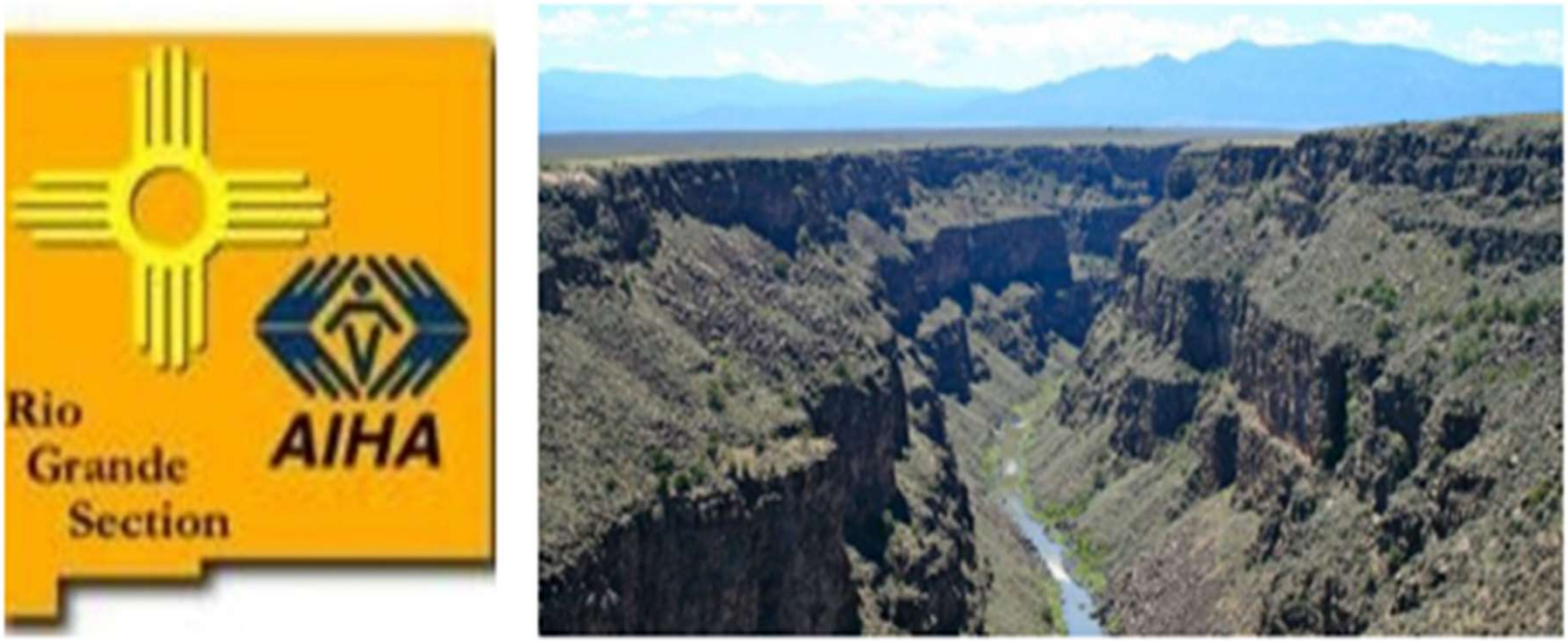
10/24/2019 Rio Grande AIHA Local Section Fall Technical Conference
Sandia Resort & Casino 30 Rainbow Rd., NE, Albuquerque, NM 87113



Keynote Speaker:
James D. McGlothlin, MPH, Ph.D., CPE, FAIHA
Faculty Scholar and Professor Emeritus, Purdue University.

Video Exposure Monitoring (VEM): A Real-Time Exposure Assessment Tool That Has Come of Age.

Video Exposure Monitoring (VEM): A Real-Time Exposure Assessment Tool That Has Come of Age.

- Presentation outline:
  - This presentation will provide:
    - a very brief historical overview of the merging of cameras (pictures to video) and sensors
    - a general overview of this evolving science of VEM from its beginnings to where it is now
      - Selected NIOSH research studies
      - Selected U.S. based Purdue research studies
      - Selected International studies
    - Latest applications for VEM (drones, construction, NASA)
    - The future: Technology disrupter and game changer: low cost, portable, easy to use, cloud-based, VEM system to perform exposure assessments in the morning, analysis over lunch, and cost-effective controls in the afternoon.
    - Demo of cloud-based VEM system.

What is VEM?

- Video Exposure Monitoring (VEM) synchronizes real-time (or near real-time) chemical, biological radiological, and/or physical agent data with video recordings of workers and/or environmental activities.

- Does this technology remind you of anything else? Something that, if you are a science geek, had seen on TV.?

The Star Trek Tricorder has been brought to life with VEM Systems

Some history and “scholarly” thoughts…..

- Before we go any further on the topic of Video Exposure Monitoring (VEM), lets go back in time to remind ourselves how technology has changed and advanced, for the most part, to better our lives.
- Much like the evolution of the light microscope that helped us see bacteria to the development of the electron microscope to help us see viruses, cameras (including smart phone cameras) have advanced significantly in our lifetime.
- So much so that the computing power in these smart phones use algorithms to make your photos “pop”. What I find amazing, is that the computing power in your smart phone is far more powerful that the computing power used to take our astronauts to the moon and back.

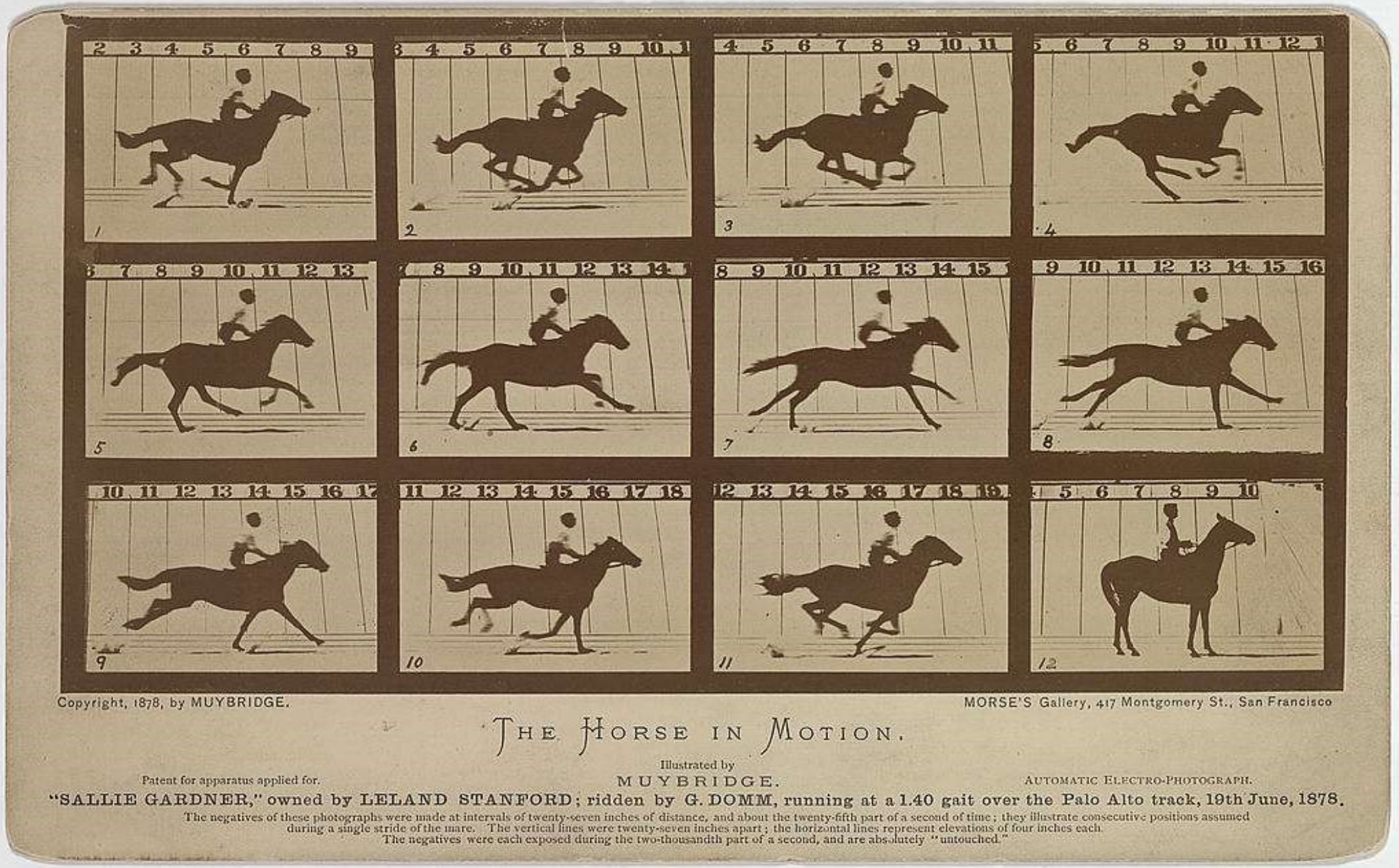
New in its day: a portable camera, more important, a series of camera pictures to settle a bet on the “flying” horse

- EADWEARD MUYBRIDGE (1830–1904), an English photographer, established his American fame in 1867 by taking a mobile studio to Yosemite Valley and producing large silver prints of its stunning vistas. Five years later he was hired by Leland Stanford, then the president of the Central Pacific Railroad, formerly the governor of California and latterly the founder of the eponymous university in Palo Alto. Stanford—who was also a horse breeder—challenged Muybridge to settle the old dispute about whether all four of a horse's legs are off the ground at one time during a gallop. • Muybridge found it difficult to prove the point. In 1872 he took (and then lost) a single image of a trotting horse with all hooves aloft. But he persevered, and his eventual solution was to capture moving objects with cameras capable of a shutter speed as brief as 1/1,000 of a second. • The conclusive experiment took place 141 years ago, on 19 June 1878, at Stanford's Palo Alto farm. Muybridge lined up thread-triggered glass-plate cameras along the track, used a white-sheet background for the best contrast, and copied the resulting images as simple silhouettes on a disc rotating in a zoopraxiscope, a device he invented in order to display a rapid series of stills to convey motion. Sallie Gardner, the horse Stanford had provided for the test, clearly had all four hooves off the ground. But the airborne moment did not take place as portrayed in famous paintings, perhaps most notably Théodore Géricault's 1821 Derby at Epsom, now hanging in the Louvre, which shows the animal's legs extended, away from its body. Instead, it occurred when the horse's legs were beneath its body, just prior to the moment the horse pushed off with its hind legs. • This work led to Muybridge's magnum opus, which he prepared for the University of Pennsylvania. Starting in 1883, he began to make an extensive series depicting animal and human locomotion. Its creation relied on 24 cameras fixed in parallel to the 36-meterlong track and two portable sets of 12 batteries at each end. The track had a marked background, and animals or people activated the shutters by breaking stretched strings.

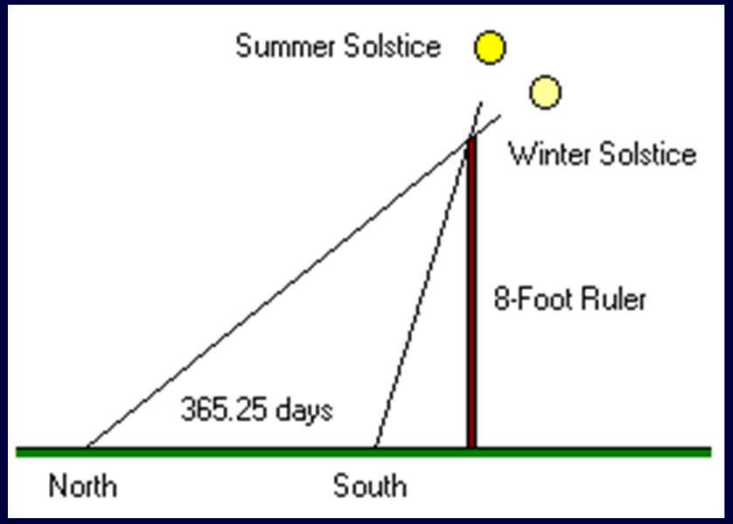
In the mind’s eye: https://tmlarts.com/wp-content/uploads/2016/09/21670_p0001255.002.jpg

Théodore Géricault's 1821 Derby at Epsom,

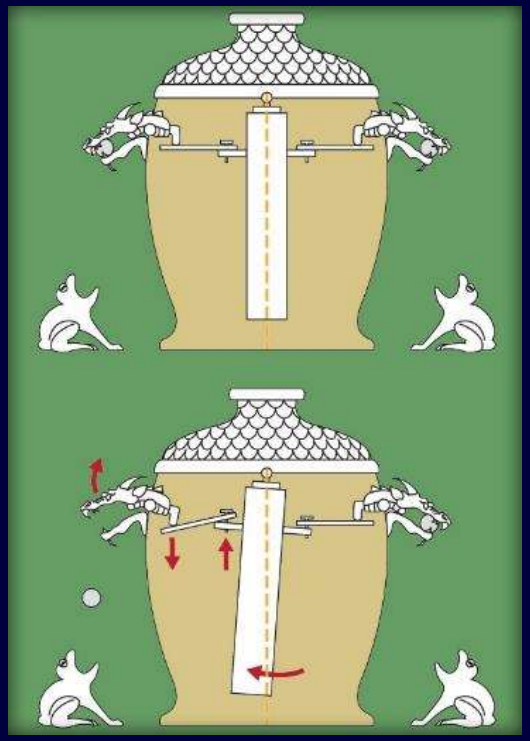
Series of photographs from EADWEARD MUYBRIDGE showing the “hoof” work of a galloping horse.



Shifting gears to real-time sensors. Not a new idea. Consider humans marking summer and winter solstice monuments such as Stonehenge
and the ancient Chinese Seismograph (~100 AD or CE current era) to detect the direction of earthquakes..



- **Science**: ancient Seismograph (device that measures the strength of an earthquake).
- When an earthquake struck, a lever inside caused a ball to drop from a dragon's mouth into a toad's mouth, indicating the direction from which the earthquake had came.



Today's sensor systems:
https://www.cbsnews.com/news/turn-your-smartphone-into-an-earthquake-detector/
https://laist.com/2019/10/17/earthquake_warning_app_los_angeles_california.php;

Turn your smartphone into an earthquake detector

BY MINDY WEISBERGER
FEBRUARY 16, 2016 / 5:28 PM / LIVESCIENCE.COM

Seismologists and app developers are shaking things up with a new app that transforms smartphones into personal earthquake detectors.

By tapping into a smartphone's accelerometer -- the motion-detection instrument -- the free Android app, called MyShake, can pick up and interpret nearby quake activity, estimating the earthquake's location and magnitude in real-time, and then relaying the information to a central database for seismologists to analyze.

In time, an established network of users could enable MyShake to be used as an early- warning system, the researchers said.

Trending News

GameSpeak: Jack Thompson

Top 10 most promiscuous cities in the U.S.

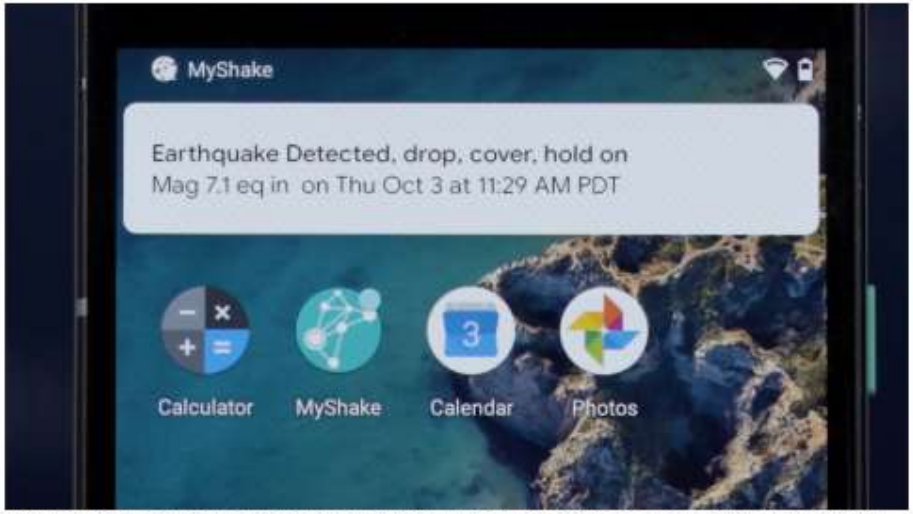
7 tricks to clear space on your iPhone without deleting photos

Baboons Smarter Than We Thought?

LA ist

California Finally Has An App That Can Tell You When The Earthquakes Are Coming

BY JACOB MARGOLIS IN NEWS ON OCTOBER 17, 2019 1:09 PM



A demonstration of a notification pushed by the earthquake early warning app MyShake. (Screenshot via YouTube/UC Berkeley)

Starting today, no matter where you are in the state of California, you're now eligible for an early warning when an earthquake is about to hit your area.

State officials announced - on the 30th anniversary of the Loma Prieta quake - that a statewide earthquake early warning system is finally available to the general public.

HOW IT WORKS & HOW TO GET NOTIFIED

For years, the U.S. Geological Survey, Caltech and other institutions have been working together to build an earthquake early warning network throughout the state.

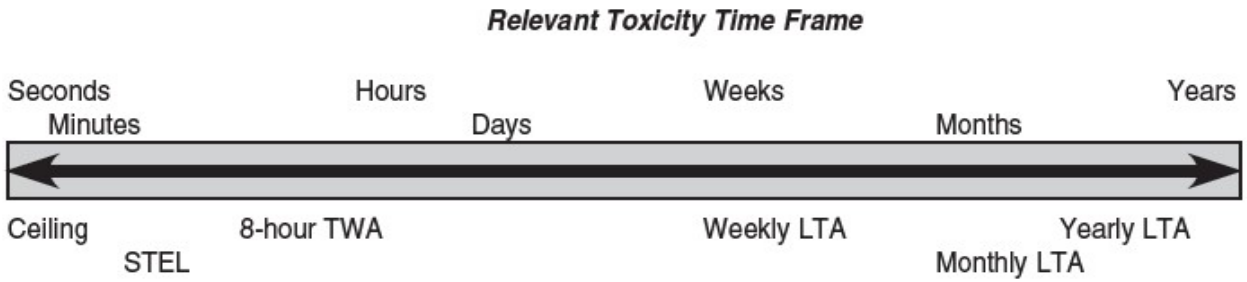
Latest update on Real-time Sensors: White Paper developed by the AIHA Exposure Assessment Strategies Group

- **A PRACTICAL GUIDE FOR USE OF REAL TIME DETECTION SYSTEMS FOR WORKER PROTECTION AND COMPLIANCE WITH OCCUPATIONAL EXPOSURE LIMITS**
- **Prepared by: Energy Facility Contractor's Group (EFCOG) Industrial Hygiene and Safety Task Group and Members of the American Industrial Hygiene Association (AIHA) Exposure Assessment Strategies Group**
- **Dina Siegel1, David Abrams 2, John Hill3, Steven Jahn2, Phil Smith2, Kayla Thomas4**
- 1 Los Alamos National Laboratory
- 2 AIHA Exposure Assessment Strategies Committee
- 3 Savannah River Site
- 4 Kansas City National Security Campus

1.0 Executive Summary

This white paper presents practical guidance for field industrial hygiene personnel in the use and application of real time detection systems (RTDS) for exposure monitoring. The focus of the paper is on protection of worker health with solid exposure decisions based on occupational exposure limits (OELs), while successfully managing compliance with applicable regulations. This paper discusses occupational exposure assessment, OELs, traditional use of RTDS, use and limitations of RTDS, use of RTDS for compliance, documentation and reporting of RTDS results. It provides practical matrices for real time monitoring decisions, and a data collection and interpretation worksheet as Attachment 1. The paper also addresses the use of professional judgement, which is broadly used to enhance an understanding of exposure and health risks.

From: **A PRACTICAL GUIDE FOR USE OF REAL TIME DETECTION SYSTEMS FOR WORKER PROTECTION AND COMPLIANCE WITH OCCUPATIONAL EXPOSURE LIMITS (White Paper)**



Appropriate OEL

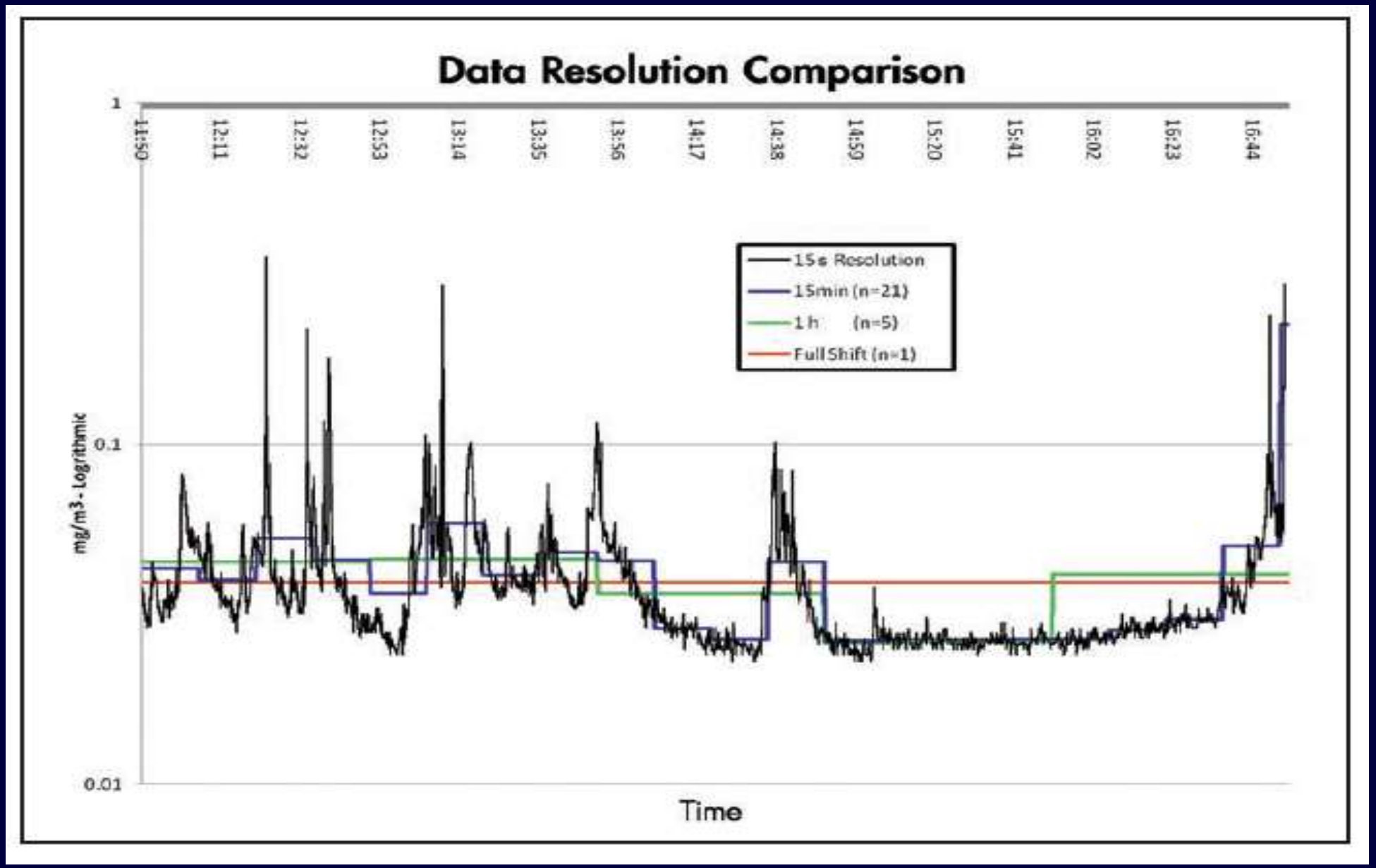
Exposure Duration: Adverse Effect	*Measurement Averaging Time*	*Occupational Exposure Limit*	*Example*
Seconds/minutes: Immediate/acute effects	Instantaneous direct-reading continuous monitoring—with data logging/alarms	Ceiling STEL[A]	H_2S (central nervous system effects) HCl (primary irritant)
Minutes/hours: Acute effects	Short-(15-minutes) or full-shift TWAs	STEL 8-hour TWA[B]	Solvents (irritation, narcosis)
Days/weeks: Subacute/chronic effects	Daily/weekly/monthly TWA	8-hour TWA LTA-OEL[C]	Lead
Years: Chronic long-term effects	Annual average exposure	LTA-OEL	Vinyl chloride

[A] STEL = short-term exposure limit
[B] TWA = time-weighted average
[C] LTA-OEL = long-term average-occupational exposure limit

Table 2.1 – Increased importance in the availability of real-time exposure assessment methods with increased toxicity (Bullock and Ignacio, 2006).[4]

The authors make a very important point about toxicity, time of exposure, and exposure levels. My theory is that changes in exposure, especially peak exposures, may have a very profound effect on our health, more so than average exposure levels – where most of our health standards are based.

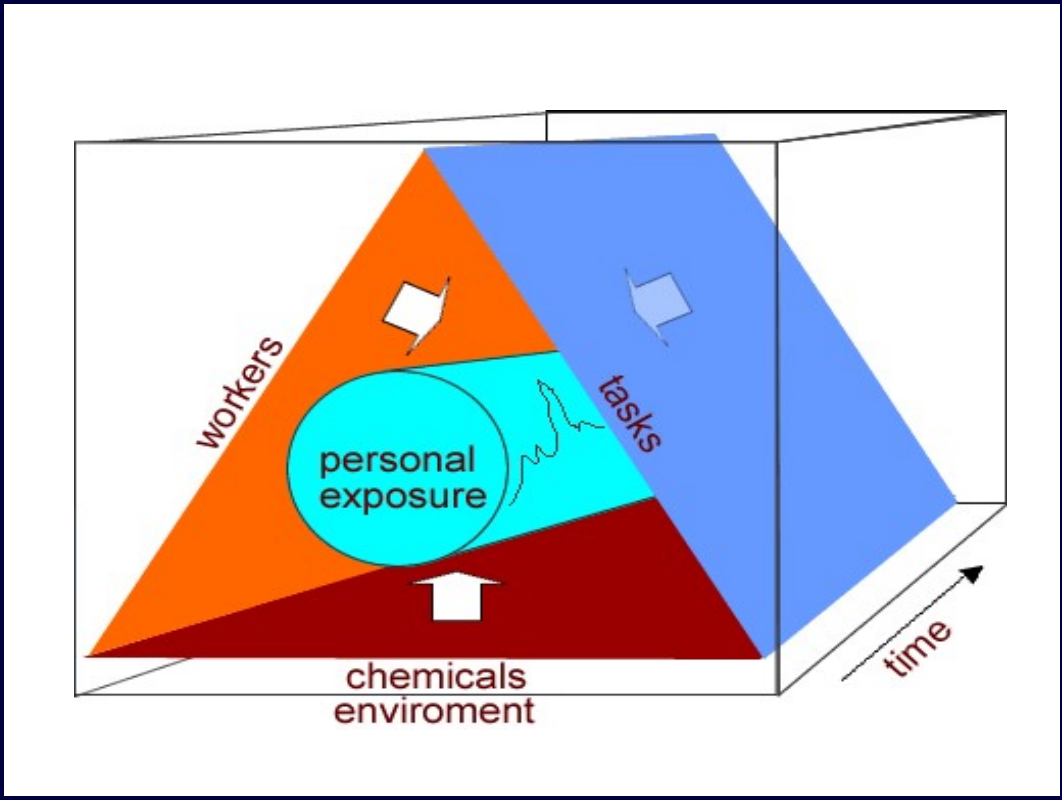
Yes, data resolution counts. The more data you collect (seconds are better than minutes, than hours…(from white paper noted in previous slide.



Occupational Exposures

- Exposures are a time event. Workers may experience different concentration levels at different time.

- Personal exposure levels are the interactive results of workers, handled materials, performed tasks and environment.



Patty's Industrial Hygiene
6th Edition, Vol 2 2012.
McGlothlin, Xu and Cole

Note: An updated chapter
Will be published in
Patty's Industrial Hygiene
7th Edition expected in 2019.

1987: First Publications on Video Exposure Monitoring (VEM)

- **McGlothlin, J. D.**, Heitbrink, W. A., Gressel, M. G., & Fischbach, T. J. (1987). Dust control by ergonomic design. **In** *Proceedings of the IXth International Conference on Production Research, August 17-20, 1987*. Cincinnati, OH. Cincinnati, Ohio: University of Cincinnati.

- In Sweden VEM is called PIMEX for Picture Mix. The first publication of PIMEX was:
- Rosén G, Lundström S. Concurrent Video Filming and Measuring for Visualization of Exposure. Amer Industr Hyg Ass J 48 (8) (1987) 688-692.

1992: ECTB: Technical Report by **Gressel**-MG; Heitbrink-WA; Jensen-PA; Cooper-TC; O'Brien-DM; **McGlothlin-JD**; Fischbach-TJ; Topmiller-JL

Promoting productive workplaces through safety and health research NIOSH

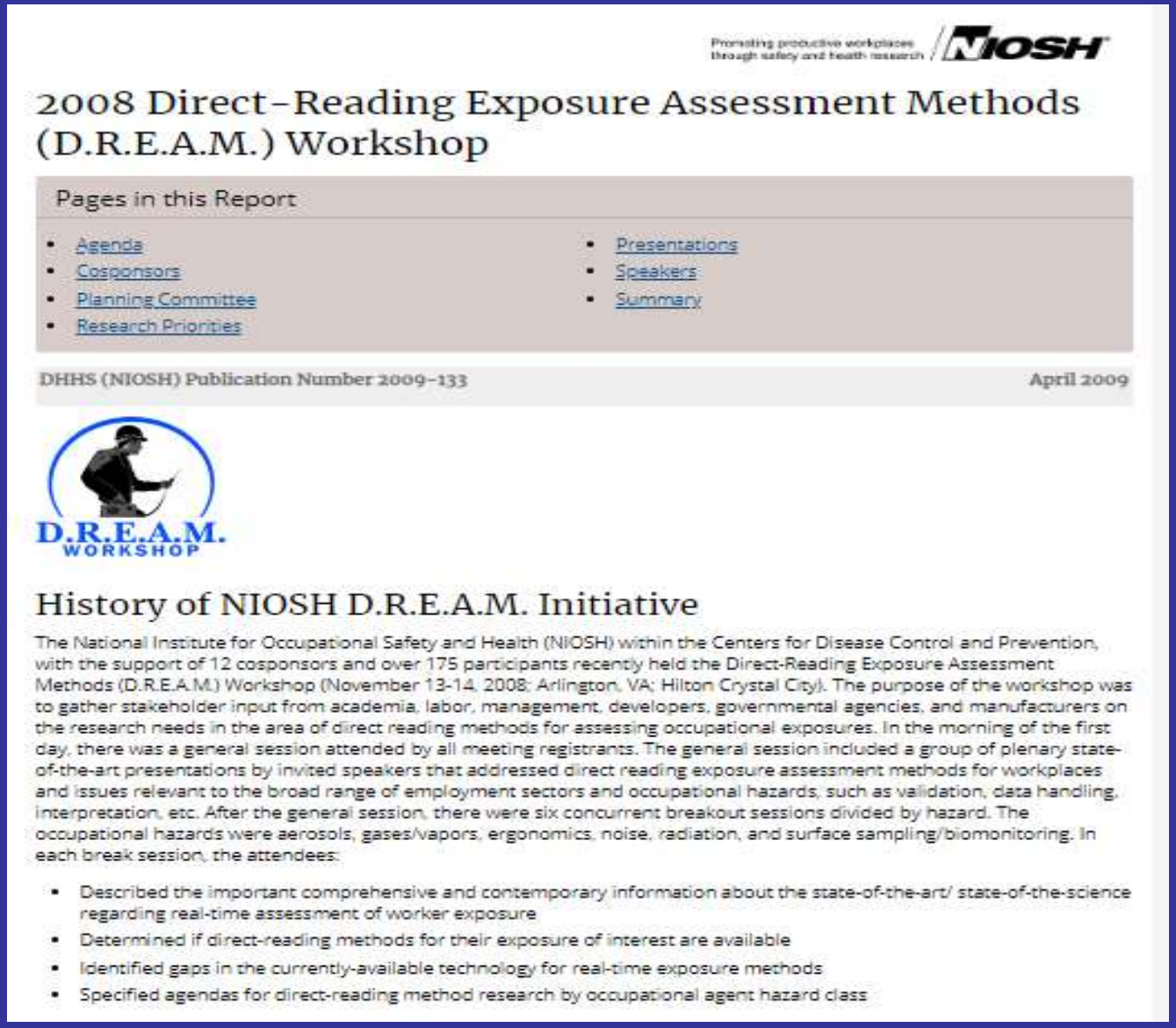
Analyzing Workplace Exposure Using Direct Reading Instruments and Video Exposure Monitoring Techniques

DHHS (NIOSH) Publication Number 92-104 August 1992

A typical evaluation of a worker's exposure to an air containinant requires a pump to draw air through a filter, sampling tube, or other media suitable for collecting the containment for a measured period of time. These integrated samples provide an indication of the extent of a worker's exposure. Depending on the worker's job tasks, these samples normally do not identify these critical work elements, a technique called video exposure monitoring has been developed by researchers from the National Institute for Occupational Safety and Health.

Analyzing Workplace Exposure Using Direct Reading Instruments and Video Exposure Monitoring Techniques [PDF – 2500 KB]

2008: Direct Reading Exposure Assessment Methods (DREAM)



Promoting productive workplaces through safety and health research / NIOSH

2008 Direct-Reading Exposure Assessment Methods (D.R.E.A.M.) Workshop

Pages in this Report

DHHS (NIOSH) Publication Number 2009-133 April 2009

D.R.E.A.M. WORKSHOP

History of NIOSH D.R.E.A.M. Initiative

The National Institute for Occupational Safety and Health (NIOSH) within the Centers for Disease Control and Prevention, with the support of 12 cosponsors and over 175 participants recently held the Direct-Reading Exposure Assessment Methods (D.R.E.A.M.) Workshop (November 13-14, 2008; Arlington, VA; Hilton Crystal City). The purpose of the workshop was to gather stakeholder input from academia, labor, management, developers, governmental agencies, and manufacturers on the research needs in the area of direct reading methods for assessing occupational exposures. In the morning of the first day, there was a general session attended by all meeting registrants. The general session included a group of plenary state-of-the-art presentations by invited speakers that addressed direct reading exposure assessment methods for workplaces and issues relevant to the broad range of employment sectors and occupational hazards, such as validation, data handling, interpretation, etc. After the general session, there were six concurrent breakout sessions divided by hazard. The occupational hazards were aerosols, gases/vapors, ergonomics, noise, radiation, and surface sampling/biomonitoring. In each break session, the attendees:

- Described the important comprehensive and contemporary information about the state-of-the-art/ state-of-the-science regarding real-time assessment of worker exposure
- Determined if direct-reading methods for their exposure of interest are available
- Identified gaps in the currently-available technology for real-time exposure methods
- Specified agendas for direct-reading method research by occupational agent hazard class

Direct Reading and Sensor Technologies now part of NIOSH Strategic Plan for 2019-2023.

Promoting productive workplaces through safety and health research / NIOSH

Direct Reading and Sensor Technologies

Overview

Direct-reading methods and sensors are being used more frequently in many different settings ranging from personal monitoring of individual health to applications in research and in clinical practice. NIOSH began organized research in this area in 2008 with the creation of the DREAM initiative (Direct Reading Exposure Assessment Methods). NIOSH will build upon and expand the DREAM program to address lessons learned, advances in technology, and stakeholder contributions. NIOSH researchers have developed a number of direct-reading methods and monitors and are exploring new ways to use these technologies to improve occupational safety and health.

The use of sensors has increased exponentially as countless remote wireless sensors are now employed for monitoring the environment, work sites, disaster response, "smart" buildings and facilities, and in agriculture and health. Wireless data transfer based on cell phone networks and smart phone technology is enhancing the adoption of these sensors, and allowing integration of geographically disperse sensors to produce comprehensive exposure pictures. Wearable and even implantable sensors are being developed that could aid in exposure assessment and clinical practice.

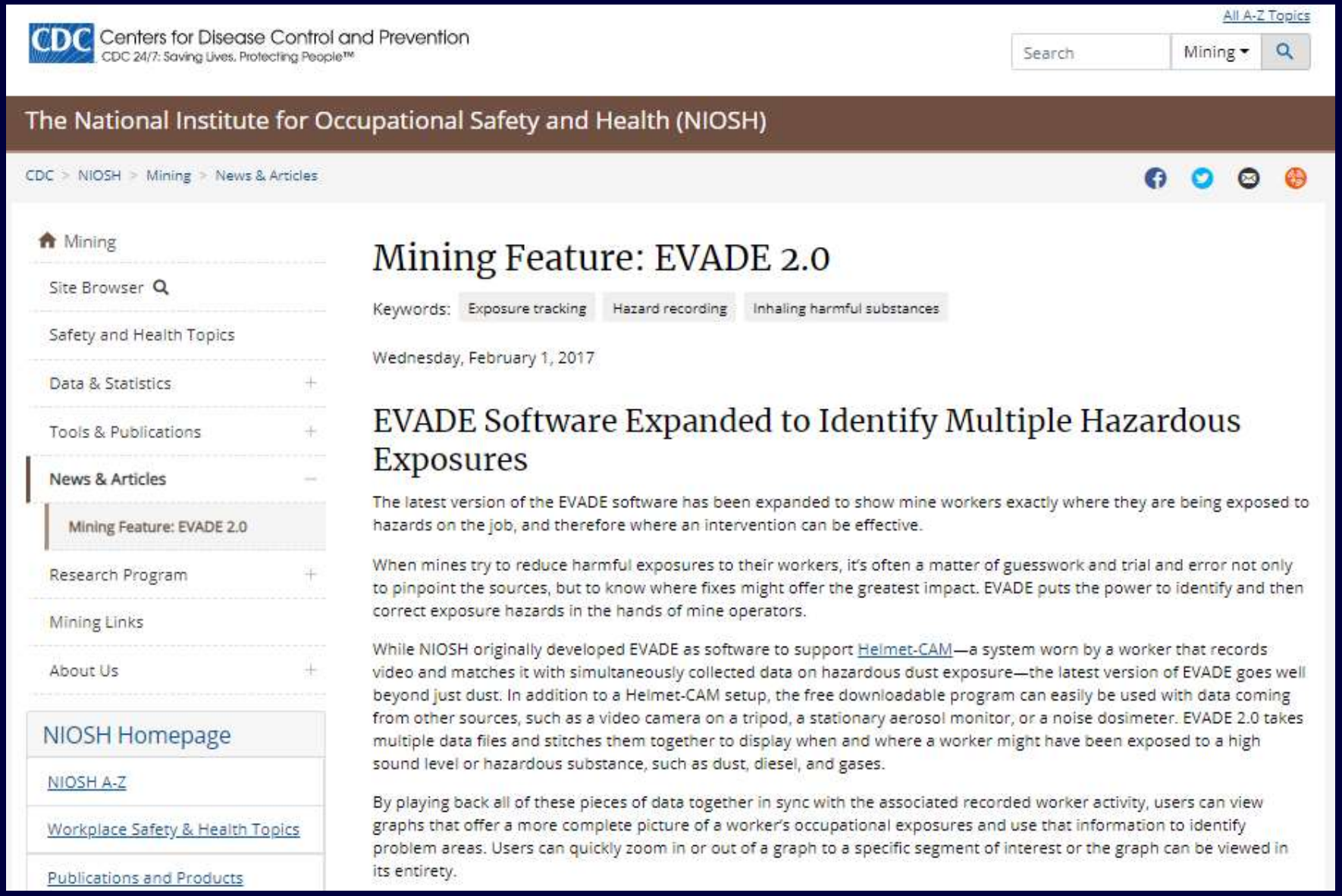
NIOSH Center for Direct Reading and Sensor Technologies

The NIOSH Center for Direct Reading and Sensor Technologies (NCDRST) was established in May 2014 to coordinate research and to develop recommendations on the use of 21st century technologies in occupational safety and health. The NCDRST is a virtual center hosted by the NIOSH Division of Applied Research and Technology and the NIOSH Exposure Assessment Cross Sector Program.

NCDRST Objectives

1. Coordinate a national research agenda for direct-reading methods and sensor technologies. Research on these technologies has been incorporated into the goals of the NIOSH Strategic Plan for fiscal years 2019-2023.
2. Develop guidance documents pertinent to direct-reading methods and sensors, including validation and performance characteristics;
3. Develop training protocols; and
4. Establish partnerships to collaborate in the Center's activities.

NIOSH EVADE TOOL 2.0 – Note: Specific for Mining Industry. (EVADE TOOL first introduced in 2014)



CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People™

All A-Z Topics | Search | Mining

The National Institute for Occupational Safety and Health (NIOSH)

CDC > NIOSH > Mining > News & Articles

Mining
Site Browser
Safety and Health Topics
Data & Statistics
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News & Articles
Mining Feature: EVADE 2.0
Research Program
Mining Links
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NIOSH Homepage
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Workplace Safety & Health Topics
Publications and Products

Mining Feature: EVADE 2.0

Keywords: Exposure tracking | Hazard recording | Inhaling harmful substances

Wednesday, February 1, 2017

EVADE Software Expanded to Identify Multiple Hazardous Exposures

The latest version of the EVADE software has been expanded to show mine workers exactly where they are being exposed to hazards on the job, and therefore where an intervention can be effective.

When mines try to reduce harmful exposures to their workers, it's often a matter of guesswork and trial and error not only to pinpoint the sources, but to know where fixes might offer the greatest impact. EVADE puts the power to identify and then correct exposure hazards in the hands of mine operators.

While NIOSH originally developed EVADE as software to support Helmet-CAM—a system worn by a worker that records video and matches it with simultaneously collected data on hazardous dust exposure—the latest version of EVADE goes well beyond just dust. In addition to a Helmet-CAM setup, the free downloadable program can easily be used with data coming from other sources, such as a video camera on a tripod, a stationary aerosol monitor, or a noise dosimeter. EVADE 2.0 takes multiple data files and stitches them together to display when and where a worker might have been exposed to a high sound level or hazardous substance, such as dust, diesel, and gases.

By playing back all of these pieces of data together in sync with the associated recorded worker activity, users can view graphs that offer a more complete picture of a worker's occupational exposures and use that information to identify problem areas. Users can quickly zoom in or out of a graph to a specific segment of interest or the graph can be viewed in its entirety.

Evolution and Applications of VEM Technology

1985: The Genesis of Video Exposure Monitoring (VEM)

Video Exposure Monitoring Research Pioneered by NIOSH Researchers* in 1985

- Company was batch processed products
- Video Exposure Monitoring for Real-time sampling was done using a:
  - Used Handheld Aerosol Monitor (HAM)
  - Apple computer was used to log airborne dust concentrations
  - VHS camera was used to record work activities.

**James McGlothlin, William Heitbrink and Mike Gressel*

Job where NIOSH researchers studied batch processing of products.

This job involved scooping of powder from a drum, weighing the powder on a scale, and putting the bag of powder in a receiving bin located behind the worker.

The power had silica and the workers were overexposed. Based on what you see what would be your solution?

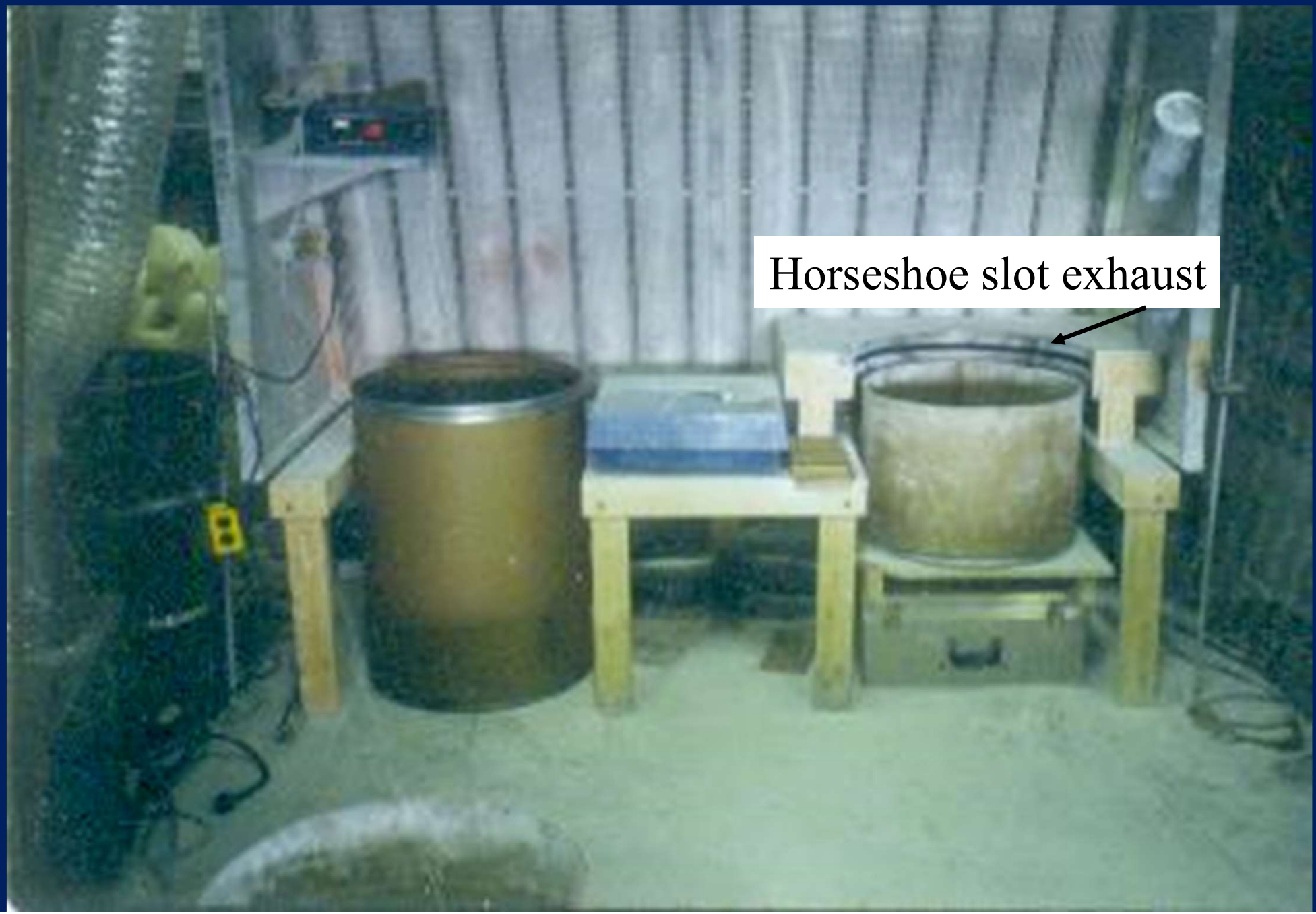
Drum Scooping Task

- After watching the video, what is your solution?

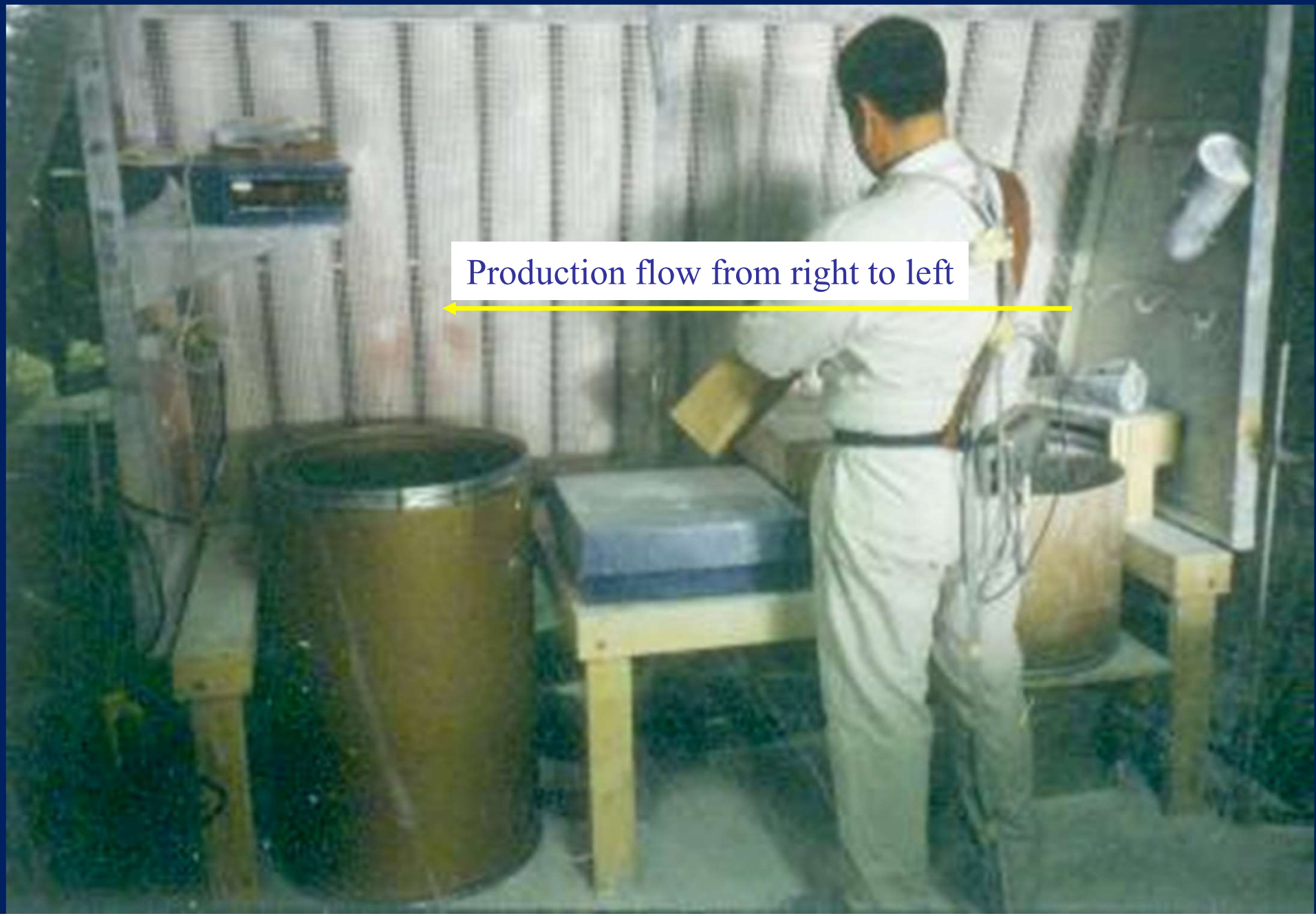
Increase ventilation?

Summary of data what was modeled based on worker dust exposure. Notice how the dust exposure increases significantly after 35 bags of powder (about ½ of the total powder in the drum) have been scooped.

New workstation layout with ½ height drum and slot exhaust to Capture any residual dust from scooping task.



Worker scooping powder from a drum cut in half and raised to waist height. The bag scooping, weighing, depositing task are in line. Making it easier and more efficient (about 1/3 the cycle time as the original job layout)



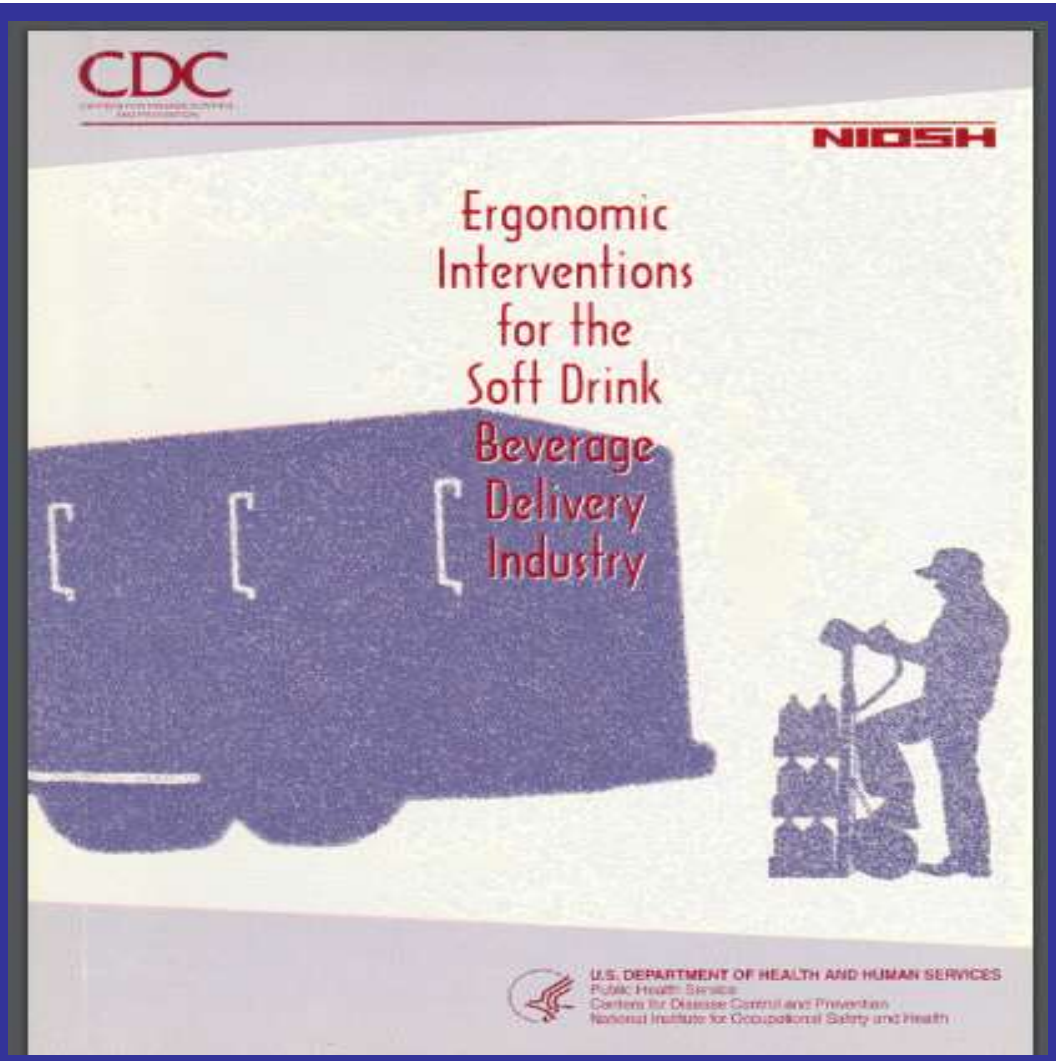
Ergonomic Intervention for the Soft Drink Beverage Delivery Industry

by Dr. James D. McGlothlin

DHHS (NIOSH) Publication Number 96-109 July 1996

The National Institute for Occupational Safety and Health (NIOSH) conducted an ergonomic study to investigate, identify, and reduce risk factors that may cause musculoskeletal disease and injury in the soft drink beverage delivery industry.

Ergonomic Intervention for the Soft Drink Beverage Delivery Industry [PDF – 3,129 KB]




PEPSI
127
90
08:34:54
08:38:52
8:37:13 AM

Based on what you see what is your solution?

Hint: Weight of product matters.

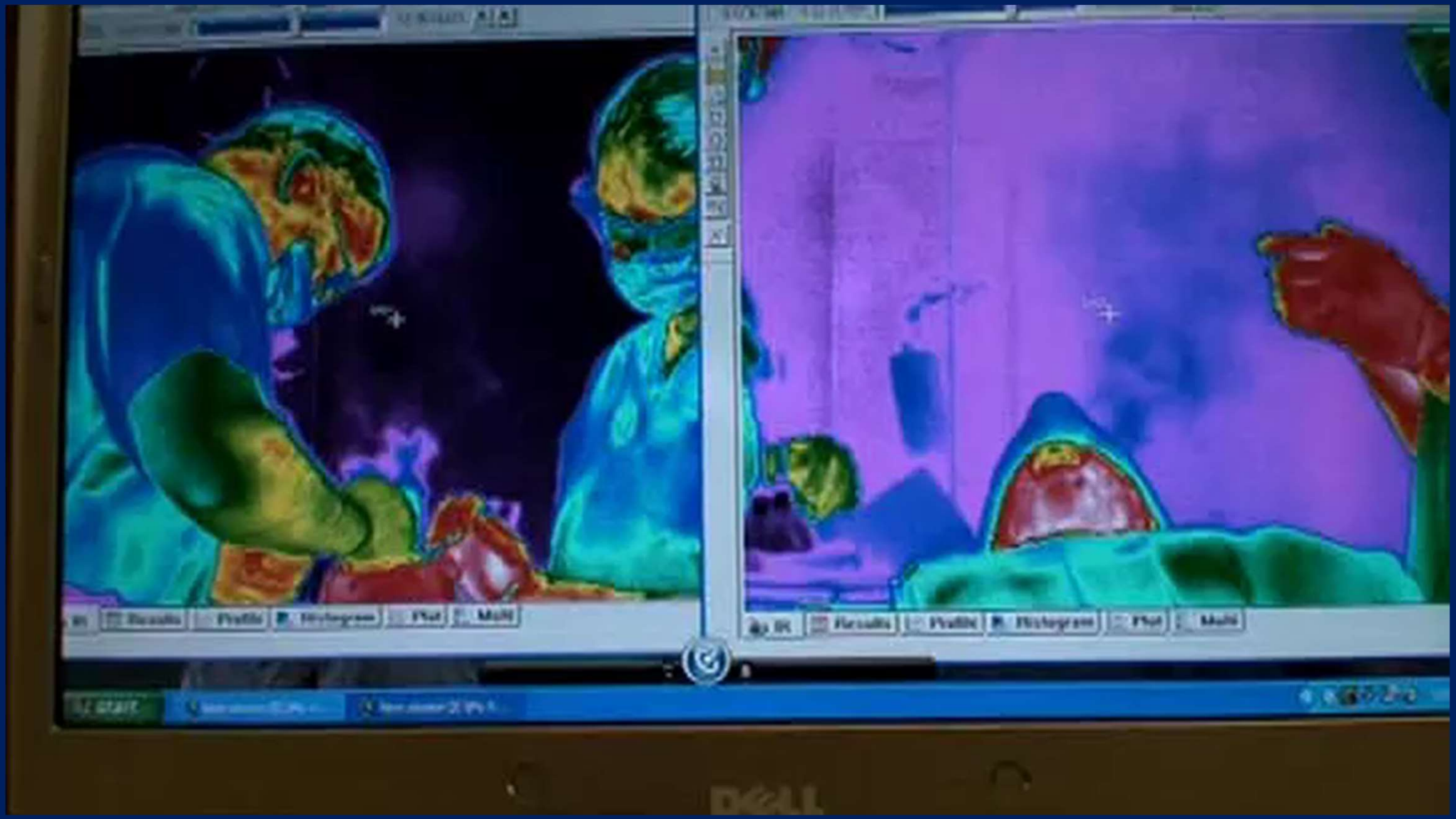
On January 1st, 1999
Dr. McGlothlin retired from NIOSH. On January 4th, 1999
Dr. McGlothlin was hired as an Associate Professor of Health Sciences at Purdue University
West Lafayette, Indiana.
The following slides show quick vignettes of VEM research conducted by Dr. McGlothlin and his graduate students at Purdue University.

Purdue student (Scott) with brain stem tumor. When it was removed he was a quadriplegic.

Installed a motion activated camera that turned on and off when he was on the move. This documentation helped Purdue make the campus accessible and user friendly for Scott and others like him.

Comparison of Nitrous Oxide scavenging systems. Use of infrared system to visualize N20

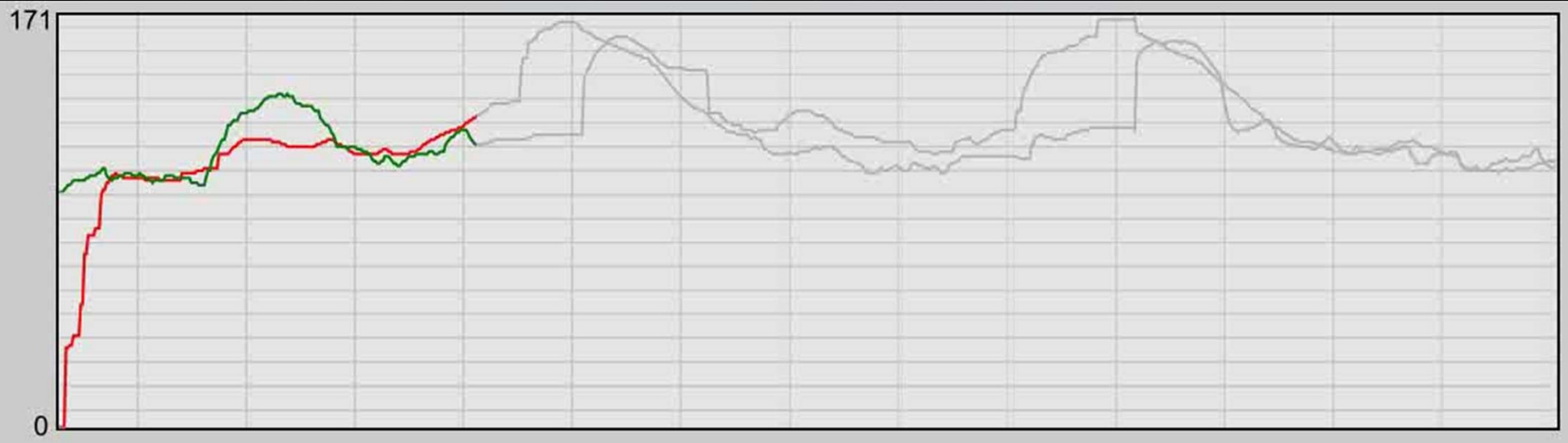
What side shows a better N20 scavenging system?



Use of infrared (heat patterns) visual, and heartrate data to help train U.S. forces safe ingress and egress from urban warzones.

Can you distinguish the heat patterns on the clothes and can you tell which person is in better shape?


Thermal
MiniDV
PURDUE
UNIVERSITY
09/07/2011
07:54:39


171
0

Finger tip radiation exposure from Purdue pharmaceutical students practicing “packing” pills that contain radioactive ingredients.

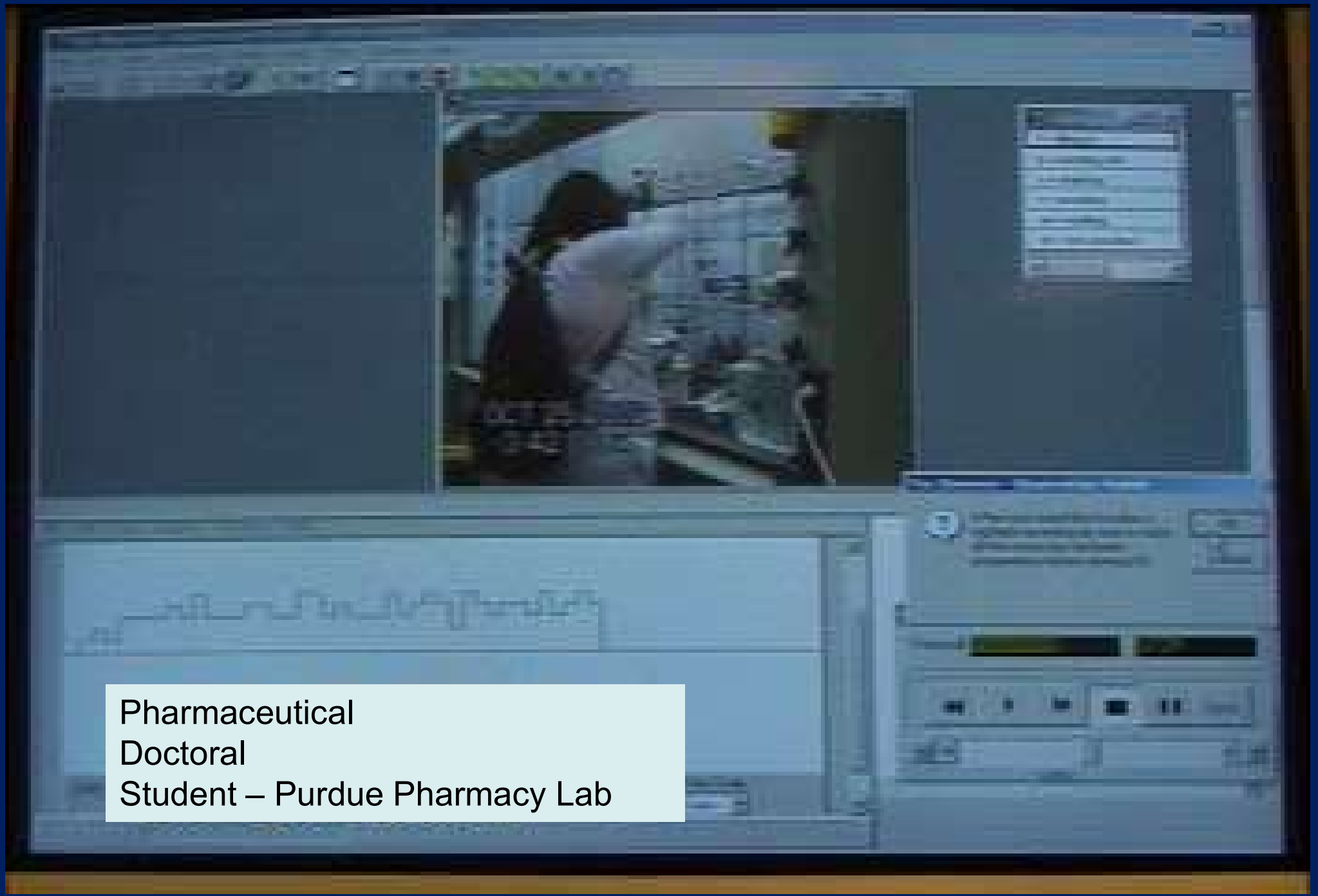
Note the exposure patterns for the right and left hands. What solutions might be implemented?


Capture Details
Start Time
End Time
Duration
Sample Rate
No of Cameras
P1 Sensitivity
P2 Sensitivity
Playback Speed
Play
Pause
Stop
Counts Per Second
Sample Time

Purdue Ph.D., pharmacy student working on a new pharmaceutical drug where benzene is used to “cut” part of the compound.

Count how many times “Carla” touches her hair and face. How many times? What is going on here? Where is the source of exposure?

Pharmaceutical Laboratory Purdue University



Purdue Ph.D., pharmacy student mixing drugs in an open environment. First time internet used to transmit data from one area of campus to anywhere in the world using the internet.

Is there an exposure problem here? What can be done?

Current wireless Real-time Video Exposure Monitoring System

Helmet cam

Area cam: remote pivot and zoom capabilities

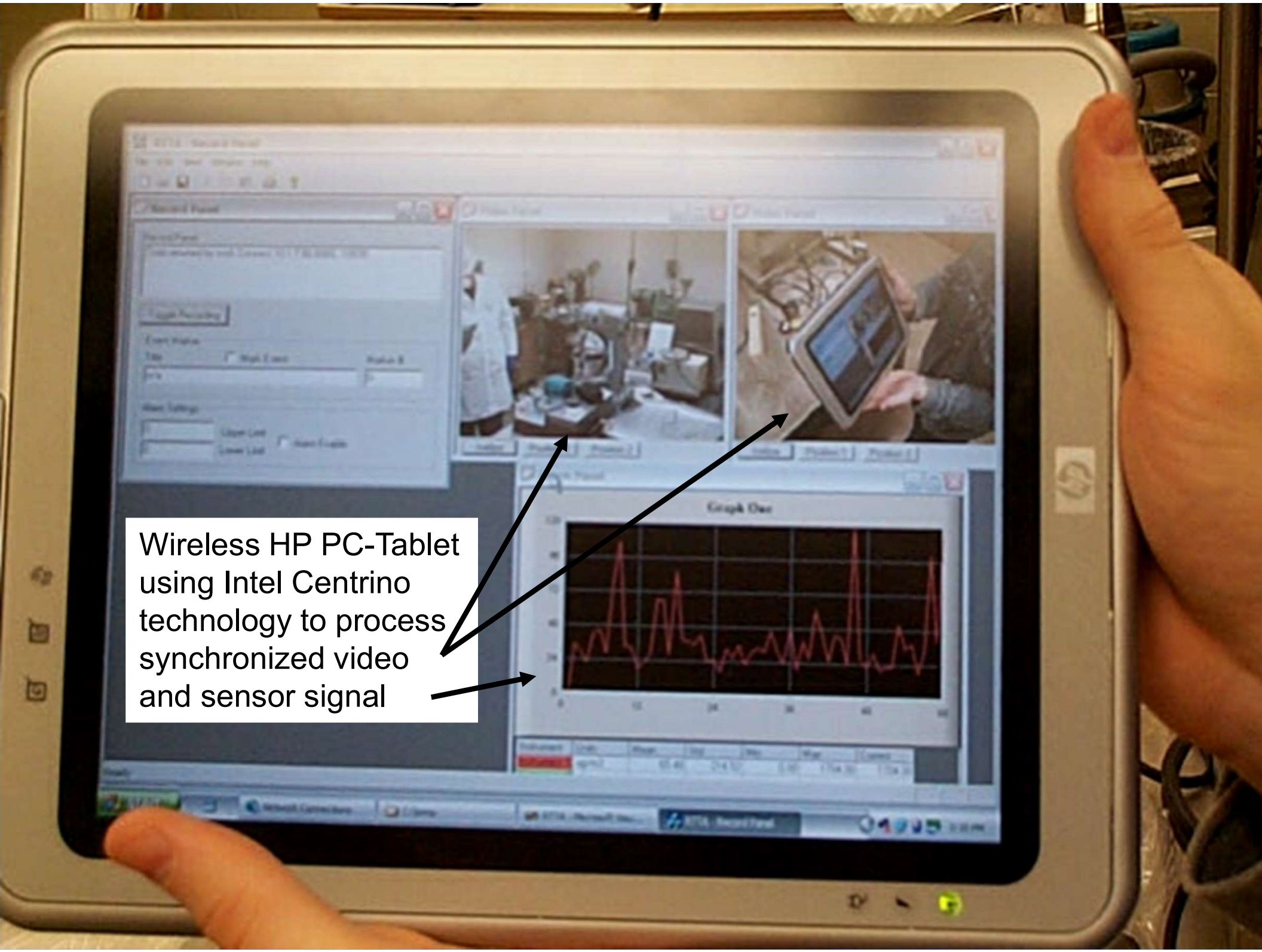
Integrated VEM with real-time sensor output and data logging

Wireless Network receiver

Particulate sensor

Wireless transmitters to area network

J.D. McGlothlin Purdue University
jdm3@purdue.edu


Wireless HP PC-Tablet using Intel Centrino technology to process synchronized video and sensor signal

Edit View Window Help

Playback Panel

yback Panel

InitPlayMode | Play/Pause | 397, eid: 0

Event Markers

Clear All Markers | Scan Event IDs

Marker 1: pouring lactose
Marker 2: mixer on
Marker 3: near table
Marker 4:
Marker 5:
Marker 6:
Marker 7:
Marker 8:

Set Current Markers

Scan Range

Upper Limit: 0

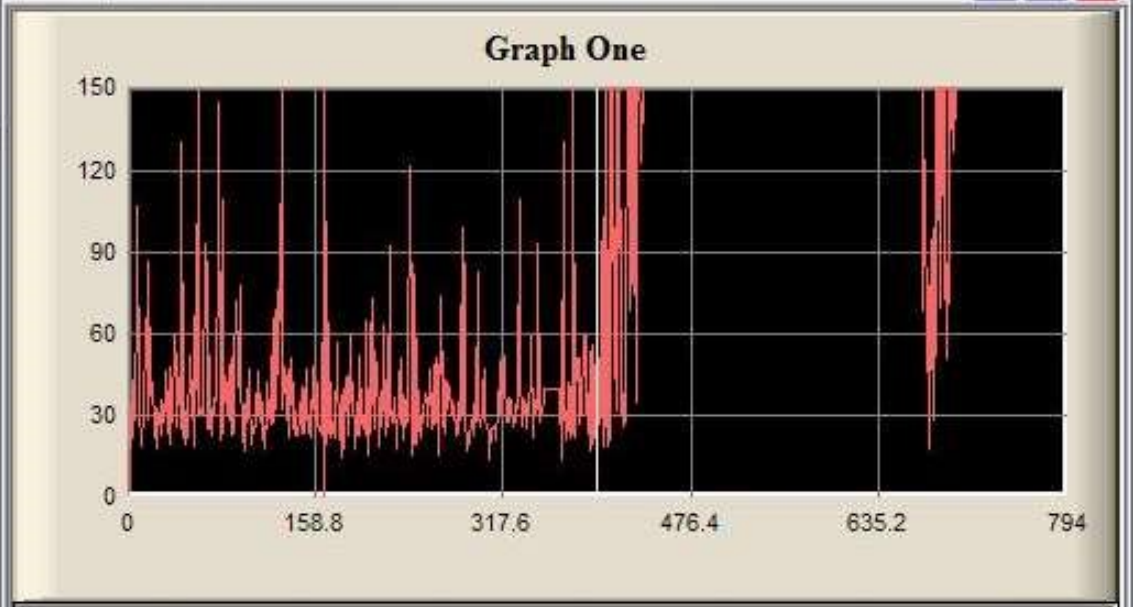
Lower Limit: 0

BACK | FWD

AVI Player

AVI Player

Graph Panel



Instrument	Units	Mean	Std	Min	Max	Current
Particulates	ug/m3	1129.53	2224.91	0.00	20000.00	51.00
SPL	dbA					

Case Application using VEM for Silica Exposure.

ASSESSMENT OF CUT-OFF SAW CONTROL METHODS FOR RESPIRABLE PARTICULATE AND CRYSTALLINE SILICA DURING HIGHWAY CONSTRUCTION APPLICATIONS

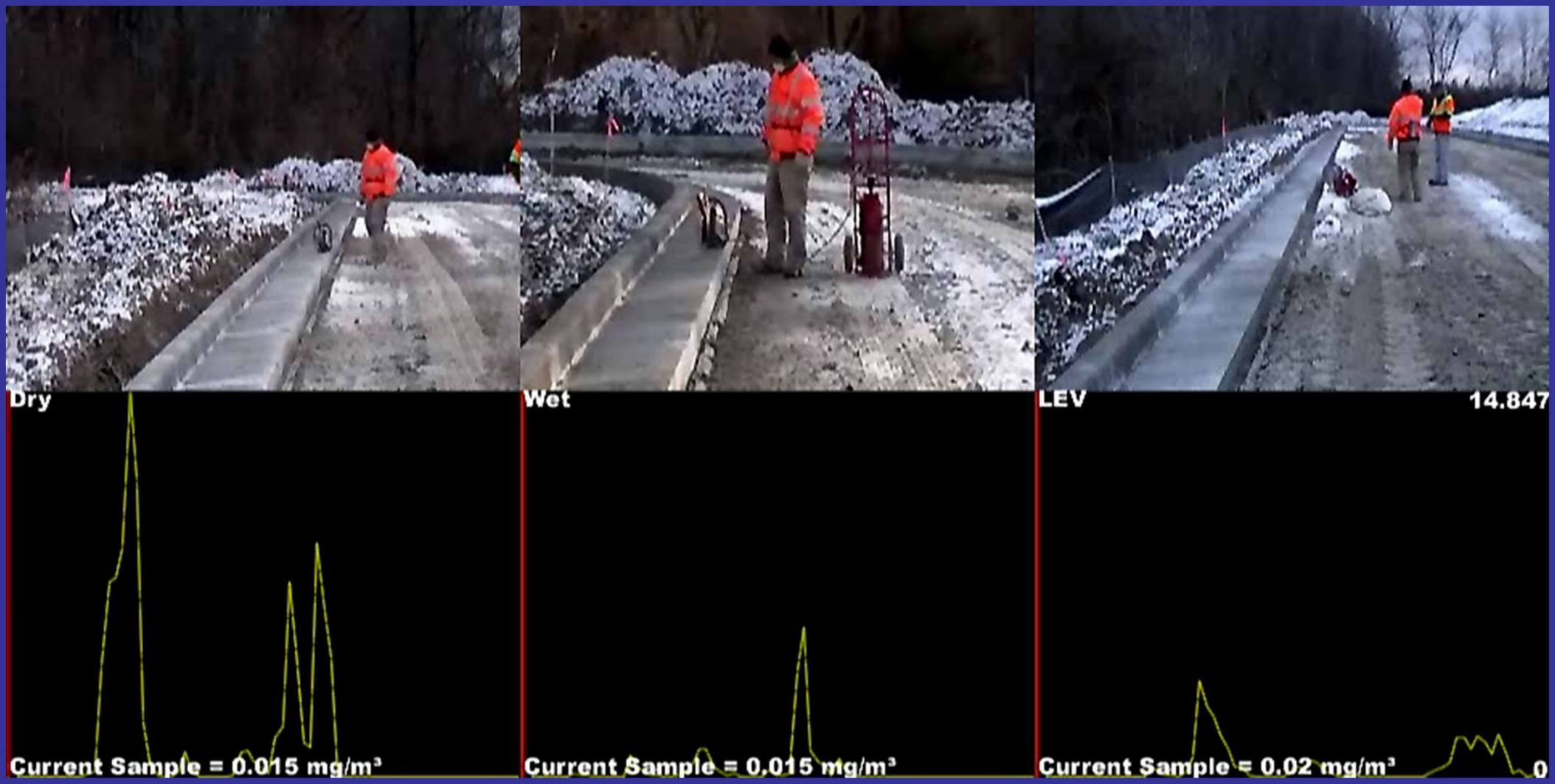
Purdue University
by
Beauregard M. Middaugh, Ph.D., CIH
(This project was his Master's Thesis)

The purpose of this study:

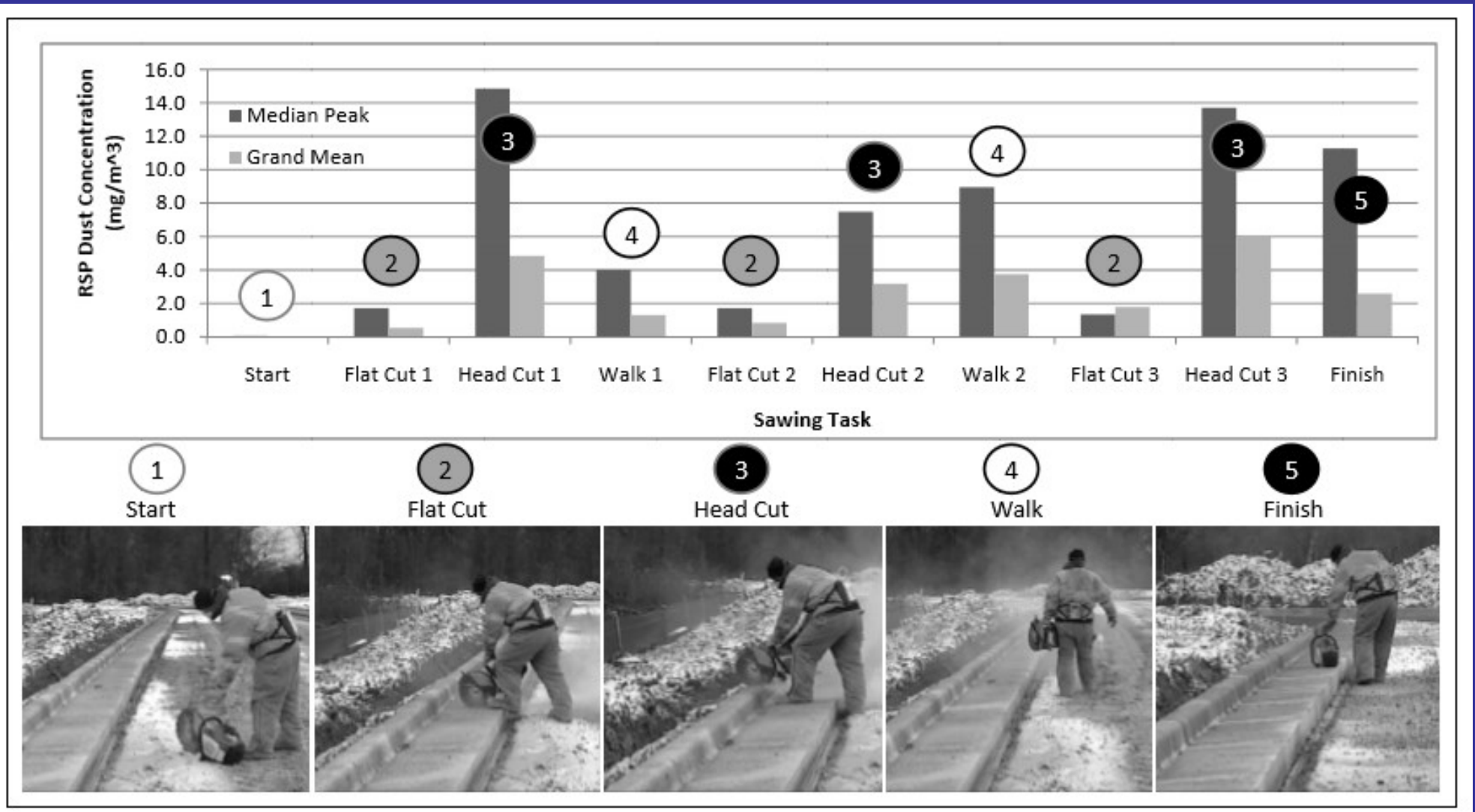
To investigate the dust reduction capabilities of currently available wet suppression and local exhaust ventilation (LEV) methods for gas-powered cut-off saws during the sawing of concrete curb on highway construction worksites. Dust control efficiency (e.g. concrete displacement rate) and weather conditions (e.g. wind) were also monitored to determine their effects on dust reduction.

Real-Time Respirable Dust Monitoring

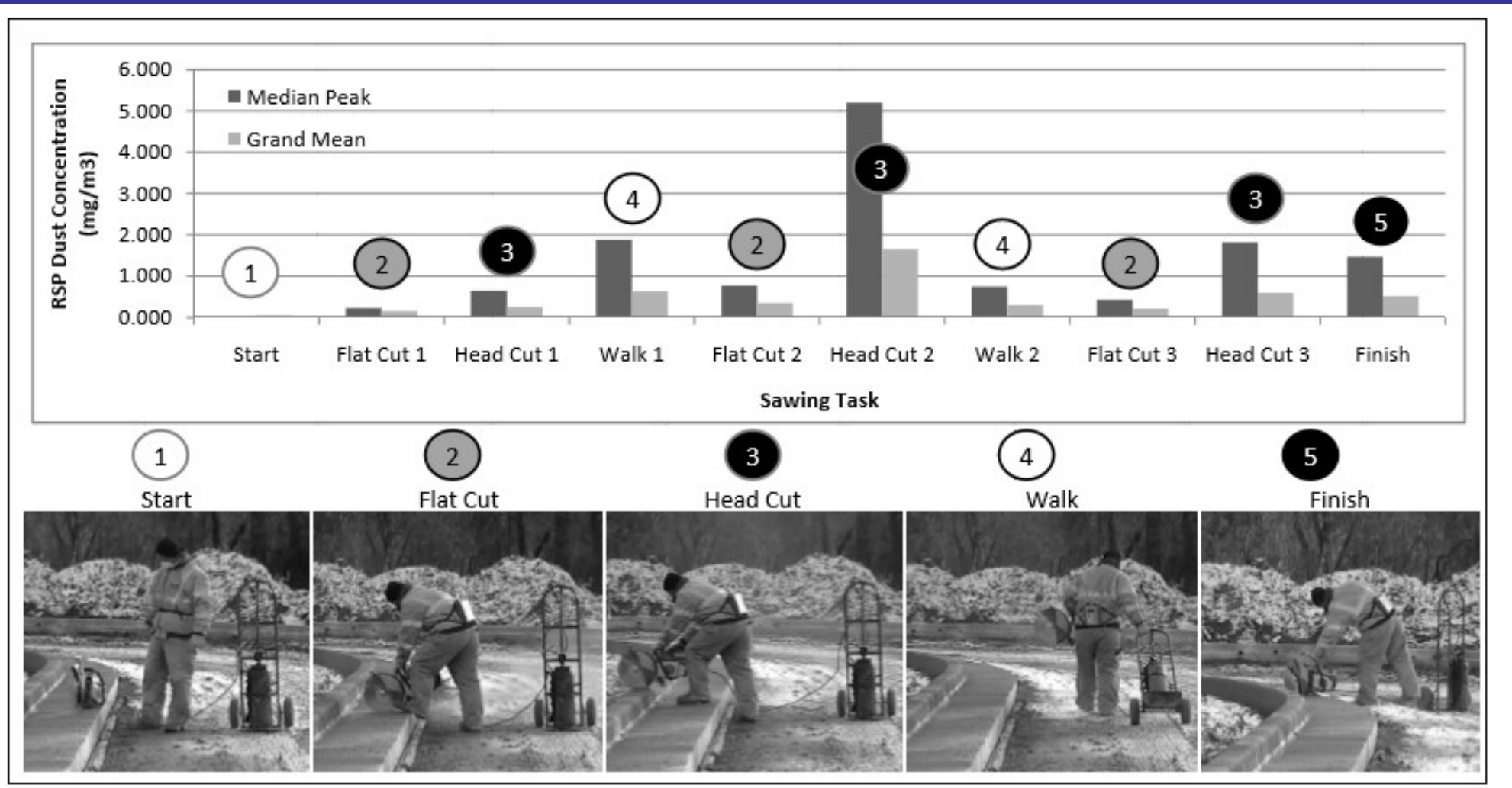
Side-by-side comparison of silica dust exposure.



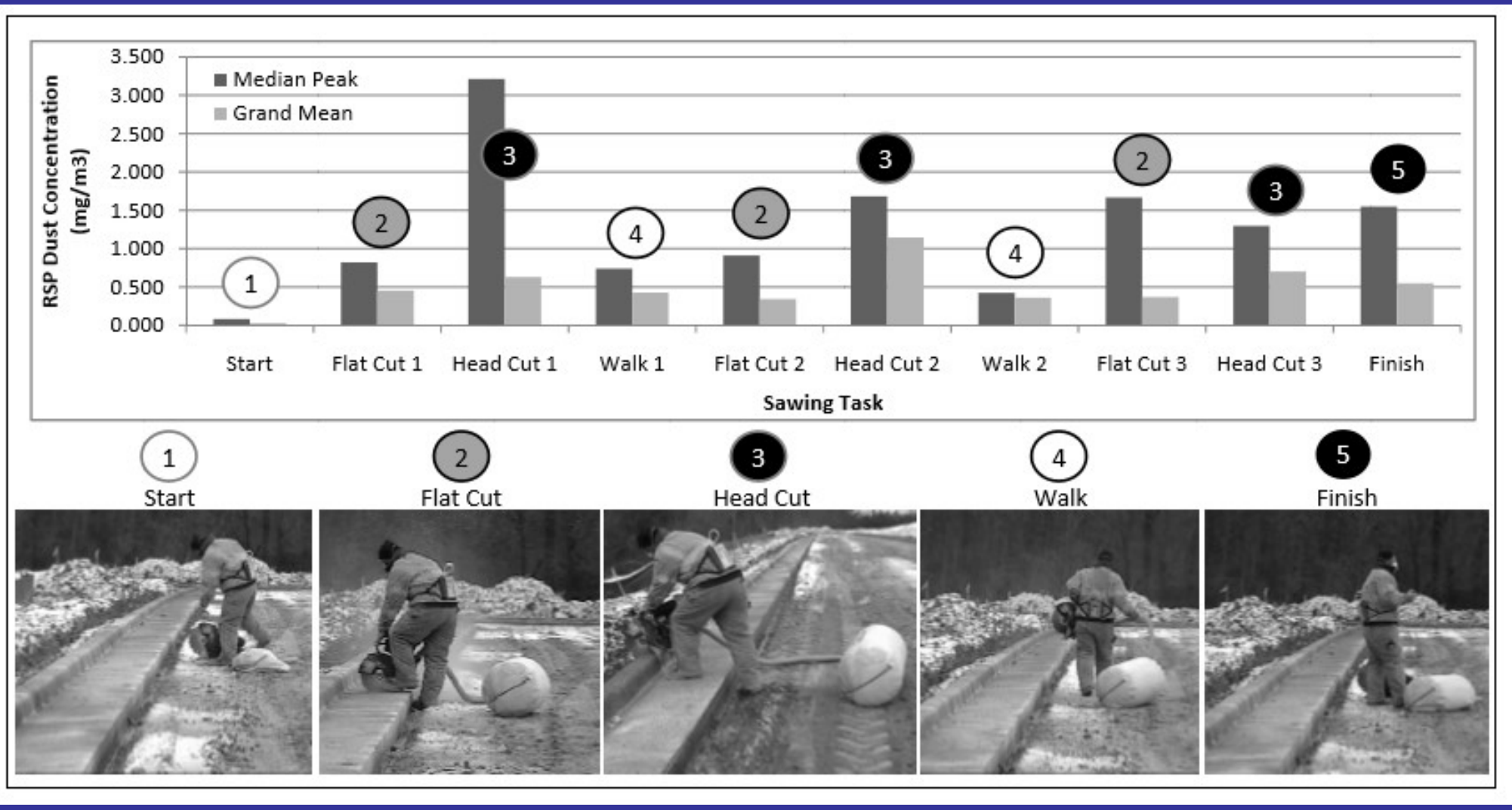
Task-Based Visualization of VEM Silica Exposure Trials (no controls).



Task-Based Visualization of VEM Silica Exposure Trials (Wet method control).



Task-Based Visualization of VEM Silica Exposure Trials (Vacuum method control).



Findings

Personal filter cassette sampling revealed a median percent reduction in respirable (RSP) dust concentrations of 87.7 percent for the wet sawing method (WSM) and 87.0 percent for the Local Exhaust Ventilation (LEV)sawing method compared to the traditional dry sawing method (DSM).

A statistically significant difference ($p<0.001$) was seen between both the WSM and LSM compared to the DSM; however, no significant difference ($p=0.118$) was seen between the WSM and LSM. Based on estimated values of percent quartz, the RSP quartz reduction was approximately 84.4 percent for the WSM and 77.1 for the LSM.

Concrete displacement rates revealed a 63.1 percent reduction in productivity for the WSM and 40.0 percent reduction in productivity for the LSM compared to the DSM.

Video exposure monitoring revealed the WSM was more consistent in reducing peak RSP dust concentrations…

Focus of control should be on the “head cut” where most of the exposure occurred.

Phase II - **"Pilot Study: Laboratory Evaluation of the Iso-Gard Scavenging System, using Bioluminescence Techniques, to control Airborne Pathogens among Healthcare Workers in the Post-Anesthesia Care Unit (PACU)."**

James McGlothlin*, MPH, Ph.D., CPE; Bruce Applegate**, Ph.D.
Josh L. Horton*, M.S., David Putt* Honors Pre-Med Student
School of Health Sciences*
Department of Food Sciences and Biological Sciences**
Purdue University

Bioluminescence as a tool to detect Pathogens

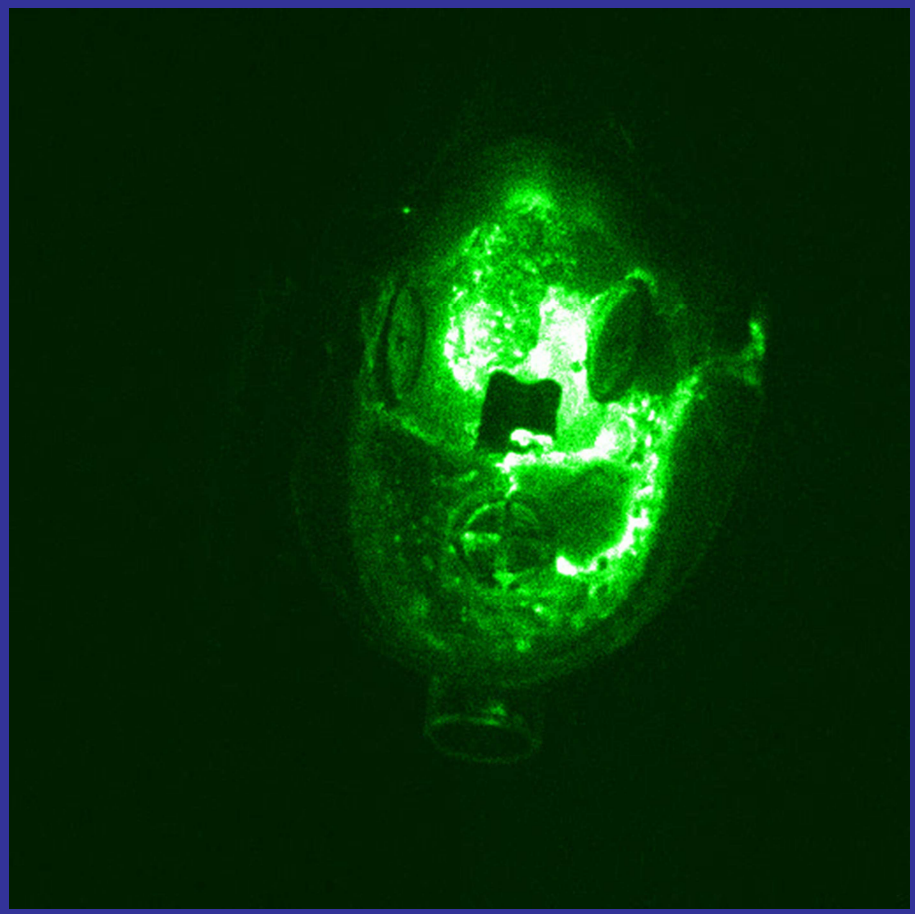
- The use of Bioluminescence will help determine where the escaped pathogens broke through the filter and identify containment by the scavenging system.
- Approximately three hundred years ago, when Robert Boyle first studied the use of Bioluminescence in the carcass of a chicken, he reported that the glowing chicken gave no heat, luminescence needed air, and pouring wine on the chicken decreased luminescence.
- The rapid detection of pathogens is necessary in healthcare settings, and bioluminescence-based methods are the most promising for the detection of bacteria.

The scavenging system initially designed to capture waste anesthetic gases (halogenated compounds and nitrous oxide off gassing from patients. opportunities

Based on bioluminescence (amount of bacteria can be quantified based on intensity of light), what additional benefits may be gained from use of this scavenging system?

Example of Bioluminescence of Iso-Gard Scavenging System

Mask in ambient light



Mask imaged in dark showing bacteria pathogen (pseudomonas)

Example of Bioluminescence of Iso-Gard Scavenging System

Mask in ambient light

Mask imaged in dark showing bacteria pathogen

Additional benefits may be gained from use of this scavenging system by making sure patients who may have a respiratory transmittable disease (such as tuberculosis) do not spread the disease to healthcare personnel in the PACU or ICU or to other patients.

International Research using VEM

“Community Exposure to Erionite and Causes of Mesothelioma in Cappadocia, Turkey”

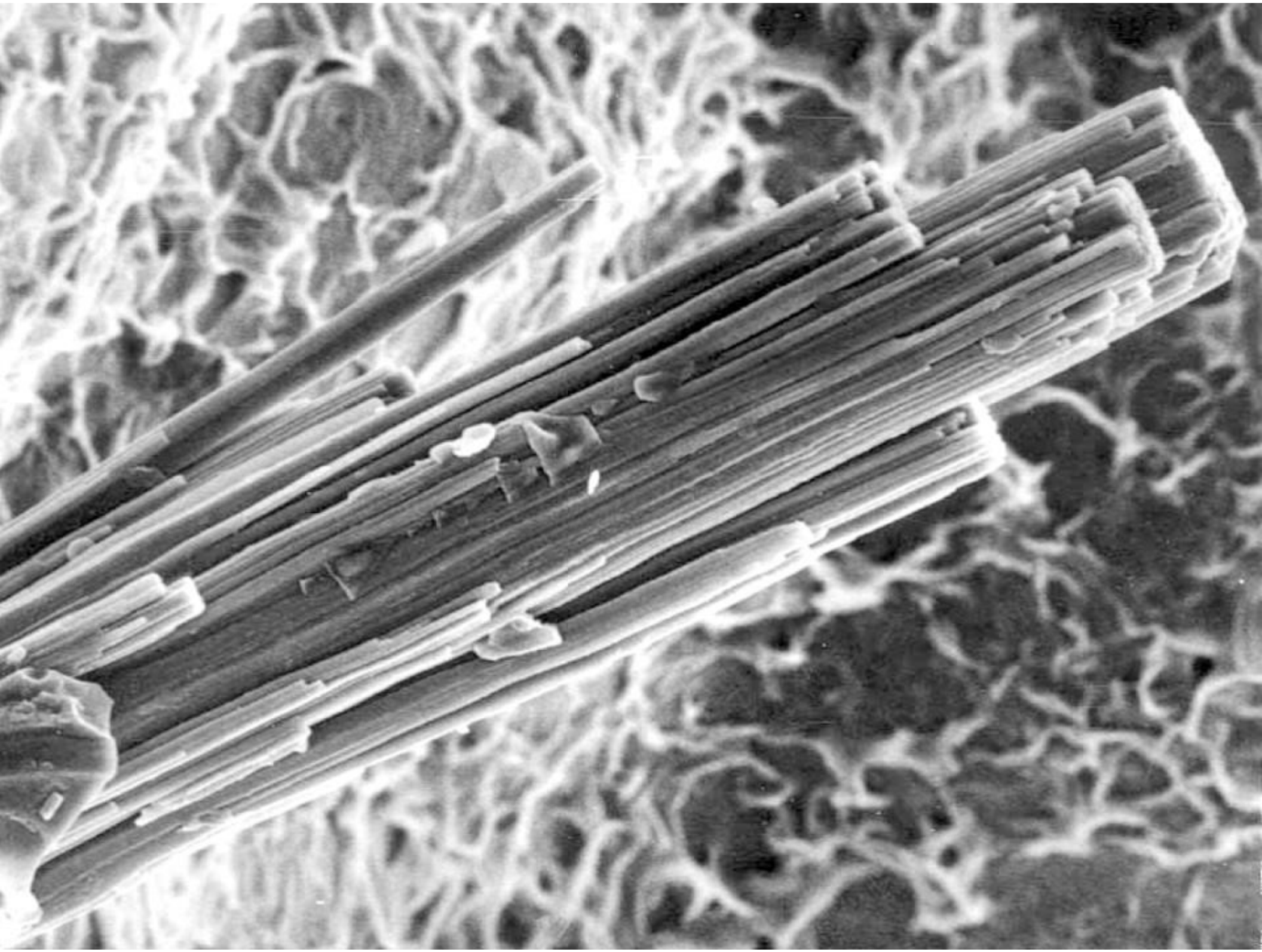
Mesothelioma

- The goal of this research is to investigate those factors that may render some individuals more susceptible to mineral fiber carcinogenesis.
- Our team studies how different factors interact in causing Malignant Mesothelioma (MM) to identify some point in the evolution of the process that is vulnerable to intervention.
- So far, we genetics appears to be a factors with mineral fibers in mesothelioma pathogenesis.
- The role occupational and environmental exposure to eronite plays in the development of MM is the focus of my research.

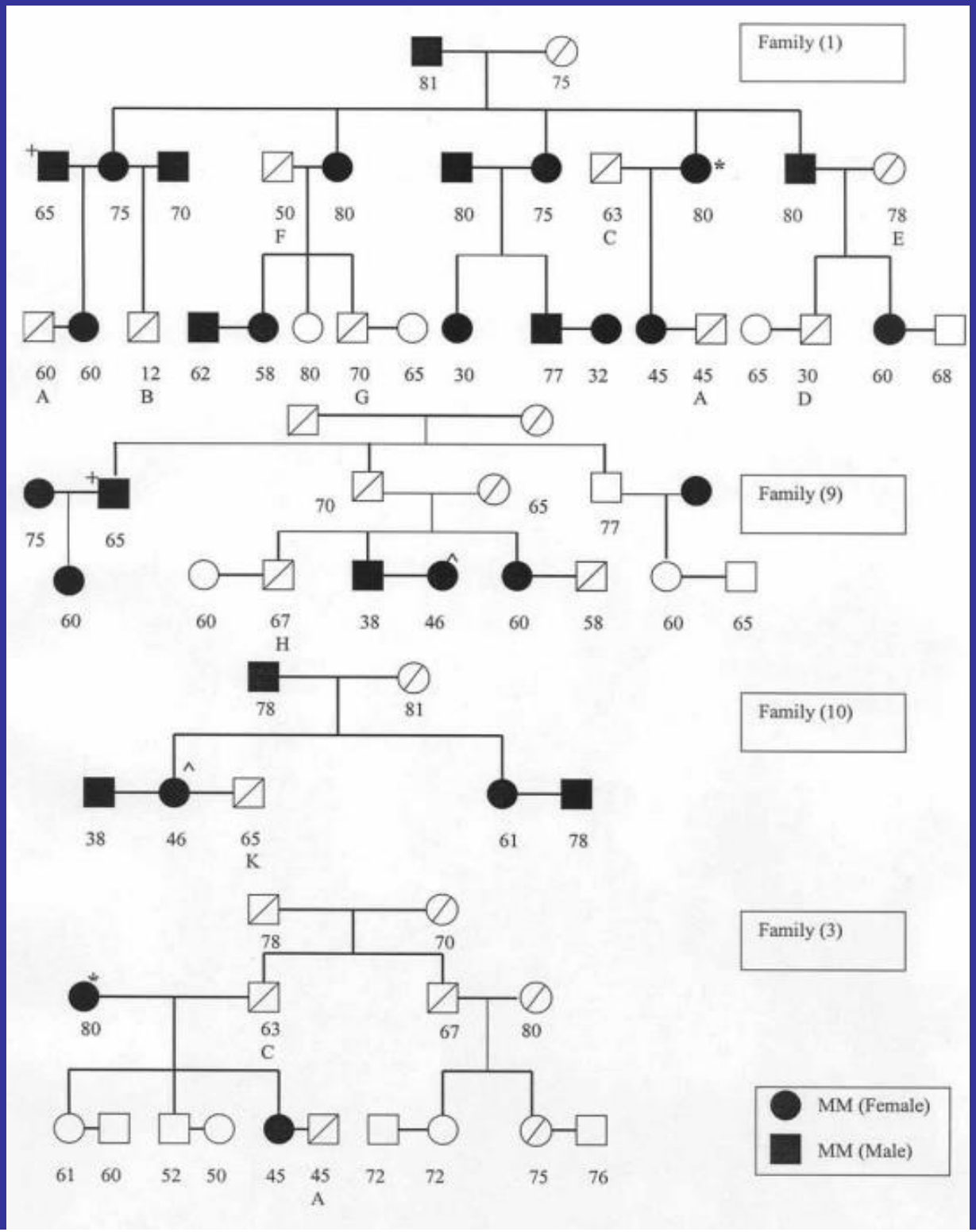
Cappadocia, Turkey

Mesothelioma and causation: Challenges

- How much asbestos cause mesothelioma?
- What type of asbestos causes mesothelioma?
- What is the role of erionite, other mineral fibers, radiation, genetics in mesothelioma?

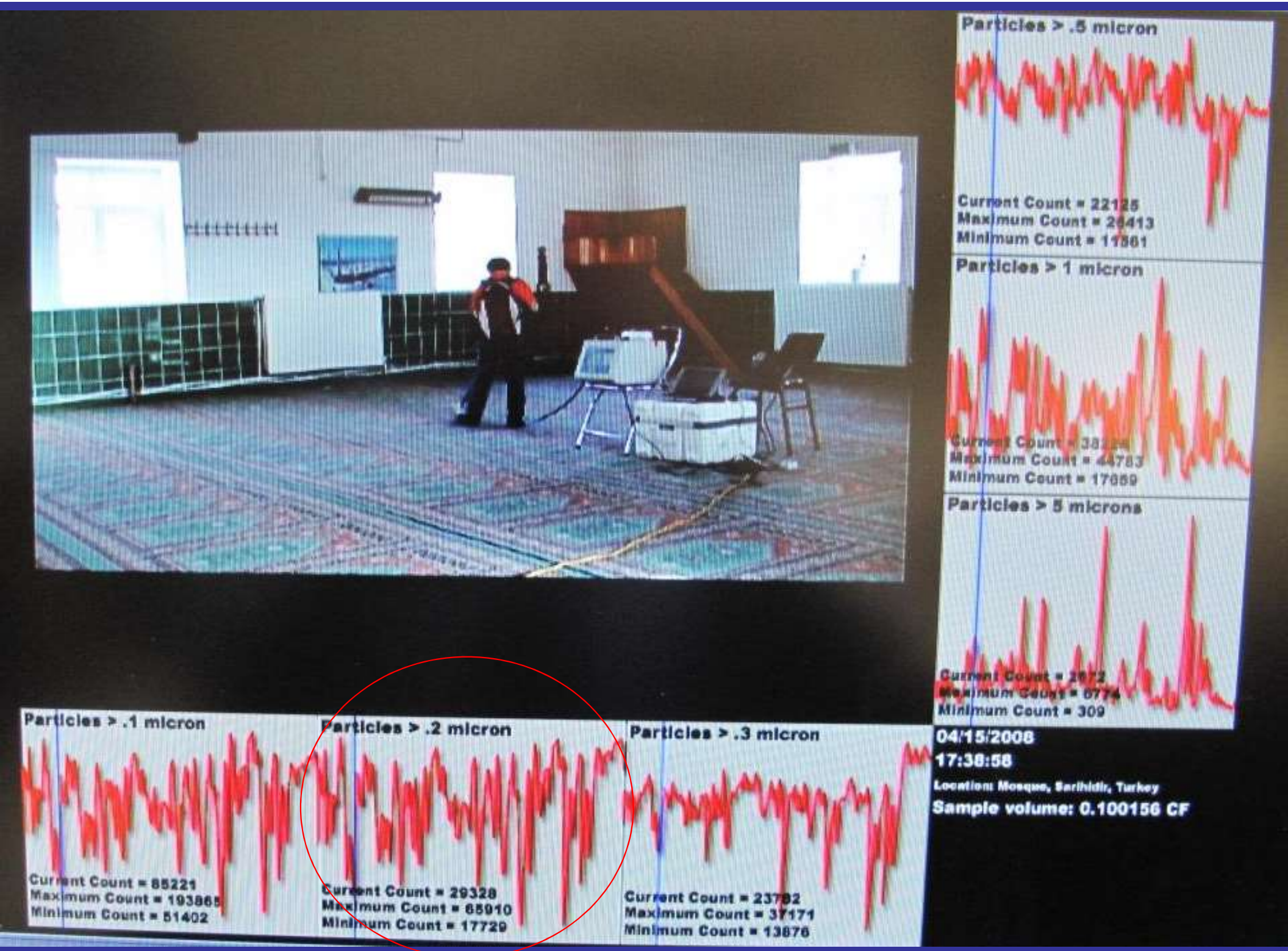


Mapping of families who had mesothelioma and genetic pre-disposition for this disease.




LASAIR II
PARTICLE MEASURING SYSTEMS
ABC 1
DEF 2
GHI 3
JKL 4
MNO 5
PQR 6
STU 7
VWX 8
YZ 9
0
A


Particle & Analog Data


Particles > .5 micron
Current Count = 22125
Maximum Count = 26413
Minimum Count = 11561
Particles > 1 micron
Maximum Count = 44783
Minimum Count = 17859
Particles > 5 microns
Minimum Count = 309
04/15/2008
17:38:58
Location: Mosque, Serihidir, Turkey
Sample volume: 0.100156 CF
Particles > .1 micron
Current Count = 85221
Maximum Count = 193865
Minimum Count = 51402
Particles > .2 micron
Current Count = 29328
Maximum Count = 65910
Minimum Count = 17729
Particles > .3 micron
Current Count = 23782
Maximum Count = 37171
Minimum Count = 13876

Yes, Erionite is in the U.S., including New Mexico.

Fig. 1.

Erionite deposits in the United States and roads with erionite-containing gravel in Dunn County, North Dakota.

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3158231/

VEM Research in New Zealand

- Control of wood dust for wood furniture construction industry.

- California pines grow 3 times as fast in New Zealand and makes the country a great resource for wood products.

VEM in a Box

New Zealand Wood Dust Study

Wood Industry – Control of Wood Dust in Wellington, New Zealand

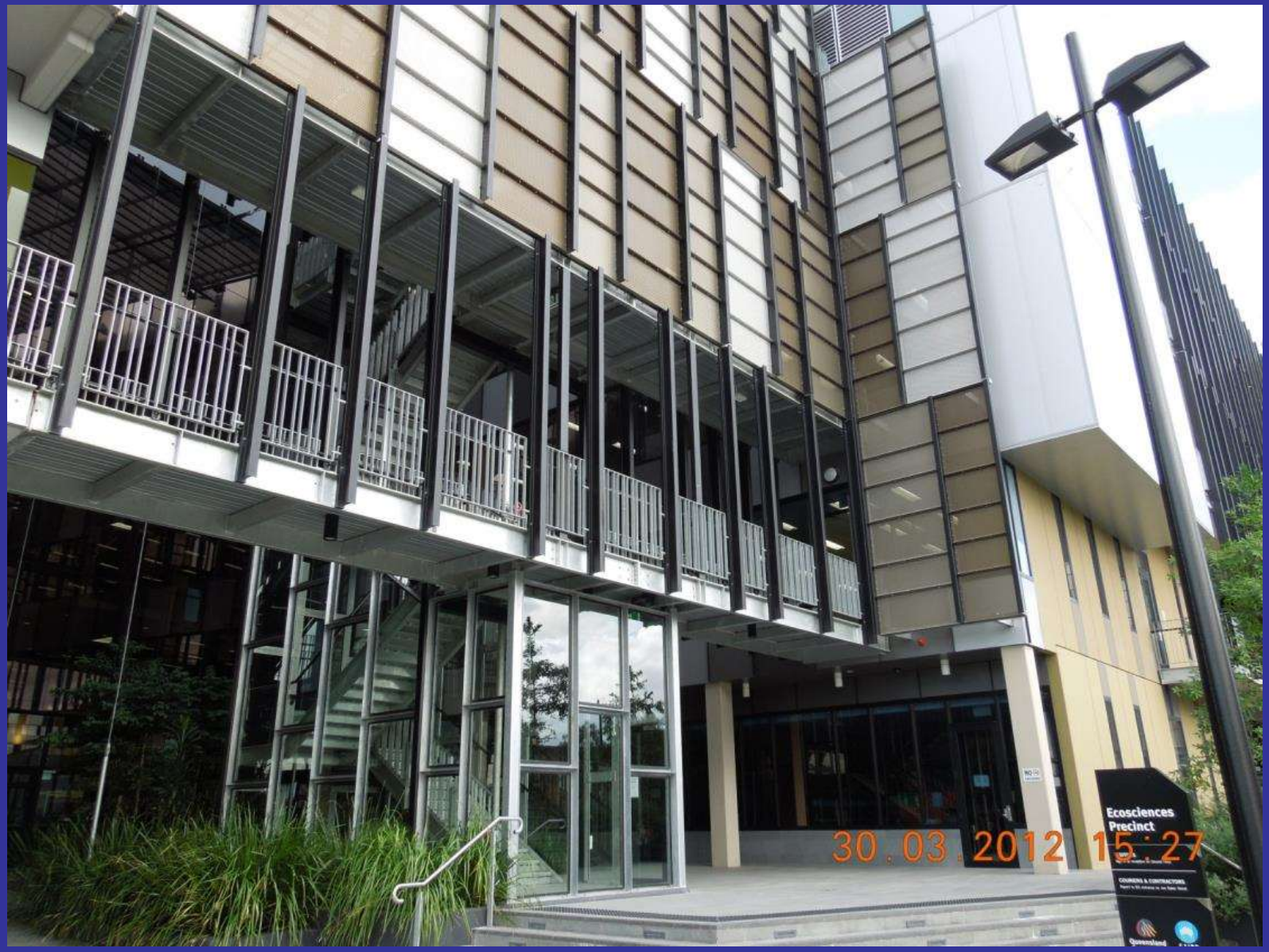
- Major findings:

80% of the airborne wood particles were generated from three wood processing machines such as the: Computer Numerical Control (CNC) router

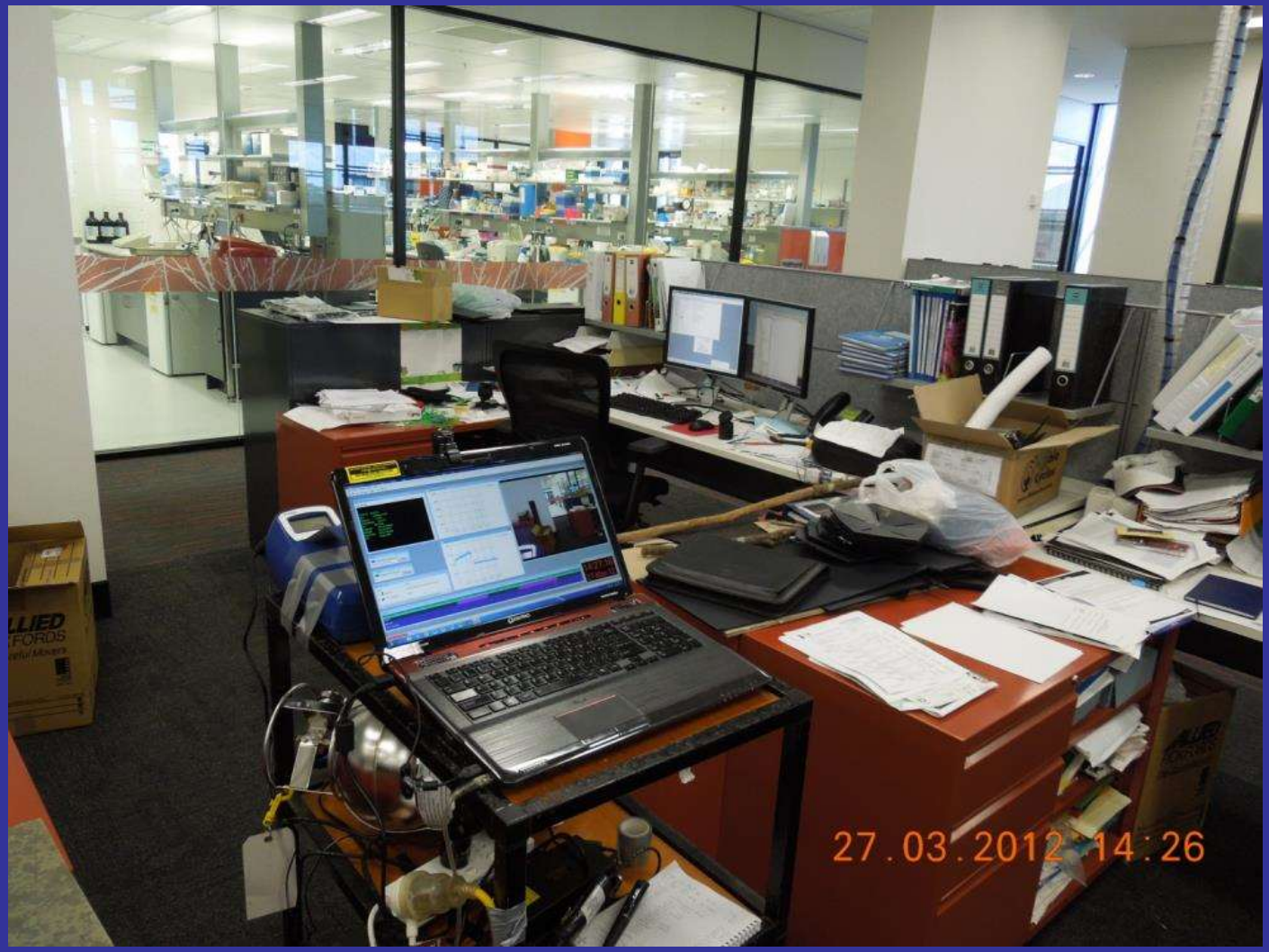
ACGIH Ventilation Manual was used to design downdraft tables to reduce airborne particulates.

- However, the motivation for installing ventilation controls was that they cleared the air enough to allow the wood workers to varnish the wood in the afternoon (the workers usually went home after lunch and clean up and came back the next day) thus doubling their production. A win-win for both the workers and the industry.

Study of Ecosciences Building on Boggo Rd.,Dutton Park, Brisbane, Australia.



Representative set up for office indoor air quality monitoring using VEM.



Video Exposure Monitoring (VEM)® Indoor Air Quality

Assessment System for collecting: TVOCs, Particulates, CO2, Temperature, and Humidity data.

- Major finding:

Based on GC/MS analysis: Glue on carpet squares appeared to have sensitized some of the workers. Other areas had different glue profiles on the carpet squares that did not have workers reporting respiratory symptoms.

Bottom line, it was very difficult to single out a specific cause that resulted in employee sicknesses.

Drones and Video Exposure Monitoring

VEM Sensors can be attached to drones for remote sensing. May be helpful in fence line monitoring, or pre-designated flight paths to spot check for leaks or routine monitoring of industrial airborne contaminants.

Advantages and Disadvantages of Drones (Unmanned Aerial Vehicles – UAV's)

Some Advantages:

- They are relatively inexpensive (~$500-1,000 dollars)
- Portable
- Can carry small sensors
- Can see real-time video and collect sensor data from drone on hand held devices such as Android tablets, and phones to iPads, and iPhones

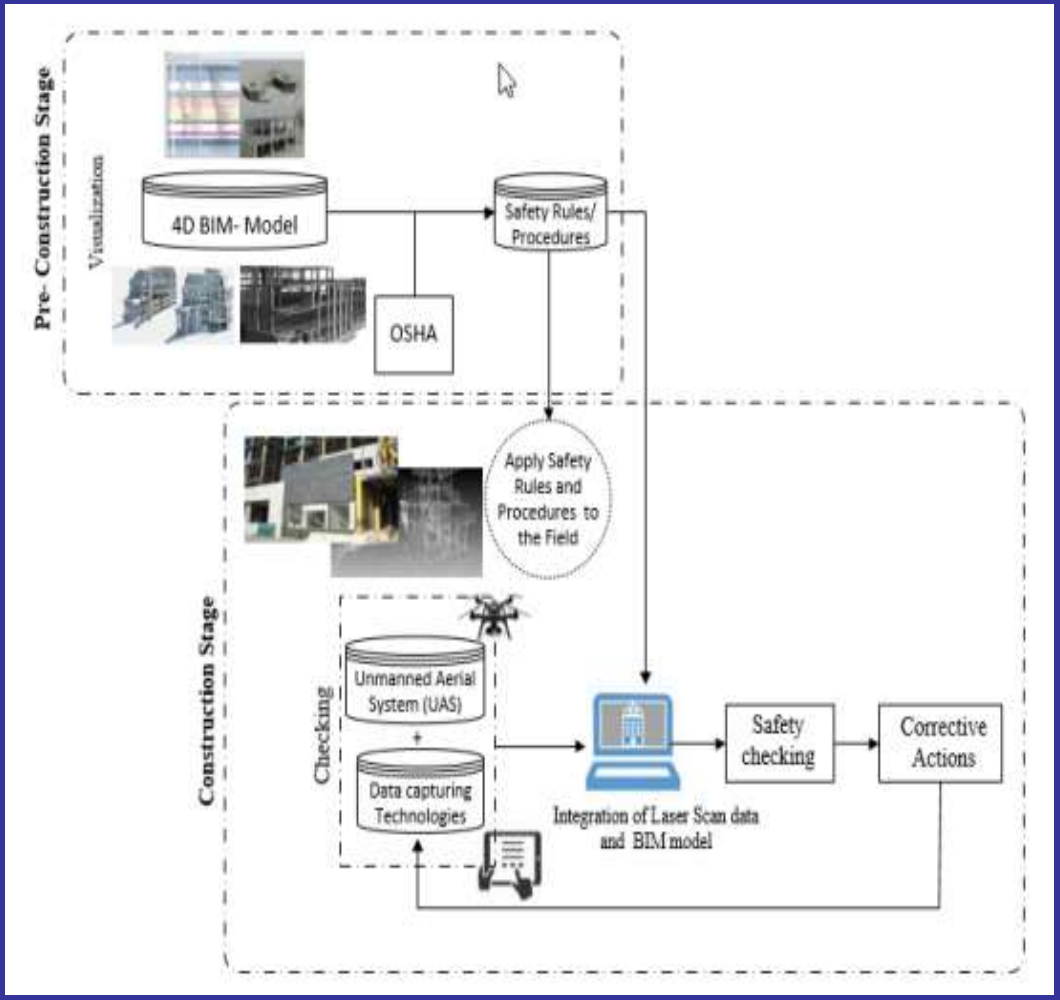
Some Disadvantages:

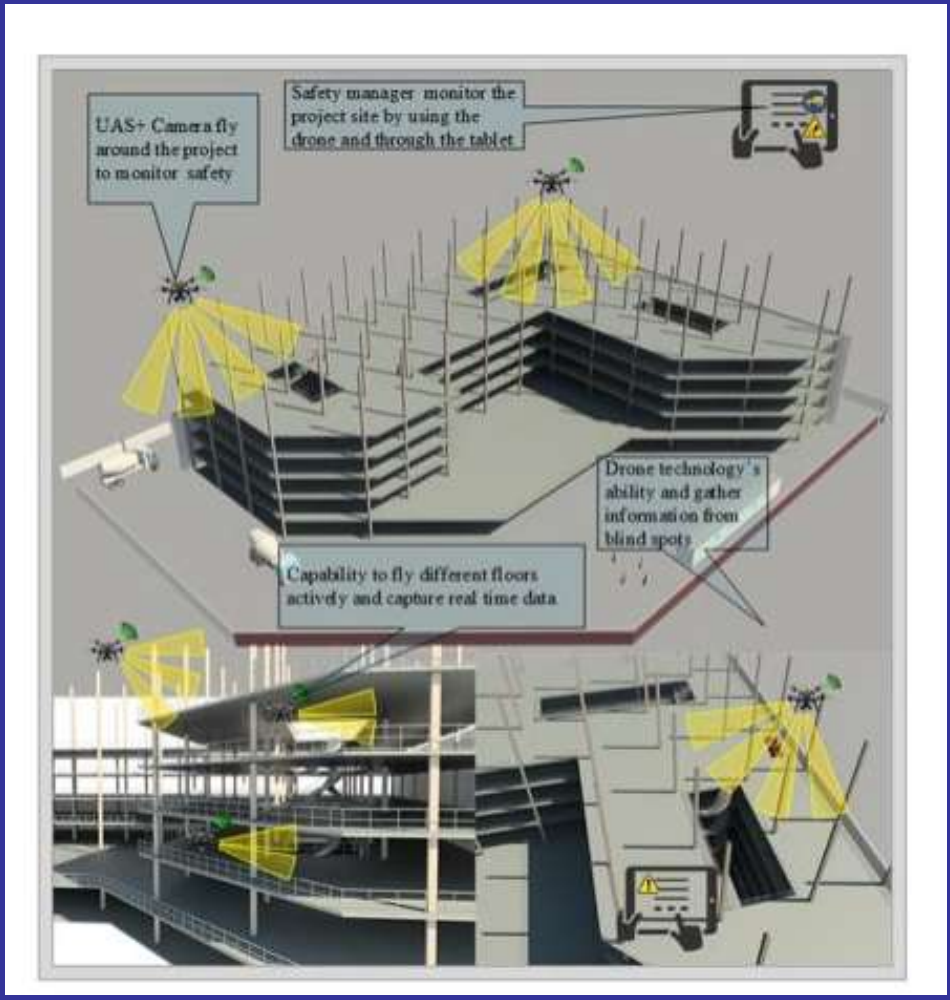
- Drone user needs training and the drone has to be registered with the FAA
- Can be damaged or lost, and can damage property.
- Limited battery life

Using drones to monitor construction projects

Source:https://www.google.com/search?q=unmanned+aerial+vehicles+for+occupational+safety+and+health&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj96reBpN3iAhUDOK0KHaAyAZoQ_AUIESgC&biw=1088&bih=486#imgrc=qVVxrtBHo9eqaM:

Use of Drones for Construction Safety: Proceedings of the 9th Nordic Conference on Construction Economics and Organization 13-14 June, 2017 at Chalmers University of Technology, Göteborg, SWEDEN
Martine Buser, Göran Lindahl and Christine Räisänen (Editors)





4D Building Information Modeling (BIM) X,Y,Z, + Time

Oct 12th, 2019: New Orleans Hard Rock Hotel Collapsing. Use of 4D Building Information Modeling (BIM) X,Y,Z, + Time, drones, and Video Exposure Monitoring may have helped prevent this tragedy.

Product handling – think hazardous products. In addition to these applications there are 100's more. The key is to know the strengths and weaknesses when using drones for safety and health monitoring. For example, it may not be practical to sample the air during flight due to the air wash from the drone propellers. It is best to fly it to a location, let it sit and sample, then fly back to it's origin.

Source:https://www.google.com/search?q=unmanned+aerial+vehicles+for+occupational+safety+and+health&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj96reBpN3iAhUDOK0KHaAyAZoQ_AUIESgC&biw=1088&bih=486#imgrc=qVVxrtBHo9eqaM:

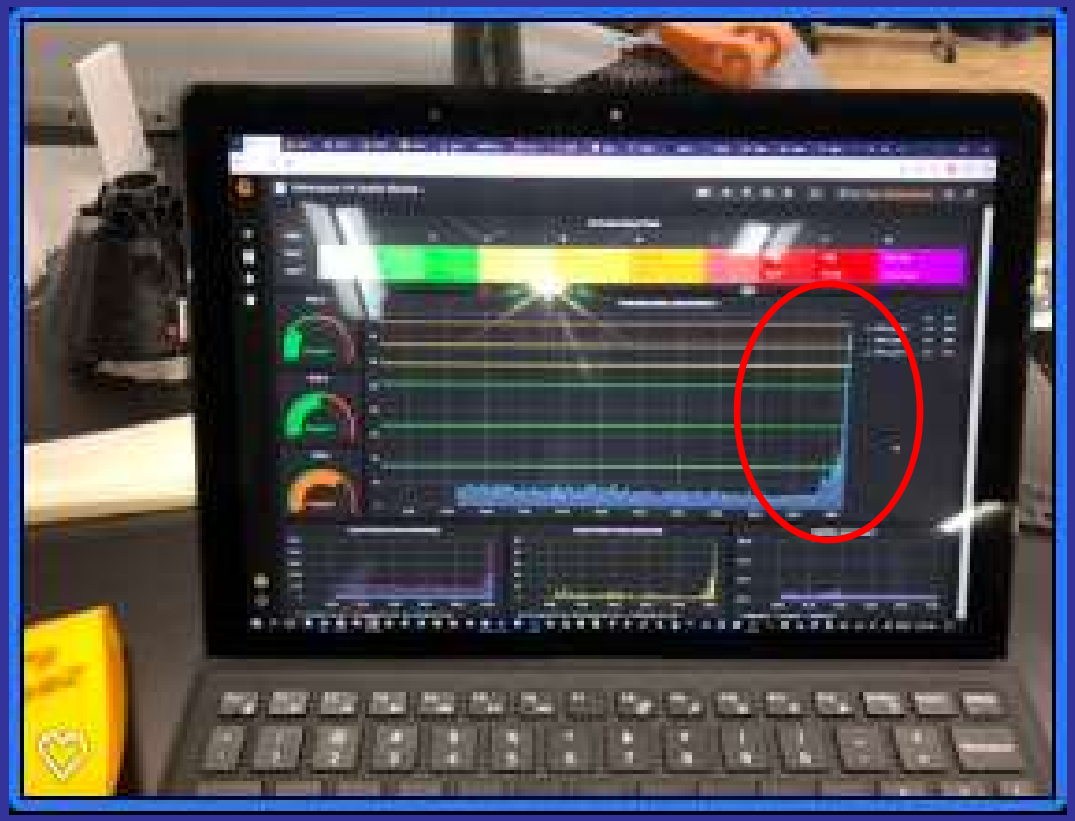
Latest Research with NASA on Health Hazards (Particulates) associated with 3-D Printers

Entrance to Presentation Hall – Engineering building

Bank of 3-D printers in 3-D printer building.

NASA’s particle sampler

Rapid increase in airborne particles as seen by NASA’s particle counter and software



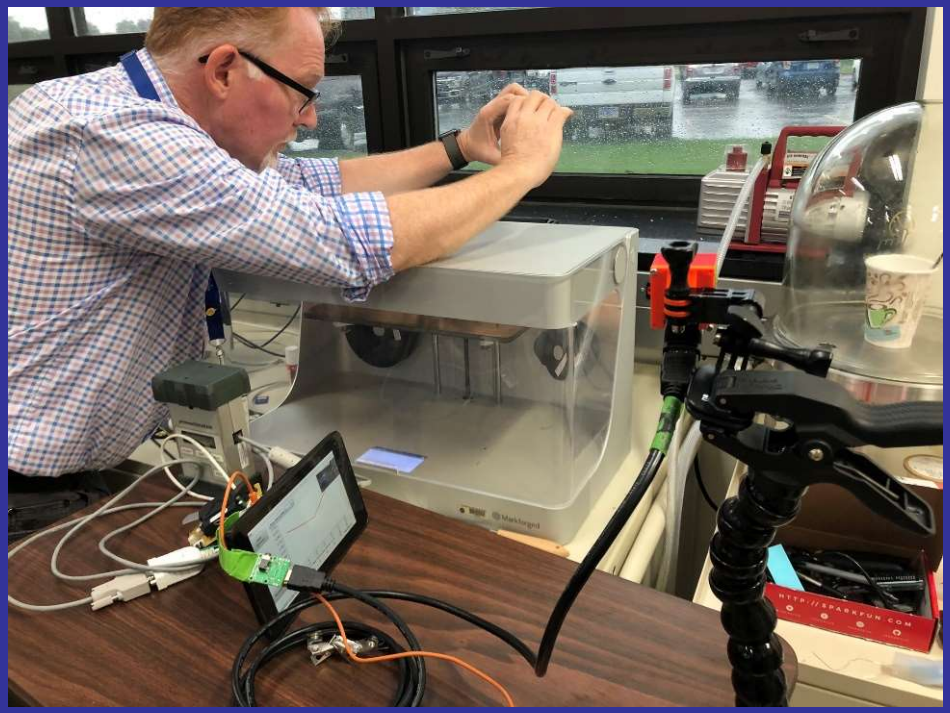
3-D printer area: note bank of 3-D printers in background.

VEM set up at 3-D printer building

VEM set up for 3-D printer particulates.

VEM set up in 3D Printing Building

The culprit: compressor with oil mist relief valve



Close up of release valve – now with small cap to reduce oil mist in the work area.

How did I know that it was the compressor oil mist that was contributing to the airborne particulate problem?

With Video Exposure Monitoring you have the not only the visual advantage but the audio advantage. Thus, you can not only see when the compressor turns on, the VEM audio picks up the compressor noise and correlates to the increase in particulates.

Back to Earth with advances in VEM

If VEM is so cool and developed in the 1980's, then why is it not a common tool in occupational safety and health today?

Because…

- It can be expensive: (~5,000 – 25,000 dollars - portable computer, sensors, communication (internet, Blue Tooth, etc.).
- It is not easy to operate. Most occupational safety and health professionals prefer plug and play devices
- It does monitors relative concentrations of contaminants not exact concentrations and therefore can't be used for compliance purposes
- Video of workers and work areas may not be permitted (privacy, proprietary equipment/operations)
- Data management: large data sets with second by second sensor data with video
- Data storage: Limited storage capacity of portable devices.
- Some companies/gov't agencies cannot use storage media because of viruses.
- And many other issues….

But: When there are may advantages of using VEM when the strengths are considered – see next slide.

Breaking News: VEM Game Changer

- **Costs matter.** New VEM Software and Hardware will reduce initial and operational costs from approximately $3,000 dollars + Sensor (~ $6,000 dollars) that may average to $6,000 or more, to ~$300 that includes an array of sensors.
- **Size matters.** The new VEM kit is portable, and like the "Tricorder", gives you a lot of information in a small package.
- **Ease of operation matters**. VEM is easy to operate, and play back.
- **Analytics matter.** Real-time data and video can be uploaded to common spreadsheet software for detailed analyses for exposure assessment and control strategies.

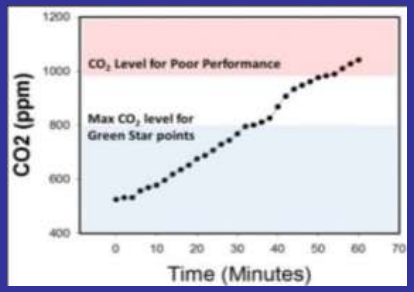
Video Exposure Monitoring – an Exposure Assessment Tool.

- Example: Exposure to vapors and gases.

Current project with Professor Dave Huizen at GVSU: Evaluation of Carbon Dioxide (CO_2) exposure in the manufacture of beer. Professor Huizen is looking at the interactions of physiologic demands, CO_2 levels, changes in heartrate, and biomechanical demands (back and shoulder disorders), of the job. His dissertation will simultaneously address safety, ergonomics and health on the job.

Video Exposure Monitoring – an Exposure Assessment Tool.

- Note: CO_2 is an asphyxiant, exposure to concentrations of 10 percent (100,000/ppm) or more of can **cause** death, unconsciousness, or convulsions. However, a recent Harvard study found "statistically significant and meaningful reductions in decision-making performance" in test subjects as CO_2 levels rose from a baseline of 600 parts per million (ppm) to 1000 ppm and 2500 ppm.*



- Our exhaled breath shows about 350 ppm of CO_2.
- It is not uncommon to find CO_2 levels in brewery's above 5,000 ppm (from yeast, but also purging vessels with CO_2).
- The CO_2 OSHA/NIOSH 8-hr limit is 10,000 ppm, for an 8-hour average, and 30,000 ppm for a 15 minute short term exposure.

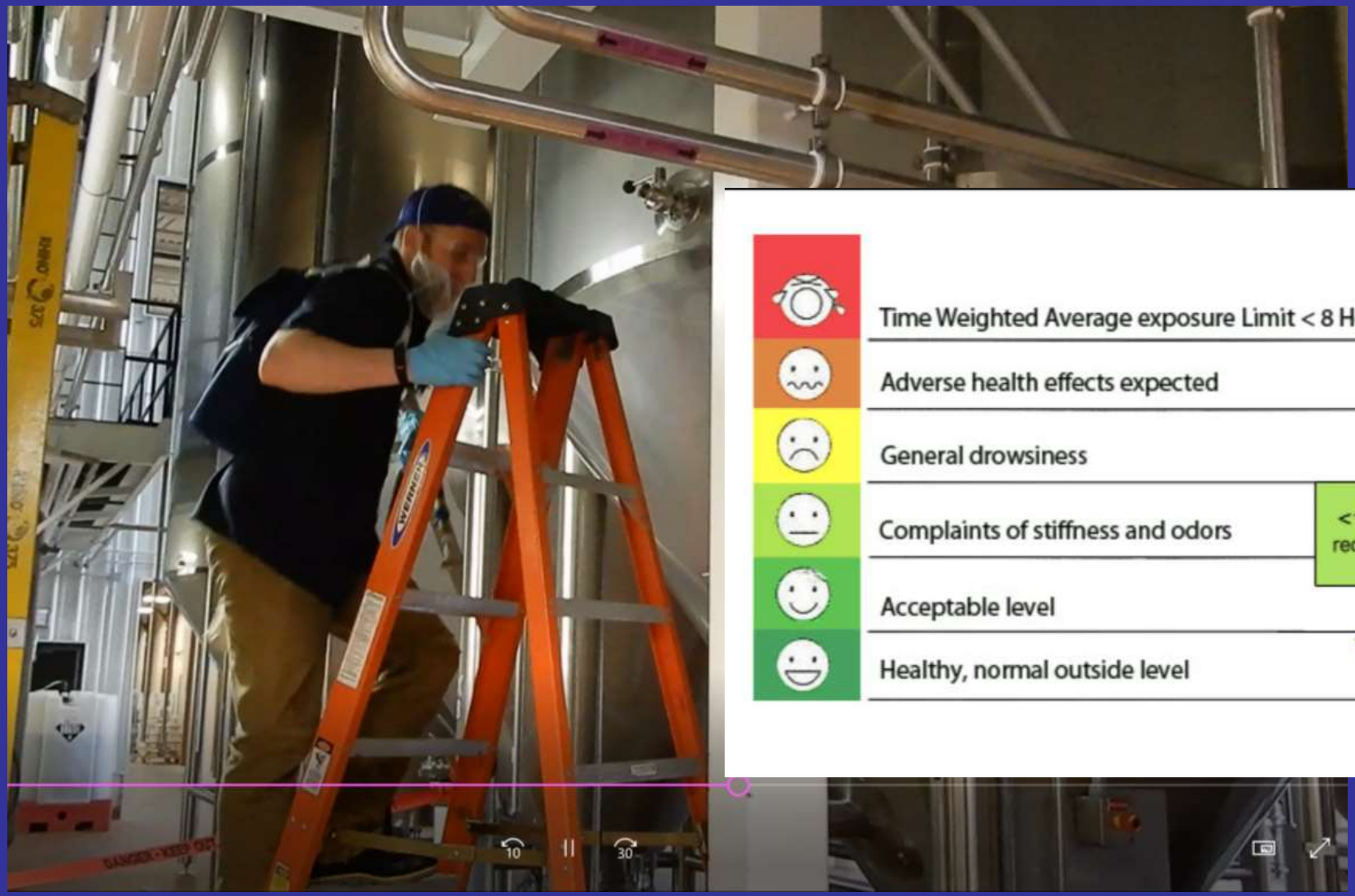
https://thinkprogress.org/exclusive-elevated-co2-levels-directly-affect-human-cognition-new-harvard-study-shows-2748e7378941/

Set up of portable-affordable VEM System

Special thanks to Kyle Fischer – B.S. (Computer Sciences), Purdue University

Portable-affordable VEM System

Water flushing tank that was purged with CO_2.



Contact Information

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  Grand Rapids, Michigan 49546
  (765) 588-7993
  McGlothlin1951@gmail.com
  jdm3@purdue.edu
  www.JAMESMCGLOTHLIN.com

Thank You!

3rd place finish: Clydesdale 40+ Triathlon Grand Rapids, MI. June 9th, 2019: Used Garmin to monitor my speed and distance, and heartrate thresholds to compete at my best. Use of real-time monitoring is so common in commercial goods why not make technology like this more common in our profession? And yes, there were more than 3 competitors in his category ☺

Demo of VEM Cloud System: development of machine learning (sometimes called Artificial Intelligence) to search for and document exposure patterns that may help our profession make smart decisions about cost-effective controls to preserve, and promote occupational safety and health.

- Welcome Mr. Kyle Fischer, Programmer and Coder for VEM using the Raspberry PI and VEM Cloud System (via the Internet).