

Wet Sand as a Silica Dust Control: Performance and Logistics Compared to Existing Controls

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Agenda

- Introduction
 - Exposure limits by play
 - Silica as a commodity
- OVV Existing Controls
 - What's worked?
- OVV Wet Sand
 - Why wet sand?
 - Exposure data
 - Where are we headed?



Operations and exposure limits

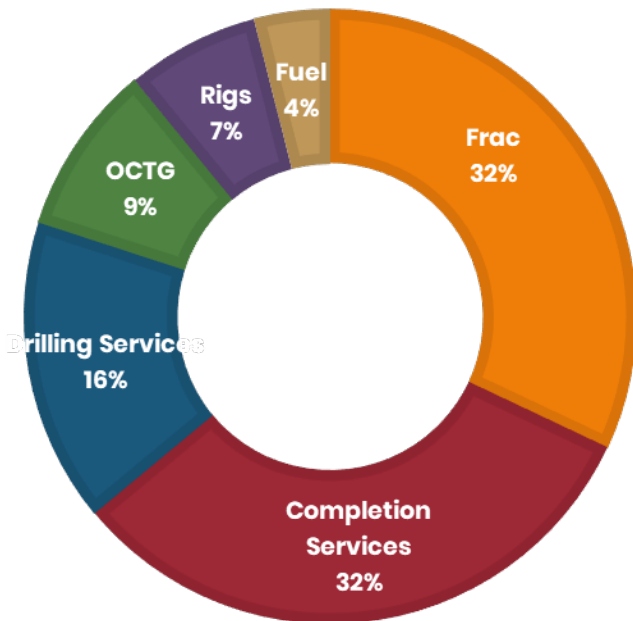
- Operating areas across North America
 - Regulatory bodies and infrastructure vary widely.
- Exposure limits
 - BC Montney - WorkSafe BC
 - 2006 was changed to 0.025 mg/m³ (25 ug/m³)
 - 2016 requirements for qualified person performing site risk assessments
 - Alberta Duvernay - AB OHS
 - 2009 was changed to 0.025 mg/m³ (25 ug/m³)
 - OSHA - 2016 issues final rule, EL enforced 2018
- Controlling employer/Prime Contractor
 - As controlling employer, OVV has sampled all workers on site directly in order to build better engineering controls



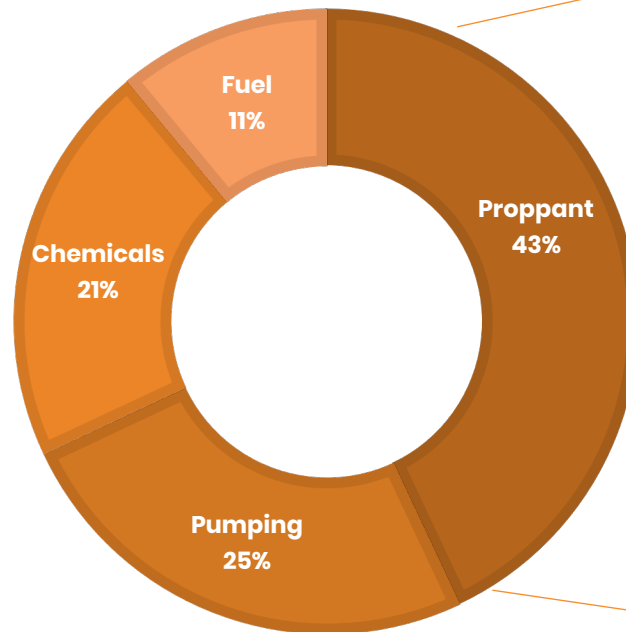
Silica: where is the cost opportunity?

- Ovintiv Supply Management manages 80% of the capital budget across the entire value cycle.
 - Unbundling proppant and going from “Premium Northern” to local sand, enabled Ovintiv to control the sand source, transport and processing. In the processing of proppant we were able to observe the mining process more closed. As an outcome of this, cost savings and EHS risk reduction was observed in using wet sand.

DRILLING AND COMPLETION MAJOR COST CATEGORIES



BREAKING DOWN FRAC SPEND



Proppant:
When imported,
logistics makes
up ~70% of the
cost of sand



Mining



Rail Transport



Trucking



Storage

Hazard communication

Exposure limit context:

- 60-100 times lower EL than that of ordinary non-toxic dust
- Same exposure limit as lead dust
- Silica dust is high percentage respirable and high percentage quartz
 - Visual appreciation of the hazard can be poor.



NIOSH Oil and Gas Extraction, Safety and Health Research; MAP Energy Summit, Eric Esswein, 2012

When working with frac sand, if you see dust the intensity is over the 8-hour EL, it is just a question of duration.

Historic controls

OVV has trialed many dust control options including but not limited to:

Substitution

- Ceramic
- Coated sand
- Wet sand

Engineering

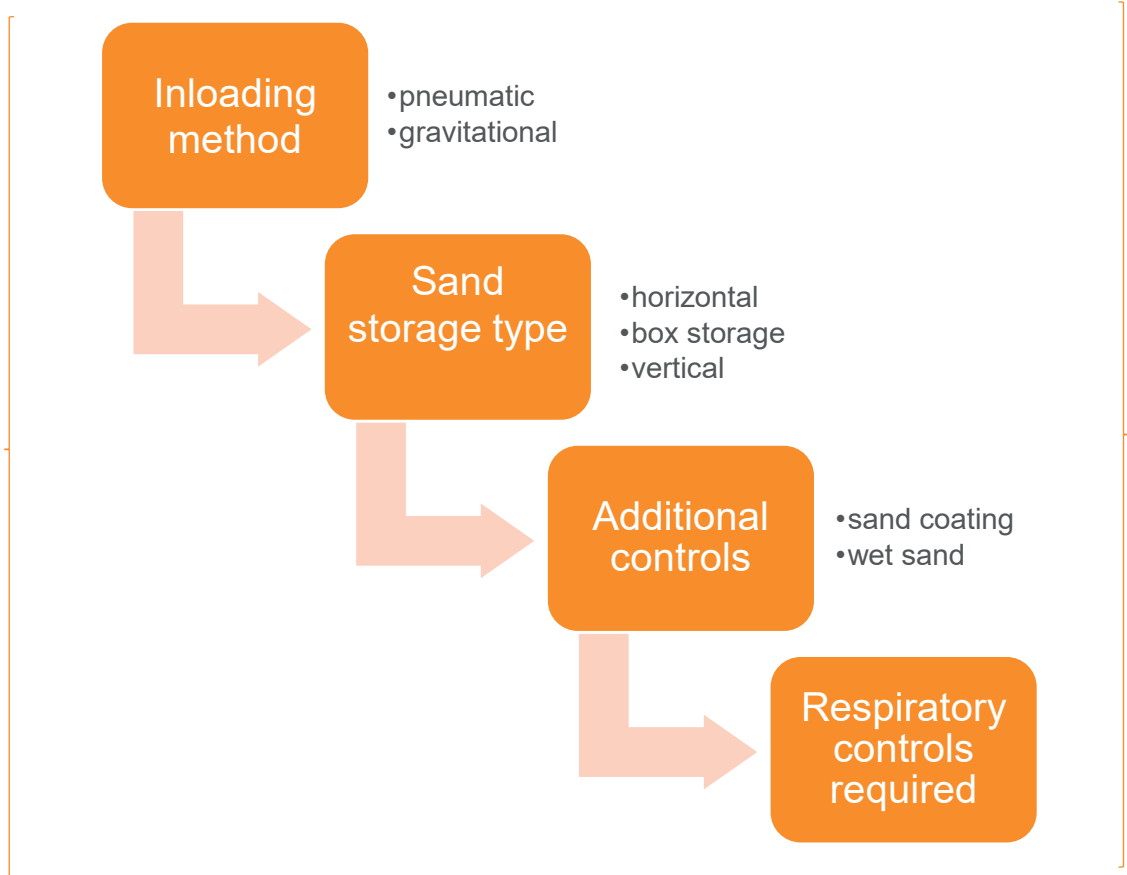
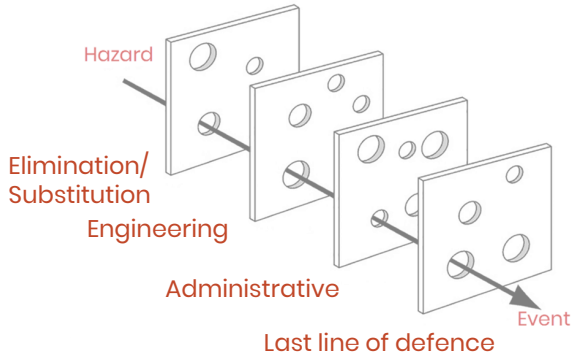
- Filtration
 - Flock tank
 - Bag filters
 - Mechanical ventilation
- Handling systems
 - Telebelt
 - Box storage

Other approaches

- Misting
- Silo
- Site arrangement
- Best practices
 - Inload rates
 - Choke feed

Existing tools

OVV Silica Risk Assessment Process



Job titles evaluated



Hopper operator



- Working adjacent to hopper
- Ensuring sand level is sufficient

Blender tender

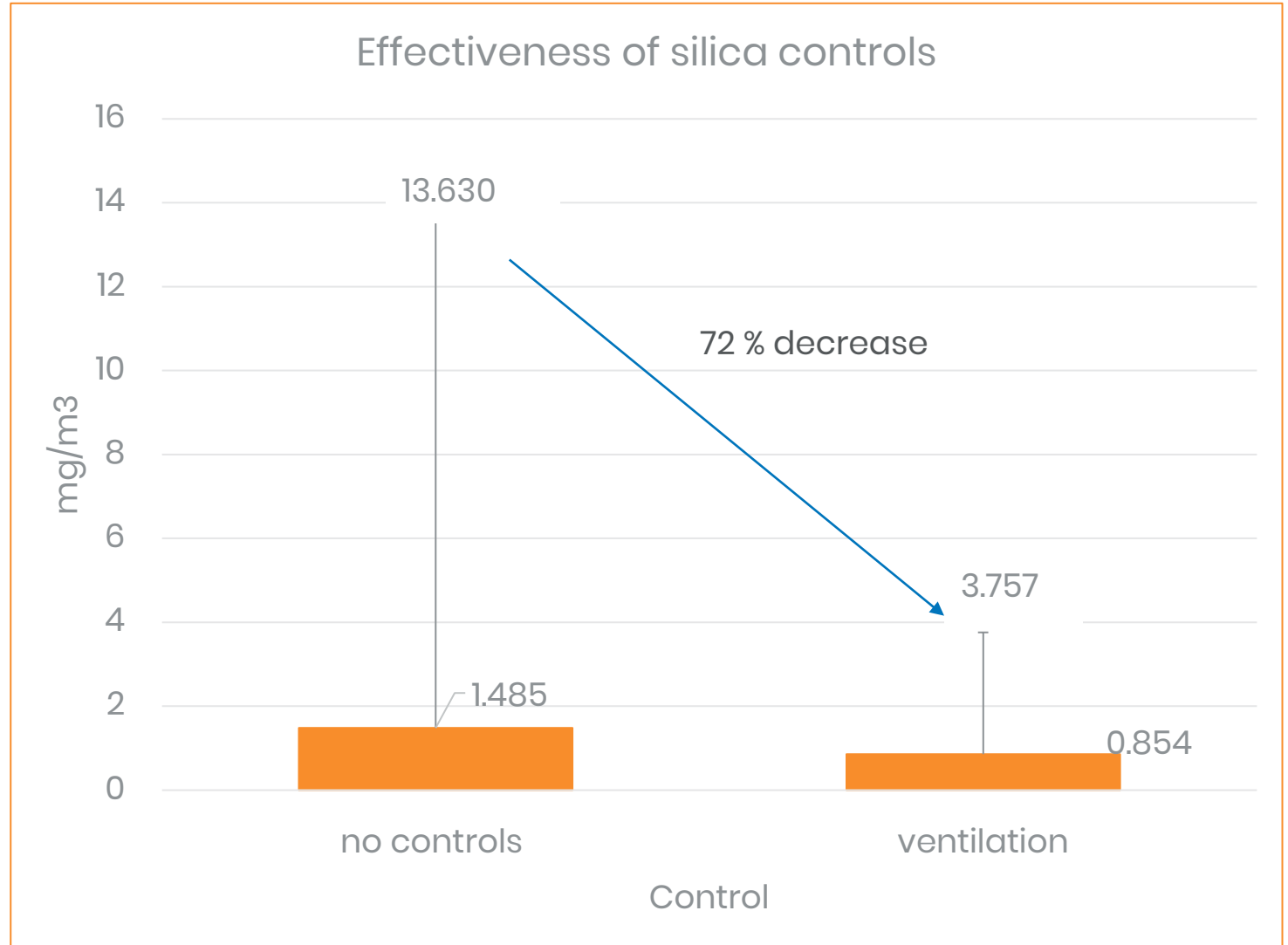
- Elevated above hopper
- Going in and out of cab



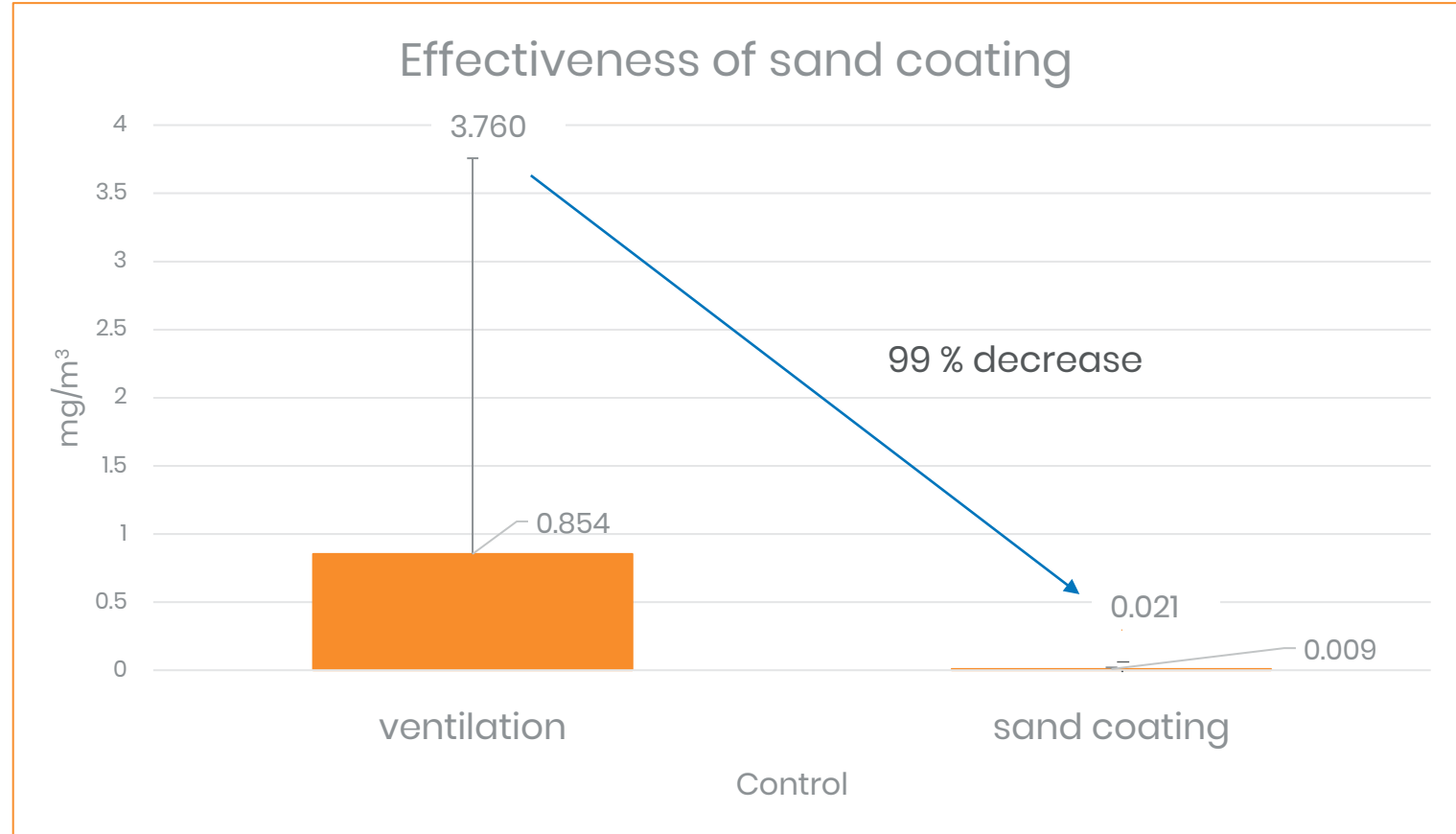
Hopper operator as a proxy,
using the 95th percentile.



Ventilation



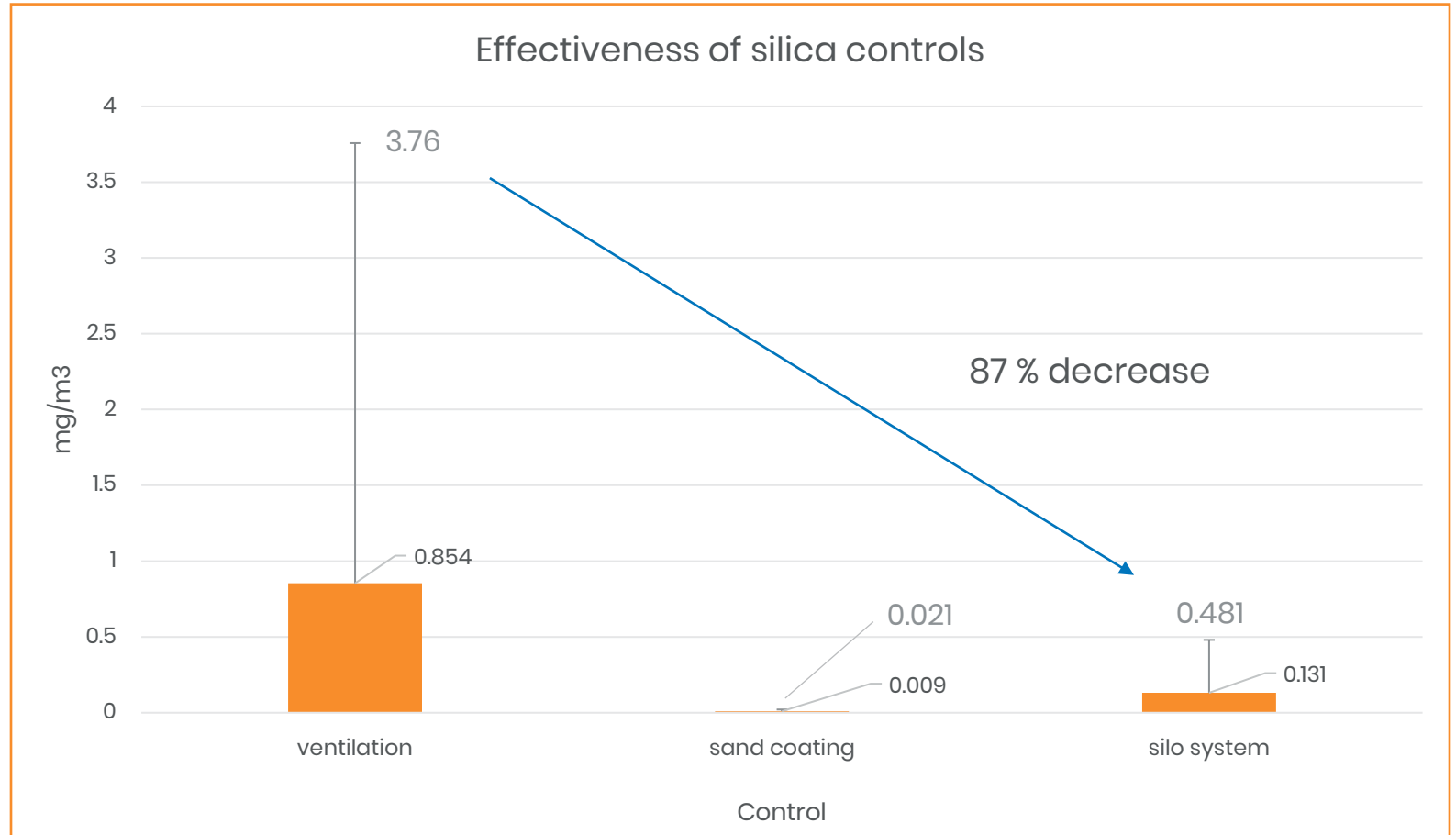
Sand coating



Silo system



Pics courtesy of Source Energy Services



Box storage

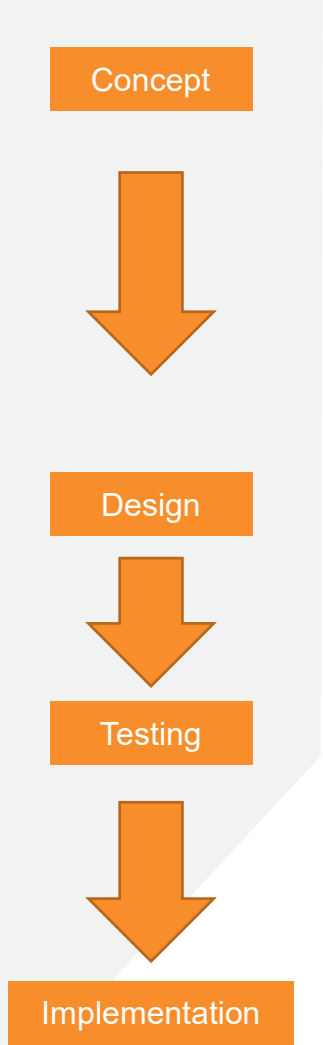
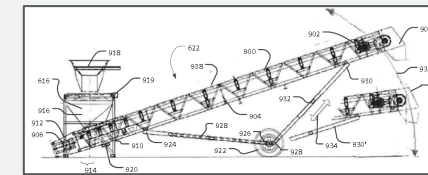
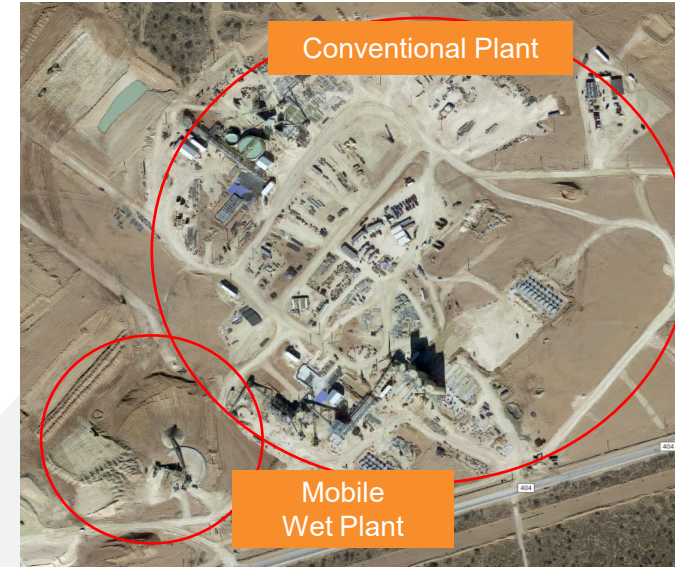
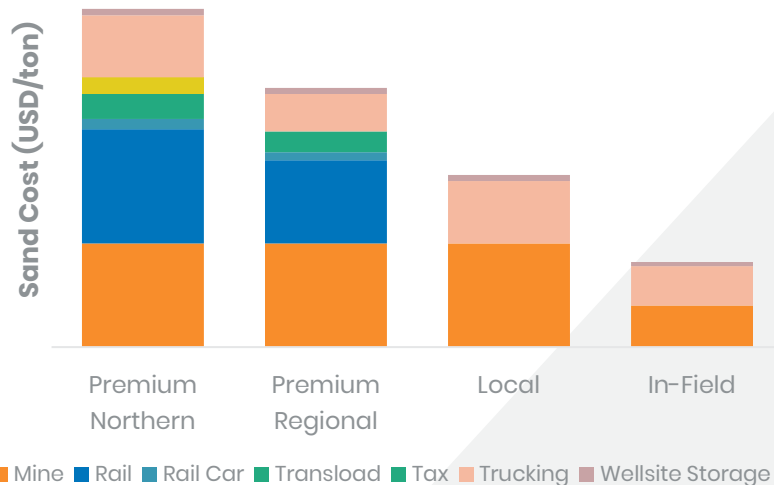


- Box storage – new exposure groups
- Results
 - Area hopper samples (n=9)
 - 95th percentile 0.508 mg/m³
 - Personal samples – forklift (n=2)
 - BDA exposure for forklift operators, trivial
 - Both samples < LOD

Wet sand: in the beginning



- Why haven't we been doing this?
 - Handling wet sand is difficult
 - Moving the moisture is costly when source is far away
 - Freezing temperatures creates sand cubes
 - But...if used properly is can be both cheaper and safer



OVV commissioned Anadarko and Permian mines for wet sand



OVV: WET SAND

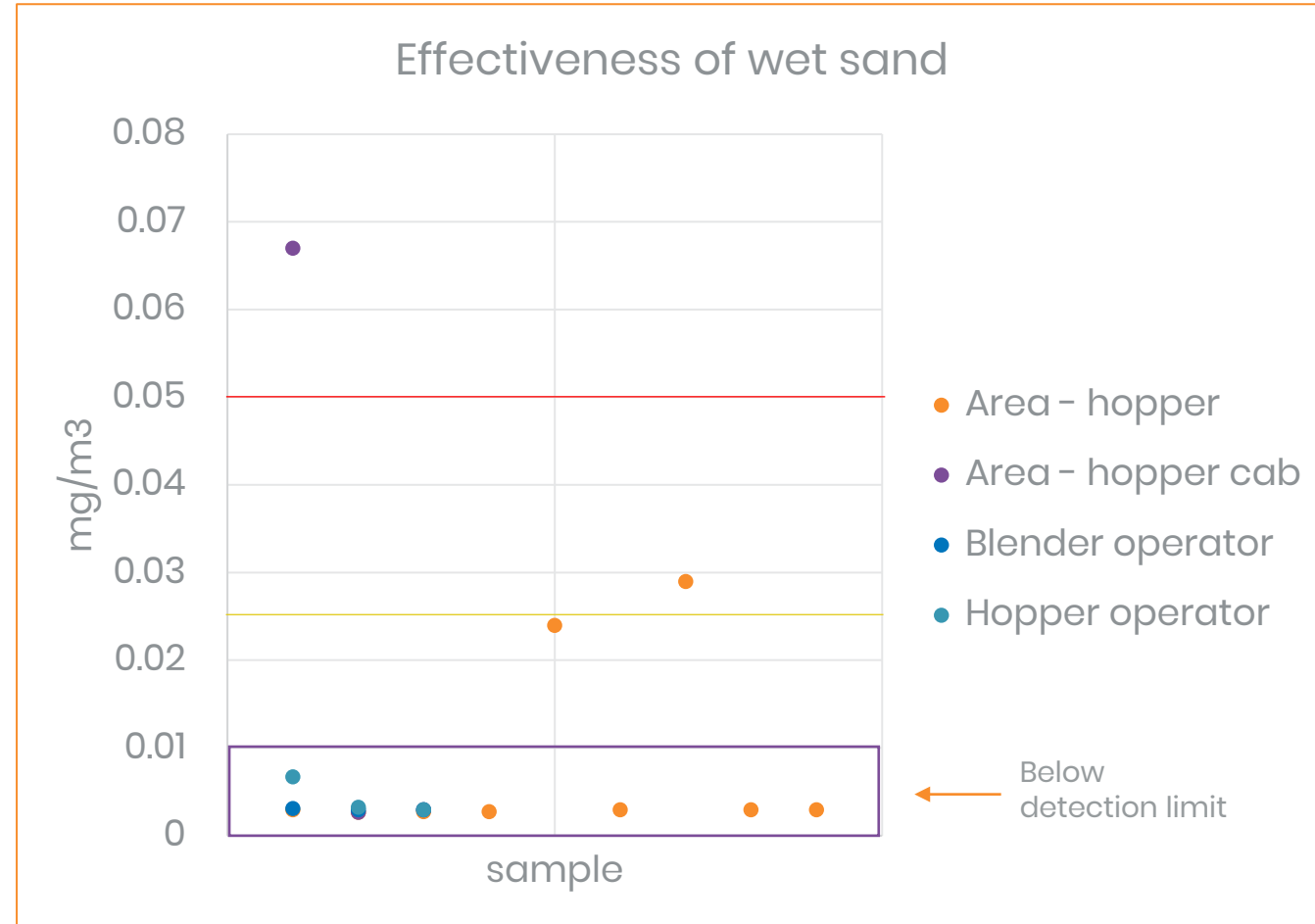
Wet sand



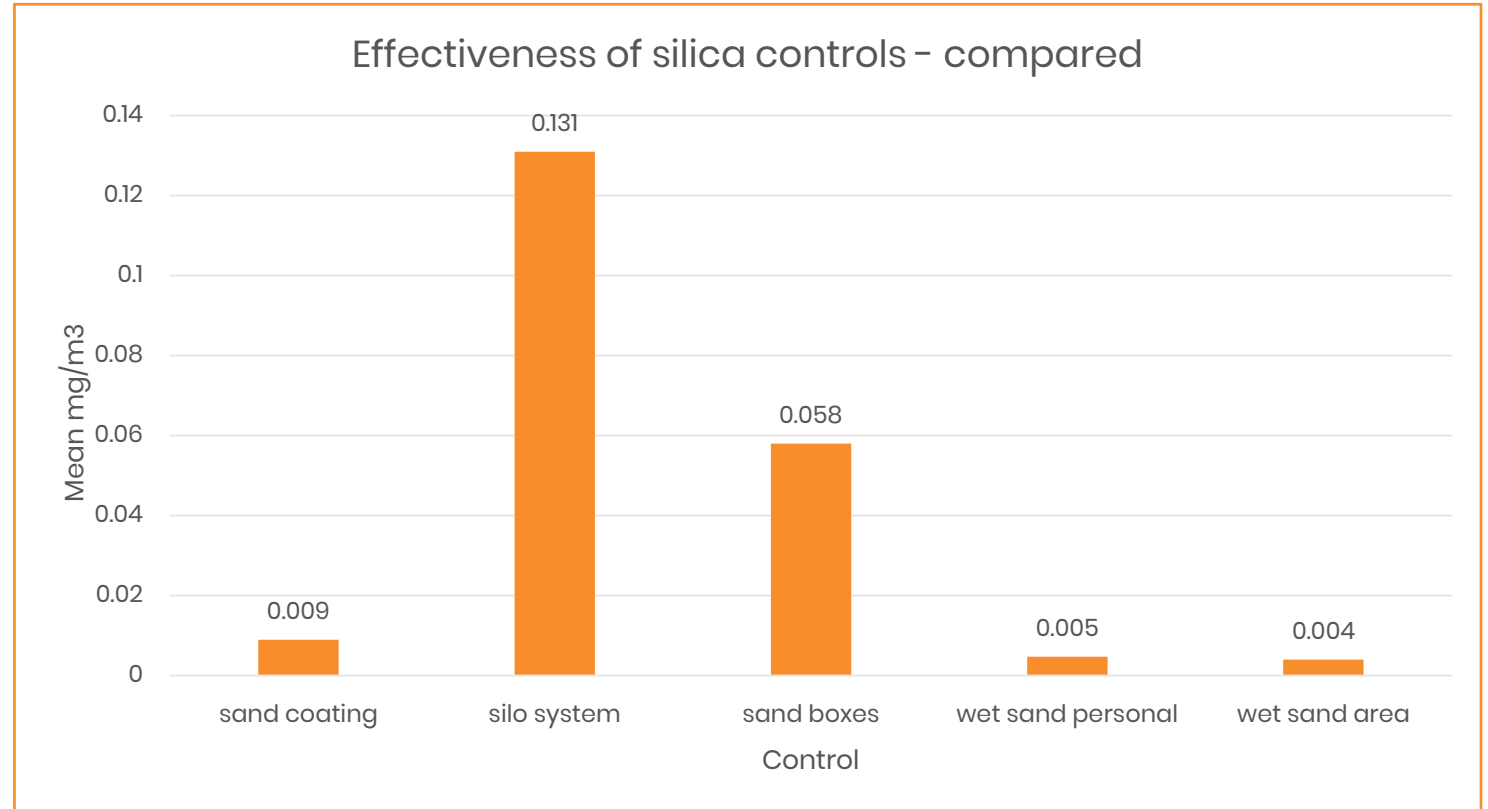
Insert pics of hopper

Wet sand data

- n = 18
- **Area samples**
 - Hopper cab (n=3)
 - Hopper (n=9)
- **Personal samples**
 - Censored (non-detect) data
 - Blender tender (n=3)
 - Hopper operator (n=3)
 - Bayesian shows posterior well controlled



Wet sand – more to come



All measurements observed in means. Wet sand results using minimum detectable concentration.