



MORTON SALT

Diesel Particulate Matter (DPM)

Safety & Technology

World Salt Symposium

June 19-21, 2018

Park City, Utah

Introductions

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Morton Salt

2003-2018



One K+S

Our Safety Credo

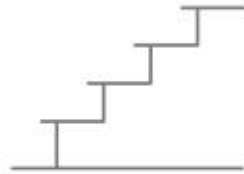


“Nothing is more important to K+S than health and safety – not production, not sales, not profit.”

Our Company Values



THINK
BIG



STEP
UP



PLAY
TO WIN



DO THE
RIGHT THING



THRIVE
TOGETHER



ALL
TOGETHER
NOW

Agenda

- Health Effects of DPM
- Morton Salt's Strategic Plan
 - Workplace Evaluation
 - Hierarchy of Controls
- Lessons Learned



Health Effects of Diesel Exhaust in Mines

In 2012, the World Health Organization classified diesel exhaust emission as a substance that is known to cause cancer in humans.

Mining sector workers beware of higher risk if you work as an underground production and development miner, heavy equipment operator, or heavy-duty equipment mechanic.



SIGNS OF EXPOSURE

- Gravimetric air sampling indicates diesel particulates
- Gas monitors indicate elevated levels of carbon monoxide (CO) or nitrogen dioxide (NO₂)
- Irritated eyes or difficulty breathing
- White, blue, or black smoke
- Visible haze
- Noticeable odour of diesel exhausts



SHORT-TERM EFFECTS

- Eye irritation
- Nose irritation
- Throat irritation
- Breathing irritation including coughing, phlegm production, wheezing, chest tightness
- Nausea
- Fatigue
- Headache
- Allergic reactions

LONG-TERM EFFECTS

- Lung cancer
- Respiratory diseases
- Decrease in lung function
- Increased risk of developing asthma
- Increased severity of existing respiratory conditions and allergies
- Cardiovascular disease



DO THE
RIGHT THING

Diesel Particulate Matter Limits

- DPM Permissible Exposure Limit (PEL)

2006 – 350 TC $\mu\text{g}/\text{m}^3$

2008 – 160 TC $\mu\text{g}/\text{m}^3$

2011 – 80 TC $\mu\text{g}/\text{m}^3$ *

2018 – 50 TC $\mu\text{g}/\text{m}^3$ *



*Morton Salt's Exposure Limit

Workplace Evaluation

NIOSH 5040 Method

- Door-Oliver Nylon Cyclone with Metal Cassette Holder
- Real-Time Monitor



Airtec™

WEARABLE, REAL-TIME
Diesel Particulate/Elemental Carbon Monitor
REPLICATES NIOSH 5040



Improve safety, compliance, and workplace health in real-time.

The image shows the Airtec monitor, a black and orange device with a screen and a sampling probe. To the left of the main device are three small inset images: the top one shows the device worn on a person's back; the middle one shows a coiled sampling tube; the bottom one shows a small container with a blue cap.

HIEARCHY OF CONTROLS

ELIMINATION	SUBSTITUTION	ENGINEERING	AMINISTRATIVE	PPE
<ul style="list-style-type: none">• ELECTRIC VEHICLES	<ul style="list-style-type: none">• Bio-Fuels	<ul style="list-style-type: none">• Effective Ventilation• Ventilated / Filtered Cabs• Tier 4 Engines or DPF Filter• Reduction at the Source	<ul style="list-style-type: none">• Modification of Work Practices• Total Horsepower per Section• No Idling• Worker Location• Clean Fuel Tanks• Clean Lubricants• Readily Change Lube	<ul style="list-style-type: none">• Respirators (Not a viable Solution)

Elimination - Electric Vehicles

MacLean Mine Mate Powder Rig

- Load Faces on electric to eliminate DPM and Heat



Engineering – Reduction at the Source

MIRENco

You Cannot Manage What You Cannot Measure

Partnership with Mirenco to perform combustion analysis. They perform a Diesel Evaluation Procedure which results in identifying machines that are producing DPM. Additionally this analysis ensures that we are getting the maximum fuel saving and extends engine life

Universal Air Filter Monitor(UAFM).
This versatile device will work on all diesel powered equipment.



Lessons Learned



- Know your Diesel Fleet
- NIOSH 5040 should be strictly followed
- Sample individuals who travel the mine
- Mirencos Recommendations need to be completed.
- Not all Tier 4 Engines are clean
- Tier 4 engines and DPF can create higher NO2 concentrations
- Small transportation vehicles should not be overlooked for combustion analysis
- Identify a DPM Site Champion and Team to drive improvements



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