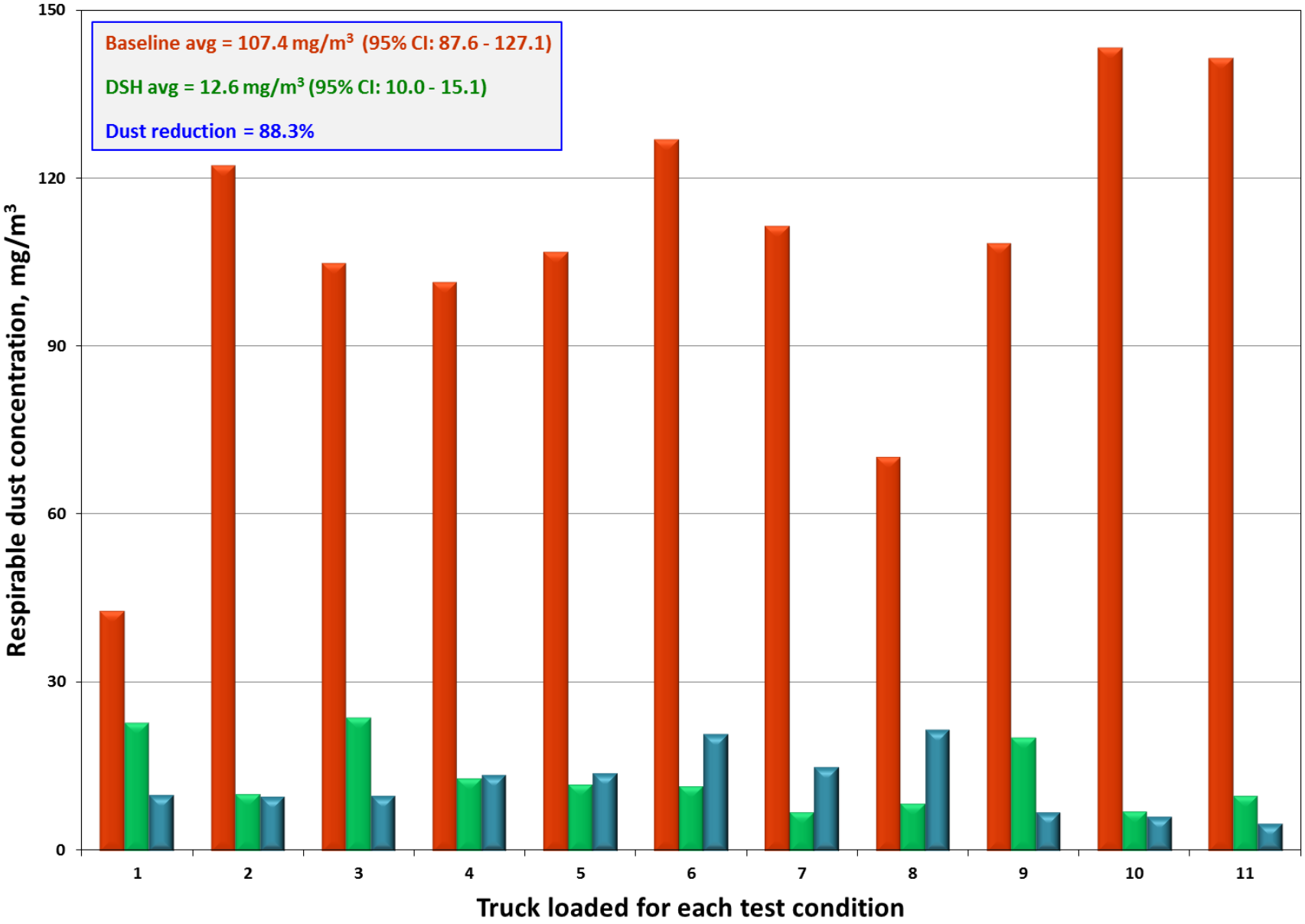
- multiple product silos used to load trucks
- added bucket elevator to feed material to DSH
- all silos fed into bucket elevator system
- more consistent but slower feed rate when compared to loading during baseline

DSH installation and operation

DSH sampling

- **July survey**
  - 11 trucks sampled
  - 13.5 minute average loading time
  - 13.2 mg/m^3 average
- **August survey**
  - 11 trucks sampled
  - 13.8 minute average loading time
  - 12.0 mg/m^3 average

Dust levels from baseline and DSH sampling



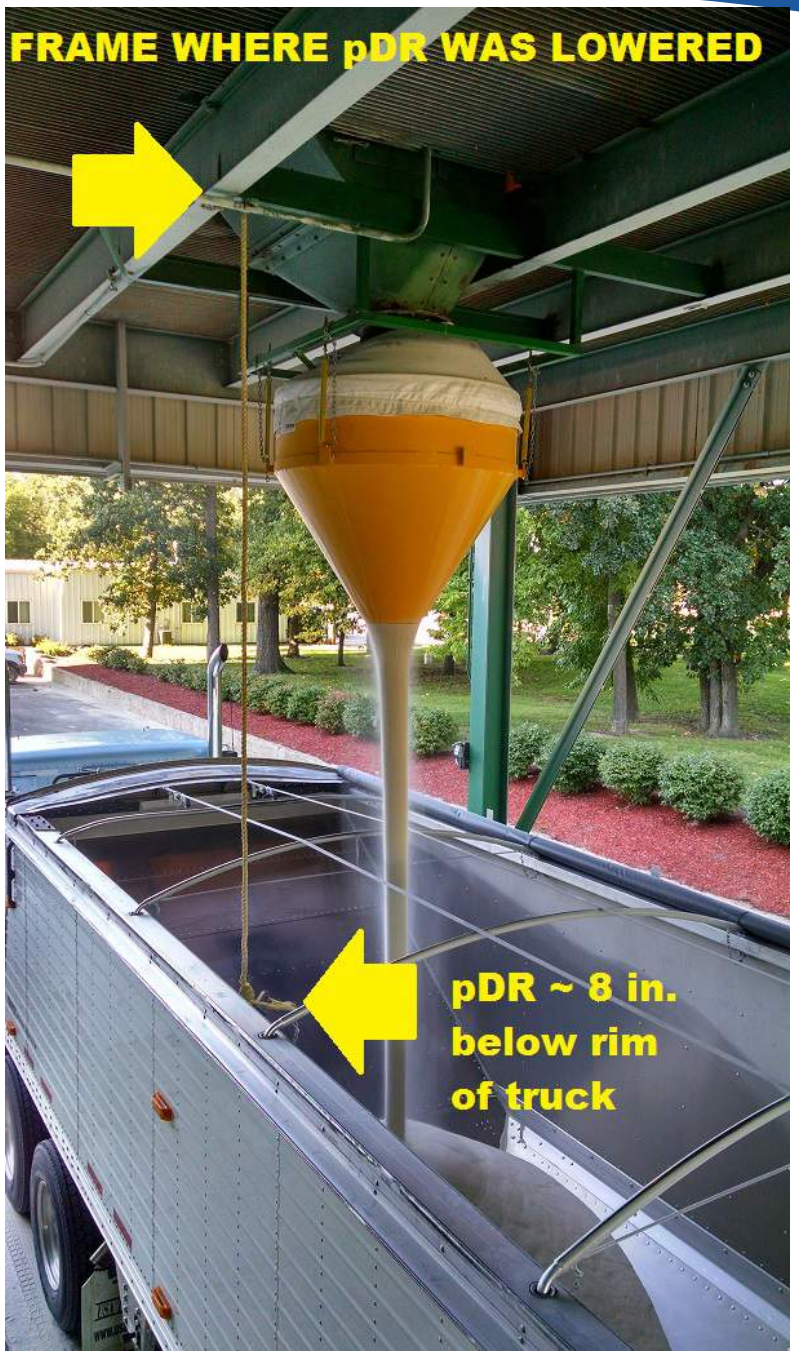
Case study # 2

- open-top trucks intermittently loaded throughout the day
- baseline readings taken few days prior to installation
- DSH installation took ~1 day
- two trucks sampled prior to install
- two trucks sampled post install

Sampling methodology

- quantify fugitive dust generation; not exposures
- Single direct-reading monitor (pDR) used, hung ~ 24 inches from column and ~8 inches below rim of trailer
- sampler started just prior to loading, lowered and removed/stopped after each truck was loaded
- single location


FRAME WHERE pDR WAS LOWERED
pDR ~8 in. BELOW RIM OF TRUCK


FRAME WHERE pDR WAS LOWERED
pDR ~ 8 in.
below rim
of truck

Data analysis

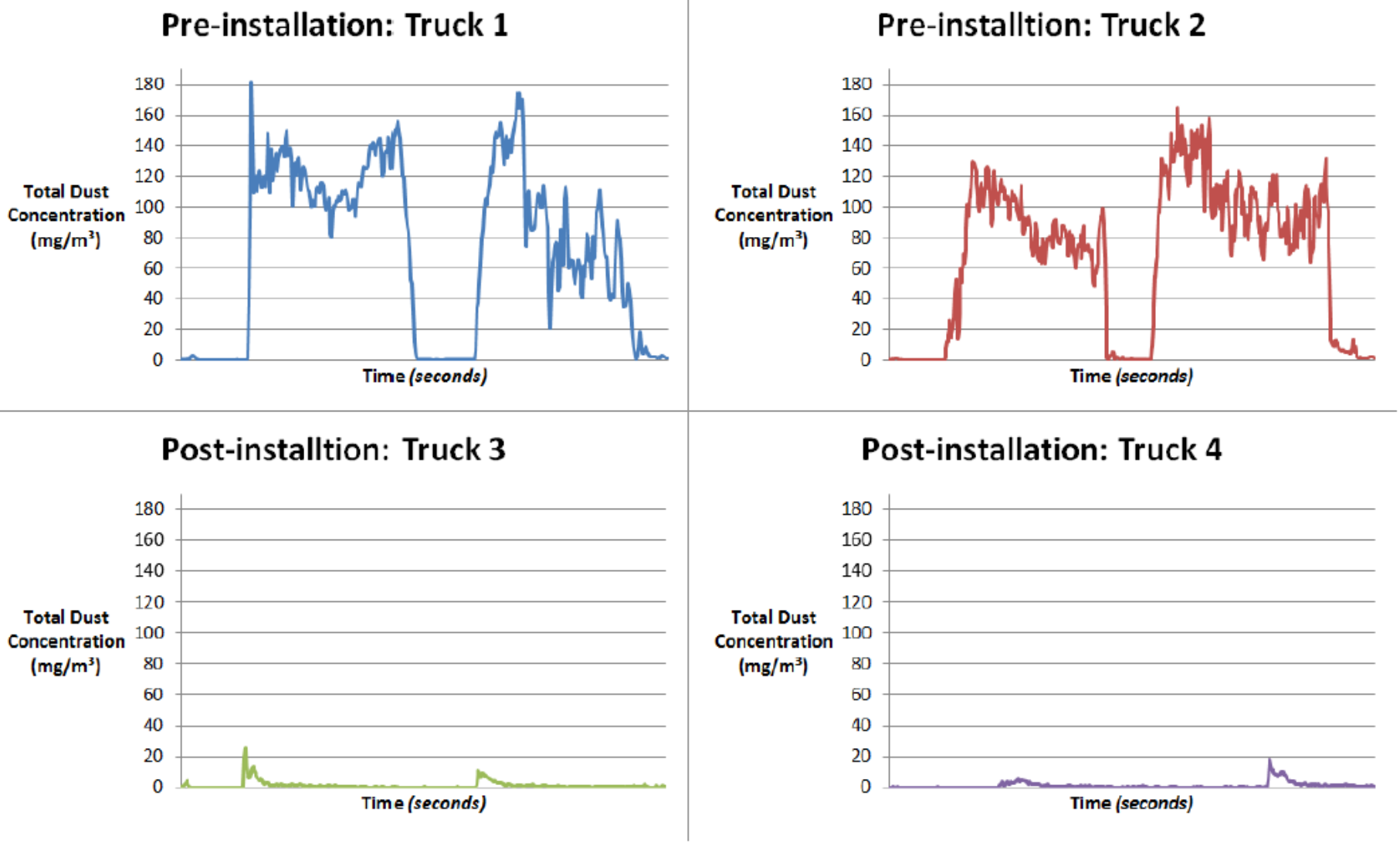


Figure 5 - Independently graphed data measuring Total Dust generated during open top truck loading before and after the installation of a DSH Hopper at the Ottawa, MN Plant using a pDR-1000.

Conclusions

- DSH reduced respirable dust liberation by
  - 88% case study #1
- DSH reduced Total Dust
  - 98% case study #2
- DSH operating without major maintenance problems

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Costs

- Ottawa, MN
- ~$20K for DSH
- The value of dust control that this technology potentially brings for the minerals industry speaks for itself.

Future Installations

- Utica, IL
- Marston, NC
- Oregon, IL

- Unimin and NIOSH hope to continue to evaluate the efficiency of the DSH systems with various field- installations.

Thank you!

Questions??

Jay Colinet
NIOSH
P.O. Box 18070
Pittsburgh, PA 15236

412-386-6825
jcolinet@cdc.gov

Jamie Robinson
Unimin Corporation
48 West Boscawen St.
Winchester, VA

540-678-1490
jrobinson@unimin.com