Dust Suppression Hoppers Reduce Airborne Respirable Dust During Bulk Loading

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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

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<th>Load-Out Rates</th>
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<td><strong>DSH MODEL</strong></td>
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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

```
y = 507.01x^{0.934}
R^2 = 0.5713
```
Normalized dust levels from baseline sampling

Average = 107.4 mg/m³
(95% CI: 87.6 - 127.1)
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/m³ average

• **August survey**
  - 11 trucks sampled
  - 13.8 minute average loading time
  - 12.0 mg/m³ average
Dust levels from baseline and DSH sampling

Baseline avg = 107.4 mg/m³ (95% CI: 87.6 - 127.1)
DSH avg = 12.6 mg/m³ (95% CI: 10.0 - 15.1)
Dust reduction = 88.3%
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
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
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
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??

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