Low Cost Dust Sensors in Mining:

Initial Results and Future Research

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Emerging Respirable Dust Sensing and Control for M/NM Mining

https://www.cdc.gov/niosh/mining/researchprogram/projects/project_DustSensing.html
NIOSH project 9390DTJ: three aims with one goal

1. Low Cost Dust Sensors
2. Smart Filtration Systems
3. Emerging Control Technologies

Emerging Respirable Dust Sensing and Control for M/NM Mining
Many controls exist – how to encourage increased adoption?
Compliance sampling captures snapshot of exposures; area monitoring networks may guide engineering controls

3%
Of workers in M/NM had a (compliance) respirable dust sample collected between 2000-2017

10%
Of Respirable Quartz Samples > MSHA PEL

31%
Of Respirable Quartz Samples > OSHA PEL
Source: https://arlweb.msha.gov/OpenGovernmentData/OGIMSHA.asp

“The next era of exposure assessment may involve continuous sensing of the working environment”
- Dr. John Howard, 2014
Mining leaders also see the benefit of real time dust sensing...

“Over the next three years, 4/5 mining companies will increase spending on 4IR technologies including automation, robotics, mobile technology and the “Internet of Things”...It’s all about efficiencies, cost savings and increased productivity, all of which will combine to make miners more nimble and profitable.

Fourth Industrial Revolution Technology is Changing the Mining Game”; energy and resource digest.com

“Smart building ventilation systems? We need that yesterday.” – Major US Sand Producer, 2019

When asked what is a smart building ventilation system... “Something that tells us in real-time that we have a dust problem, that a filter needs changed, etc. Not waiting until a health audit reveals this.” – Major US Mining Co., 2018
Area & personal dust monitors exist but are cost-prohibitive for more than a few areas or units
Sensor classifications; benefits and limitations

Sources:
TSI (left and middle), Plantower (Right)
Inner workings of common low-cost dust sensors (LCDM)

Source:
Can low-cost dust sensors be useful in mining applications?

$20 Sensor; $250 package
Example of LCDM aerosol chamber processing
Research Goal: Characterize the performance of low-cost dust sensors and evaluate their use in operational environments.
NIOSH has installed or assisted in the setup of ~20 LCDM in CA, IL and AR
Examples of installed sensor locations

NW TRIPPER FLOOR

N CENTER TRIPPER FLOOR

NE TRIPPER FLOOR

SW TRIPPER FLOOR

SE TRIPPER FLOOR

NEW CONTROL ROOM
Parallel gravimetric sampling to establish in-field calibration
LCDM data is real-time; transferred to cloud by WiFi
Data can be separated into shifts...**1st, 2nd, 3rd**
The reason to collect continuous dust data is to drive change - justifying the targeted installation of dust controls.
Aerosol Chamber
Upcoming lab testing

Data After Synchronization & Cropped

Cropped Data, Decreasing Conc Only
What level of operator protection is possible with a “SmartCab”?

**Measure**
- Dust levels
- CO2
- Cab Pressure

**Improve**
- Adjust intake airflow
- Change recirculation airflow

**Inform**
- Display cab pressure
- Suggest filter change
- Log air quality

Integrate to Create SmartCab System

Link to Smart Cab Notice of Intent @ Sam.gov
How effective are portable welding fume capture units?
Questions?