August Mack
ENVIRONMENTAL

Taking the Mystery Out Of Industrial Hygiene Sampling

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What is IH Sampling?

- Industrial Hygiene (IH) Sampling
- Using accepted sampling methods to determine employee exposure to chemical hazards.
  - Often associated with airborne chemical hazards, but not limited to only these hazards.
  - Includes skin hazards, radiation, noise, and more.

The Dose Makes the Poison

- Industrial chemicals can be health hazardous.
- Almost anything can be health hazardous – even seemingly inert materials such as sand.

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Why conduct IH Sampling?

- Regulatory driver: 29 CFR 1910.1000
  - Must assess employee exposure to substances listed in Tables Z-1 through Z-3.
- Additional driver: Worker's Compensation
- Business driver: Sick employees are unproductive employees
- Final driver: Ethical concerns

Today's Objectives

- Provide safety professionals with an understanding of what must be done to assess employee exposure to all **airborne** hazards in their workplace.
- Understand how you can identify what you should sample for.
- Introduction to interpretation of results and responding to overexposures.
- Learn to manage IH sampling.

Today's Objectives

This presentation will not provide all-encompassing instructions on how to conduct your own IH sampling. This requires years of study.

We are focusing on understanding the concepts behind exposure assessment so you can use resources available to you to assess the exposure of your employees.

OELs – What you need to know

Occupational Exposure Limit (OEL), usually expressed in mass per volume of air.

- **OSHA PEL (8 hour) – enforceable**
- **OSHA STEL (15 min) – enforceable**
- **IDLH - enforceable**
- **OSHA Action Level (8 hour) - enforceable**
- NIOSH REL
- ACGIH TLV

Types of Airborne Toxins

- Particulates - solids from mechanical processes such as abrasion
- Aerosols – airborne liquids, dispersed by a number of actions
- Gases

Some Common Toxins

- Carbon Monoxide
- Particulate Not Otherwise Regulated (PNOR)
- Respirable Crystalline Silica
- Asbestos
- Many types of organic vapors, such as the many solvents found in paint vapors

The Great Unknown

- Which toxins are present in my operation?

The Great Unknown

- Start by reviewing Safety Data Sheets (SDS) for all the materials you utilize.
- Next, identify what chemical and mechanical processes these materials are undergoing to identify chemical byproducts.

The Great Unknown

- You may be buried in paperwork.
- Sampling for all of these materials will overwhelm both your schedule and your budget.

The Problem

- How do I assess exposure to the hundreds (and potentially thousands) of materials in my operation?
- It is too time consuming and expensive (median analysis price is $100/sample) to conduct sampling for each one.

The Solution

- We will qualitatively assess exposure to each material to identify the highest risk, and then quantitatively assess exposure (sample) for the high risk chemicals.
- This is known as a Qualitative Exposure Assessment (QEA).
- Qualitative – a measure based on the quality of something rather than its quantity.

Qualitative Exposure Assessment

- The QEA starts with an exhaustive review of SDS for materials in your operation.
- Hazardous constituents are identified and listed, normally in a spreadsheet format.
- The second step is to identify how each material is used, paying special attention to the chemical and mechanical processes it undergoes.

Qualitative Exposure Assessment

- The QEA should identify any byproducts created by the chemical or mechanical processes for inclusion in the assessment.

Qualitative Exposure Assessment

- Most importantly, the QEA identifies the highest risk materials by identifying:
  - The material's OEL (the lower the OEL, the higher the risk)
  - How often the material is used
  - The level of control currently used to limit employee exposure to the material

Qualitative Exposure Assessment

SDS Name	Chemicals	Department	Exposure Frequency	Routes of Exposure	Health Hazard	Controls	OEL	OEL Type	2nd OEL	OEL Type
Paints										
FS800008	Tert-Butyl Acetate	Painting	Weekly	Inhalation	Irritant	Capture	950 mg/m3	OSHA PEL	950 mg/m3	NIOSH REL
FS800008	Tert-Butyl Alcohol	Painting	Weekly	Inhalation	Irritant	Capture	300 mg/m3	OSHA PEL	300 mg/m3	NIOSH REL
FS800008	Tert-Butyl Alcohol	Painting	Weekly	Skin Absorption	Irritant	Capture	30	SLV		
FS800009	Acetone	Painting	Weekly	Inhalation	Toxic	Capture	2400 mg/m3	OSHA PEL	250 mg/m3	NIOSH REL
FS800009	Acetone	Painting	Weekly	Skin Absorption	Irritant	Capture	240	SLV		
PA005500	Acetone	Painting	Weekly	Inhalation	Toxic	Capture	2400 mg/m3	OSHA PEL	250 mg/m3	NIOSH REL
PA005500	Actetone	Painting	Weekly	Skin Absorption	Irritant	Capture	240	SLV		
PA005500	Tert-Butyl Acetate	Painting	Weekly	Inhalation	Irritant	Capture	950 mg/m3	OSHA PEL	950 mg/m3	NIOSH REL
PA005500	Toluene	Painting	Weekly	Inhalation	Toxic	Capture	200 ppm	OSHA PEL	100 ppm	NIOSH REL
PA005500	Xylene	Painting	Weekly	Inhalation	Toxic	Capture	435 mg/m3	OSHA PEL	435 mg/m3	NIOSH REL

Qualitative Exposure Assessment

- These inputs are used to put the chemicals in exposure categories:
  0) Trivial
  1) Insignificant
  2) Significant
  3) Significant
  4) Unacceptable

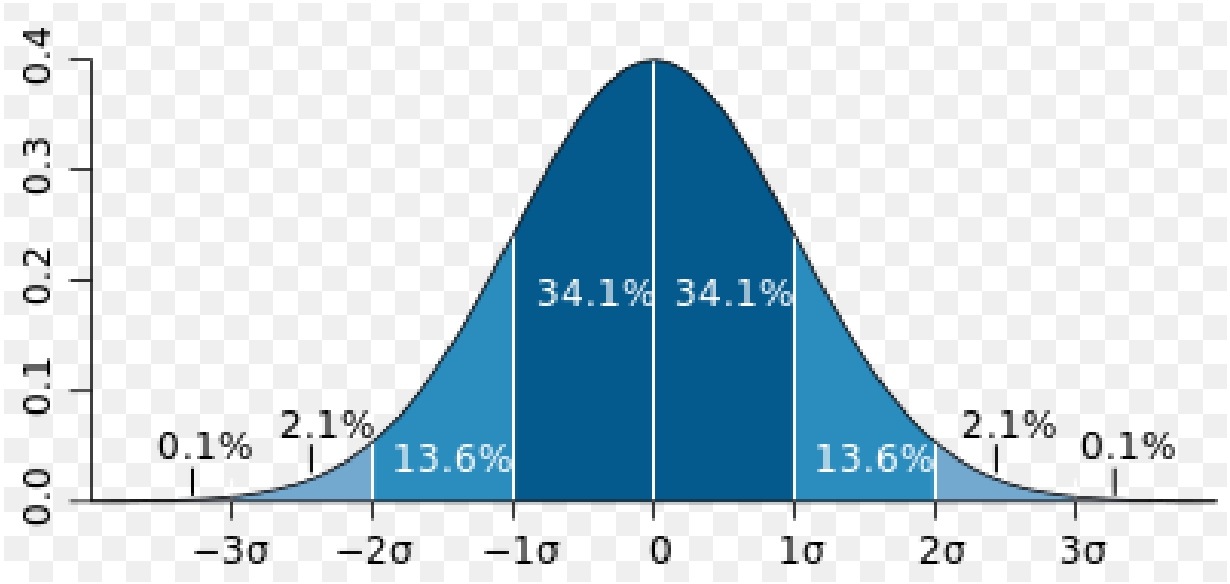
Sampling Plan

- The QEA will identify the high exposure risk materials in your operation, as well as the Significant Exposure Groups (SEGs).
- Next, create a sampling plan for gathering quantitative data for employee exposure.
- For each exposure category, assign a number of samples that need to be collected per year.

Sampling Plan

- How many samples do I need to take per year for each exposure category?
  - This varies from operation to operation, with the answer rooted in statistics.
  - Take enough samples for the exposure data to be normally or log normally distributed.
  - ???

What is Normal Distribution?



Sampling Plan

- For most situations, you will need 10-50 samples for each material in order to obtain normal or log normal distribution.
- For the higher risk materials, you want to reach normal distribution faster than the low risk chemicals.
- To reach normal distribution faster, collect more samples per year.

Sampling Plan

- Example:
  0) Trivial – 1 sample/year
  1) Insignificant – 2 samples/year
  2) Significant – 3 samples/year
  3) Significant – 5 samples/year
  4) Unacceptable – 6-10 samples/year

*Example **ONLY!**

Sampling Plan & QEA

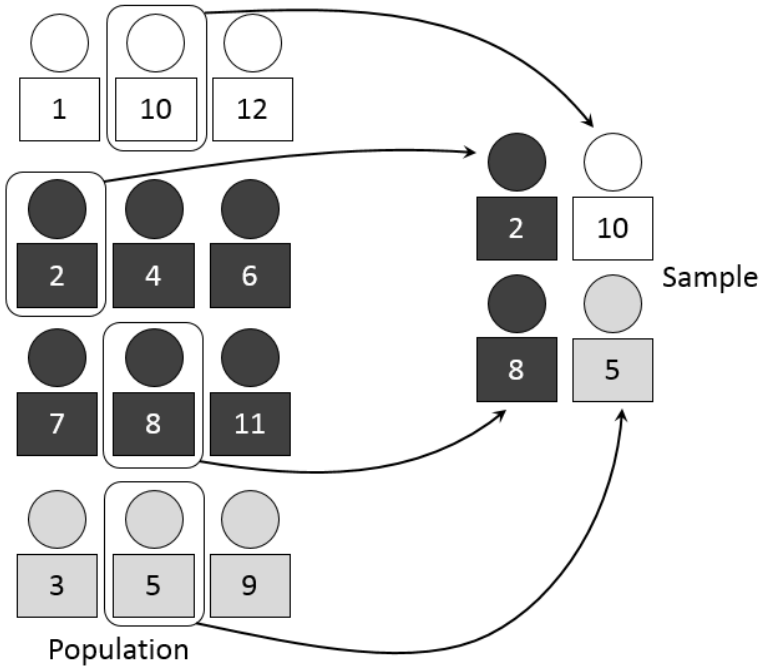
- Both of these are living documents, and should be updated with exposure data as you collect samples.
- Based on the data, you can re-prioritize your sampling as materials move up or down in exposure category.

Conducting Sampling

- What are my options for gathering the samples?
  - Consultant
  - Insurance Company
  - INSafe
  - Collect samples yourself (get training)
  - Use corporate assistance, if available
- Advantages and disadvantages to each

Conducting Sampling

- Representative sampling
- Select the worst-case individual for each SEG.
- Their sample can be used to represent all others in the SEG.



Conducting Sampling

- What makes a valid sample?
  - Performed in accordance with the sampling method used.
  - Most sampling methods are published by NIOSH, and specify the equipment and specs used to collect the sample.
  - Sample must be representative of all activities performed during sampling event (cover the entire work shift's activities).

Conducting Sampling

- Additionally, certain materials have ancillary sampling requirements (such as respirable crystalline silica) that require you to document specific information about the sampling event.
- Always review the appropriate reg to identify the ancillary requirements,

Conducting Sampling

- What makes a great sample? Additional data gathered during the sampling event:
  - Environmental conditions
  - Work activities performed
  - Production schedule (using a metric appropriate to the material being sampled)
  - Location of employee sampled documented
- Why is all of this important?

Conducting Sampling

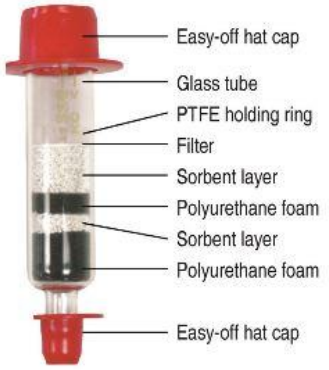
- Let’s briefly review a few of the common methods used to sample different materials

Pump and filter cartridge

- An air pump draws air through a filter cartridge, usually containing a filter.
- This is most commonly used for particulates as they are trapped in the filter.
- Long sampling times that can cover an entire work shift.

Pump and sorbent tube

- A pump draws air through a tube containing sorbent materials (often charcoal).
- Typically used for sampling vapors.
- Tend to have shorter sampling times, so you have to replace the tube several times in order to cover an entire work shift if activities are variable.



Badge

- Passive badges require no air pump and are worn for a long sample time.
- Used almost exclusively for vapors.
- These are a great option for collecting samples.
- Light weight

Sampling Results

- Once you have collected samples, they will need to be analyzed in order to determine a result expressed in mass per volume of air (often milligrams per cubic meter).
- Use an AIHA-accredited lab for analysis.
- What should be done with these results?

Sampling Results

- All results must be made available to employees [29 CFR 1910.1020(e)(2)(i)(A)].
- Employees must be informed of the exposure results annually [29 CFR 1910.1020(g)(1)].
- Make it simple: inform your employees of their exposure. You can do this with individual letters or by posting the results in a common area.

Sampling Results

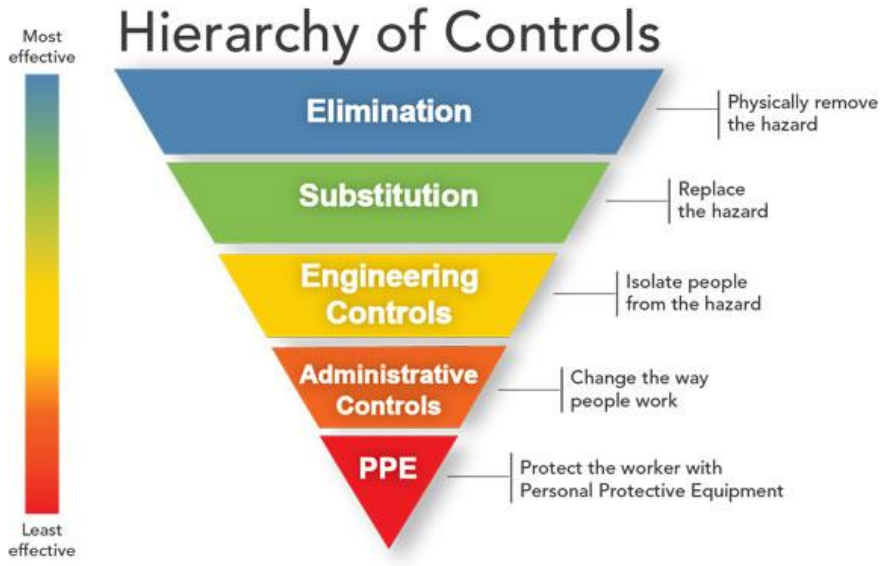
- The results are one data point on the normal distribution of all exposure.
- You cannot assume one sample accurately characterized an employee's exposure to a material for every day.
- Enter your exposure data and achieve normal distribution. This will tell you a % of the time your employees are exposed > OEL.

Sampling Results

- What if my results come back > OEL?
- Increase sampling frequency and immediately place employees in respiratory protection.
- You will need to implement the hierarchy of controls to reduce employee exposure to below the OEL.

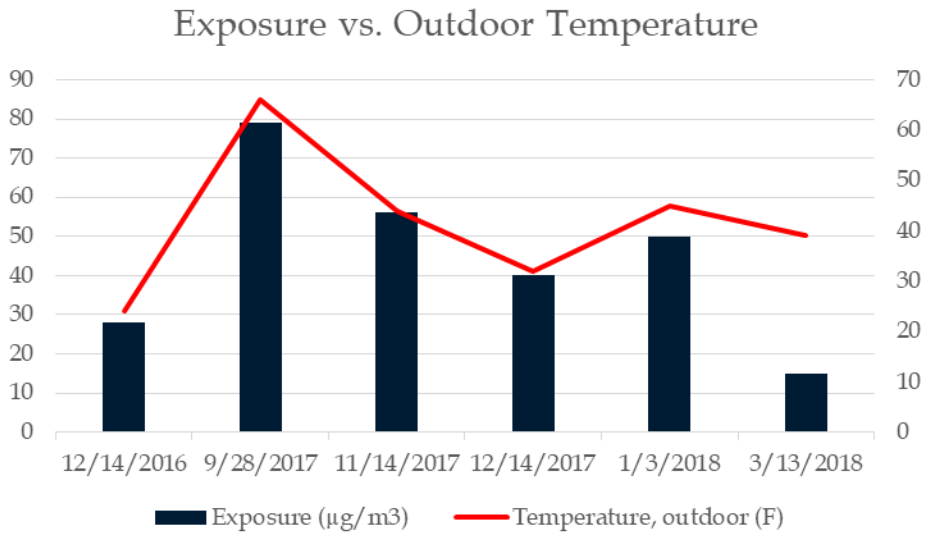
Sampling Results

- Identify root causes behind overexposure to effectively lower employee exposure.
- There are a number of ways to conduct the root cause analysis.



Root Cause Analysis

- Use notes gathered during the sampling event to identify correlations.
- This is why great IH sampling is so important!



Root Cause Analysis

Segmented sampling

8 hours



50 minutes (C1)

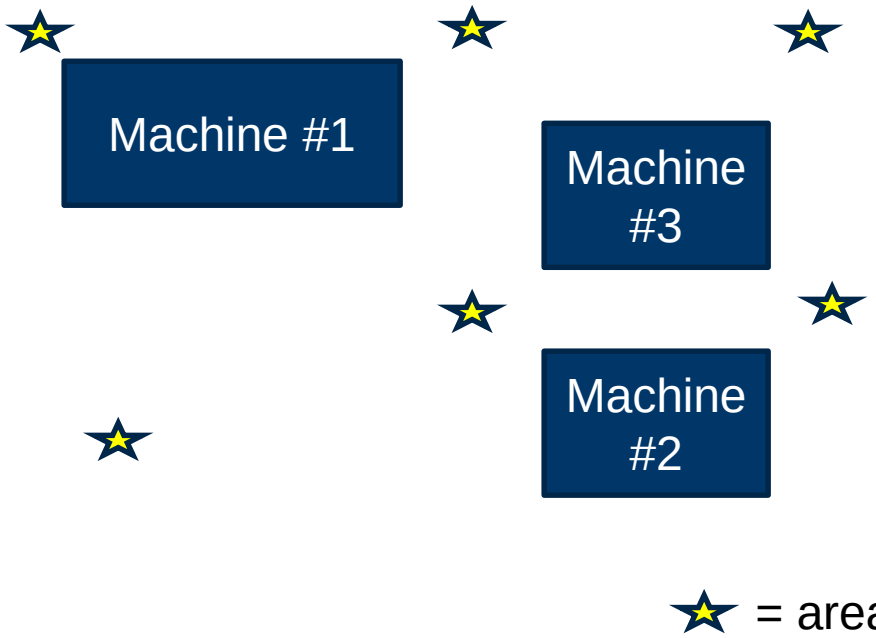
50 minutes (C2)

50 minutes (C3)

TWA = (50 min * C1) + (50 min * C2) + (50 min * C3) / 150 minutes

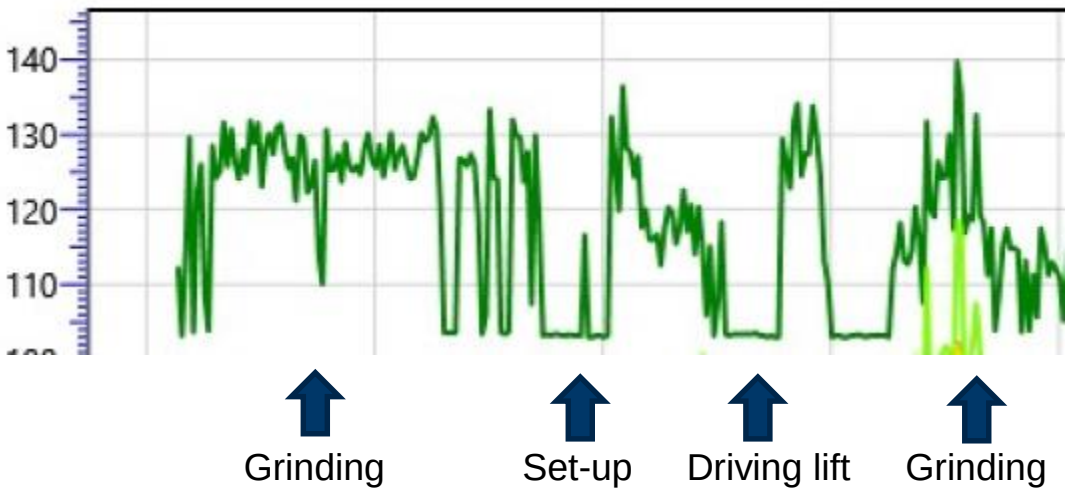
Root Cause Analysis

Area Sampling



Root Cause Analysis

Personal Real-Time Monitoring



Root Cause Analysis

- Use these methods, as appropriate, to determine the source of overexposure and control it.
- Control options vary greatly depending on the situation.
- Always confirm the control worked by re-sampling.

Lessons Learned

Step 1) QEA to identify what needs sampled.

Step 2) Sampling plan to prioritize sampling.

Step 3) Conduct valid sampling until log normal distribution is achieved.

Step 4) Track your sampling data using statistical analysis tools, revise sampling plan as necessary.

Step 5) Use root cause analysis to respond to overexposures.

Lessons Learned

- Remember: one sample will not be enough to characterize an employee's daily exposure!
- A great IH sample goes a long way towards helping you correct overexposure.
  - Make sure sampling conditions are documented!

Resources

- *Safety Professional's Reference and Study Guide*, Second Edition, Pages 227-244
- 29 CFR 1910.1000-1096, specifically Table Z-1
- QEA Checklist and IHSTAT available for free at: https://www.aiha.org/ > Get Involved > Volunteer Groups > Technical Committees > Exposure Assessment Strategies Committee

Questions

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