An Effective Industrial Hygiene Program

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Tuesday March 13, 2018
WHAT IS INDUSTRIAL HYGIENE

The Science and Art devoted to the ANTICIPATION, RECOGNITION, EVALUATION and CONTROL of occupational hazards

WHEN SHOULD WE DO INDUSTRIAL HYGIENE?
EVALUATION

• Sampling Questions
  • Who
  • What
  • When
  • Where
  • How

• Third Party or Local?
  • Advantages / Disadvantages

CONTROL

• ELIMINATE

• SUBSTITUTION

• ENGINEERING

• ADMINISTRATIVE

• PPE
ONLY PART OF THE STORY

- Sampling at paint line once per year
  - Different paint types have different agents at different concentrations
- Custom work on stainless steel
  - Conducted infrequently (project-based)
  - Results in wildly varied exposure potentials
- Ladle Drying process
  - The process involves heating a newly-rebrickled ladle to use temperature. Binder used can release formaldehyde gas
- “Should’ve been here yesterday”

INDUSTRIAL HYGIENE PROGRAM

- Can include
  - A comprehensive written program
  - Management commitment / policy statement
  - Sampling strategy
  - Data Management System
INTEGRATING IH INTO YOUR FACILITY’S CURRENT PROGRAMS

- PPE
- HAZARD COMMUNICATION
- CONFINED SPACE
- HEARING CONSERVATION
- RESPIRATORY PROTECTION
- THERMAL STRESS MANAGEMENT
- EXPOSURE CONTROL PROGRAM(S)

DATA MANAGEMENT SOFTWARE

- IH RASP
  - More on this in a minute

- PURCHASED SOFTWARE SOLUTIONS

- CUSTOM DATABASES
RISK ASSESSMENT AND SAMPLING PLAN

• RISK ASSESSMENT
  • A Qualitative judgement about the agents and hazards associated with work tasks throughout the facility

• SAMPLING PLAN
  • A prescribed frequency of sampling at each location for each agent, based on the results of the Risk Assessment, and the bank of current sampling data.

THE RISK ASSESSMENT

• RISK
  • HAZARD SEVERITY
    • How “bad” the agent is
  • HAZARD PROBABILITY
    • How likely to be exposed
# THE RISK ASSESSMENT

<table>
<thead>
<tr>
<th>Hazard Probability</th>
<th>Hazard Severity</th>
<th>Not Particularly Toxic (Minor irritation, etc.)</th>
<th>Moderately Toxic (Irritants, Chronic Effects Possible)</th>
<th>Quite Toxic Possible Carcinogens, Chronic Effects</th>
<th>Very Toxic, Carcinogenic, Chronic Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure is not likely</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Minimal Likelihood (startup / shutdown or brief tasks)</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Moderate Likelihood (intermittent exposures during workshift)</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>High Likelihood (significant exposure likely over entire shift)</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
</tbody>
</table>

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### Melt Deck employees alternate their time between the Pulpit (Control Room), and the furnace area. There is equipment operated nearly 100% of the time inside the control area, with little or no exposure to employee and temperature controlled. There is a small chance that the first helper will be needed on the Melt Deck to help tap the furnace, collect samples, fill tap holes or clean the deck.

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### THE RISK ASSESSMENT MATRIX

<table>
<thead>
<tr>
<th>ID</th>
<th>Assessment Date</th>
<th>Department</th>
<th>Job/Task</th>
<th>P/Q Code</th>
<th>Source</th>
<th>Description</th>
<th>Frequency Monitored Disregarding Monitoring</th>
<th>Haz Sev</th>
<th>Haz Prob</th>
<th>Frequency Monitored</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB-001</td>
<td>5/28/2015</td>
<td>Melt Deck</td>
<td>First Helper</td>
<td>P</td>
<td></td>
<td>Scrap Metal, Fluxes, Dust</td>
<td>4</td>
<td>4</td>
<td>Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Silica, Iron</td>
<td>4</td>
<td>4</td>
<td>Quarterly</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Zinc, Nickel</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cobalt, Chromium</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thorium, Thallium</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rubidium</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Copper</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nickel</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Barium</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Molybdenum</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vanadium pentoxide</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heat Stress Ambient and Furnace</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Carbon monoxide</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cold Stress</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Respiratory Illness</td>
<td>4</td>
<td>4</td>
<td>Semi-Annual</td>
<td></td>
</tr>
</tbody>
</table>

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**Note:**
- P/Q Code: P = Port, Q = Quarters Code
- Haz Sev: Hazard Severity
- Haz Prob: Hazard Probability
- Frequency Monitored: Annual, Quarterly, Semi-Annual, Biennial, Monthly, Daily, Weekly, Hourly
## THE RISK ASSESSMENT

### SAMPLING INFO.

<table>
<thead>
<tr>
<th>Average % of Limit</th>
<th>Minimal Sample Size (n &lt; 6)</th>
<th>Small Sample Size (n 6-15)</th>
<th>Moderate Sample Size (n 15-30)</th>
<th>Well Characterized Data Set (n &gt; 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% or Greater</td>
<td>0.5</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>75-100%</td>
<td>0.5</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>50-75%</td>
<td>0.75</td>
<td>1.5</td>
<td>2.25</td>
<td>3</td>
</tr>
<tr>
<td>Less than 50%</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

### CALCULATING THE RISK SCORE

- **SAMPLE MATRIX AND FINAL SCORE**

\[
\text{Final Risk Score} = \frac{\text{Risk Matrix Score}}{\text{Sampling Matrix Score}}
\]
## SAMPLING FREQUENCY

- FINAL RISK SCORE DETERMINES FREQUENCY

<table>
<thead>
<tr>
<th>Sampling Frequency</th>
<th>Final Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>1-2</td>
</tr>
<tr>
<td>Biennial</td>
<td>3-5</td>
</tr>
<tr>
<td>Annual</td>
<td>6-9</td>
</tr>
<tr>
<td>Semi-Annual</td>
<td>10-13</td>
</tr>
<tr>
<td>Quarterly</td>
<td>14+</td>
</tr>
<tr>
<td>Periodic</td>
<td>Not Calculated</td>
</tr>
</tbody>
</table>

## SAMPLING PLAN MATRIX

<table>
<thead>
<tr>
<th>Department</th>
<th>Job/Task</th>
<th>Agent</th>
<th>Sampling Frequency</th>
<th>Risk Score</th>
<th>Risk Score (Monitoring)</th>
<th>Final Sampling Frequency</th>
<th>Last Sample Date</th>
<th>Next Sample Due Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Occupational Noise</td>
<td>Annual</td>
<td>9</td>
<td>36%</td>
<td>2</td>
<td>Biennial</td>
<td>Biennial</td>
<td>10/13/2016</td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Cumene</td>
<td>Annual</td>
<td>6</td>
<td>4%</td>
<td>1</td>
<td>Annual</td>
<td>Annual</td>
<td>10/13/2017</td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Methyl ethyl ketone</td>
<td>Annual</td>
<td>15</td>
<td>8%</td>
<td>3</td>
<td>Baseline</td>
<td>Annual</td>
<td>10/13/2017</td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Formaldehyde</td>
<td>Annual</td>
<td>19</td>
<td>18%</td>
<td>3</td>
<td>Baseline</td>
<td>Semi-Annual</td>
<td>10/13/2017</td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Acetone</td>
<td>Annual</td>
<td>4</td>
<td>1%</td>
<td>1</td>
<td>Annual</td>
<td>Periodic</td>
<td>12/8/2010</td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Xylene</td>
<td>Baseline</td>
<td>5</td>
<td>1%</td>
<td>1</td>
<td>Baseline</td>
<td>Baseline</td>
<td>12/8/2010</td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Methyl isobutyl ketone</td>
<td>Annual</td>
<td>1</td>
<td>1%</td>
<td>1</td>
<td>Annual</td>
<td>Annual</td>
<td>1/17/2008</td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Heat Stress</td>
<td>Biennial</td>
<td>0</td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
<td>Baseline</td>
<td>1/0/1900</td>
<td></td>
</tr>
<tr>
<td>Paint Line</td>
<td>1F Coater Operator</td>
<td>Cold Stress</td>
<td>Biennial</td>
<td>0</td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
<td>Baseline</td>
<td>1/0/1900</td>
<td></td>
</tr>
</tbody>
</table>

Most Recent Sample Date and Due Date Shown Here

Color codes indicate status of Plan. Red = Overdue, Yellow = due within 45 days, Blue = no samples recorded
IH RASP LIMITATIONS

- Does not account for PPE
  - Tracked in the spreadsheet, but not in the frequency calculation

- Does not account for employee workload or task-based
  - Tracked in the spreadsheet, but not in the frequency calculation

- Errs on the side of more monitoring with a weak data set

TRENDING

Measured concentrations peaked in 2012, prompting additional sampling
HOW TRENDING CAN BE USED

- Example: Sampling at Melt Deck Conducted every quarter for over 3 years
- Trending analysis showed steadily increasing concentrations
- Prompted additional Engineering Controls and concentrations were reduced

CONCLUSION

- AN EFFECTIVE INDUSTRIAL HYGIENE PROGRAM
  - Is based on a policy that is committed to from the top-down
  - Includes a written program
  - Effectively manages data and explores trends
  - Is pervasive throughout other company programs
  - Is integrated into the facility’s culture
Corporation Perspective

• First, find a consultant with the same values and understands your business.

• Second, ensure they have a team that can support your needs.
  • This includes future needs

Managing IH

• How do you manage your IH?
• Do you have multiple sites?
• Who will be performing the work?
  • Consultant or company personnel?
• What is your goal?
• Do you have a time line?
• Do you have internal support?
Database

• Use some type of data base!
  • Don’t just file your report but manage it.

<table>
<thead>
<tr>
<th>Date</th>
<th>Q</th>
<th>Year</th>
<th>Division</th>
<th>Facility</th>
<th>Consultant</th>
<th>Shift</th>
<th>TWA/TSK</th>
<th>P/A/C</th>
<th>Crew</th>
<th>Sample ID</th>
<th>Sample Time</th>
<th>Name</th>
<th>Dept.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/1/2018</td>
<td>1</td>
<td>2018</td>
<td>Steel</td>
<td>Anywhere, IN</td>
<td>AAA</td>
<td>Day</td>
<td>TSK</td>
<td>P</td>
<td>A</td>
<td>5-120765</td>
<td>480</td>
<td>John Doe</td>
<td>Crane Crew</td>
</tr>
<tr>
<td>2/1/2018</td>
<td>1</td>
<td>2018</td>
<td>Steel</td>
<td>Anywhere, IN</td>
<td>AAA</td>
<td>Day</td>
<td>TSK</td>
<td>A</td>
<td>A</td>
<td>4-267929</td>
<td>485</td>
<td>AREA</td>
<td>Electric Arc Furnace</td>
</tr>
<tr>
<td>2/1/2018</td>
<td>1</td>
<td>2018</td>
<td>Steel</td>
<td>Anywhere, IN</td>
<td>AAA</td>
<td>Day</td>
<td>TSK</td>
<td>P</td>
<td>A</td>
<td>5-120805</td>
<td>480</td>
<td>John Smith</td>
<td>Electric Arc Furnace</td>
</tr>
</tbody>
</table>

You can see that certain percentages trigger a color.

Risk Assessment Sampling Plan (RASP)

• First off, we developed a RA from the AIHA guidelines from the: Strategy for Assessing and Managing Occupational Exposures.
  • Determine if you need to audit your IH program. AIHA has a great book to help you (Industrial Hygiene & Safety Auditing: A Manual for Practice.)
### Industrial Hygiene - Health Hazard Exposure Assessment Sheet

**Industrial Hygiene - Health Hazard Exposure Assessment Sheet**

- **Plant Location:**
- **Assessment Conducted by:**
- **Date of Assessment:** 1/1/2018
- **Review Conducted by:**
- **Revised by (date):**

**J, Q, P, & C - This column indicates whether the assessment was based solely on judgment (J), quantitative monitoring data (Q), the existence of a site-specific program (P), or company imitative (C).**

**n = number of samples**

### Enter the name of the Building and then Department

<table>
<thead>
<tr>
<th>Department</th>
<th>Job Title</th>
<th>Process Task</th>
<th>Material or Agent</th>
<th>Source</th>
<th>Carcinogen or SEN?</th>
<th>Health Effect Rating</th>
<th>Exposure Category</th>
<th>Risk Rating</th>
<th>Monitoring Priority</th>
<th>Assumptions of Method*</th>
<th>Sampling Frequency</th>
<th>Controls</th>
<th>Comments</th>
<th>Exposure Monitoring Data (as of 12/1/2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>All employees</td>
<td>Conducting maintenance on production floor, generating noise from handling power tools, etc.</td>
<td>Noise</td>
<td>Power tools and production equipment</td>
<td>NO</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>Medium</td>
<td>Q</td>
<td>Every 3 Years</td>
<td>Hearing Protection Devices (HPDs) are required</td>
<td>Approximately twelve maintenance employees work 12-hour shifts in the department. Employees work most of their shifts on the production floor, being exposed to process equipment noise. Additionally, power tools and other machinery causes noise. Noise exposure occurs all day every day at high levels.</td>
<td></td>
</tr>
</tbody>
</table>

### Sampling Plan

**Now you have a RA, what are you going to do with it?**

**IH Sampling Plan for XXX**

**Sampling Plan**

<table>
<thead>
<tr>
<th>Dept</th>
<th>Job Class</th>
<th>Process / Job Task</th>
<th>Chemical</th>
<th>Sampling Frequency</th>
<th>Last Sampling Result (TWA or STEL)</th>
<th>Next Sampling Date</th>
<th># of Employees</th>
<th># of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>All employees</td>
<td>Conducting maintenance on production floor, generating noise from handling power tools, etc.</td>
<td>Noise</td>
<td>Every 3 Years</td>
<td>in AHA (X) dBA and in AHA (X) dBA</td>
<td>6/7/2019</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>

**SEG Exposure Risk Rating**

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Monitoring Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (&lt;10% of OEL)</td>
<td>Every other year</td>
</tr>
<tr>
<td>2 (10-50% of OEL)</td>
<td>Every nine months</td>
</tr>
<tr>
<td>3 (50-100% of OEL)</td>
<td>Every six months</td>
</tr>
<tr>
<td>4 (&gt;100% of OEL)</td>
<td>Annual</td>
</tr>
</tbody>
</table>

**Management and Exposure Control Categories**

- **OSHA Exposure Levels**
- **Applicable Management Control**
- **Threshold Limit Values**
- **Chemical-Specific Hazard Communication**
- **Personal Protective Equipment**
- **Immunization, Eye Protection, Respiratory Protection and Containment**

*All of the listed information can be found in the ACGIH Strategy for Assessing and Managing Occupational Exposures*
Managing SEGs

Statistical Tools

• First, Exposure Assessment Tools.
  • IH STAT-FREE with AIHA Membership!
  • [https://www.aiha.org/get-involved/VolunteerGroups/Pages/Exposure-Assessment-Strategies-Committee.aspx](https://www.aiha.org/get-involved/VolunteerGroups/Pages/Exposure-Assessment-Strategies-Committee.aspx)
  • IHDDataAnalyst V1.33
    • [https://www.easinc.co/ihda-software/](https://www.easinc.co/ihda-software/)
    • Free “student” for 1 year
What Stats will tell you?

• Statistics:
  • Non-parametric (order) statistics
  • Descriptive statistics
  • Compliance statistics
  • Non-parametric compliance statistics
• Goodness-of-fit analysis
  • Subjective (graphical analysis)
  • Objective (formal statistical tests for goodness-of-fit)
• Bayesian Decision Analysis
  • Calculation of probability that the true exposure profile is in a specific AIHA exposure control category or an EU Hazard Band
  • Appropriate class of respirator (i.e., Assigned Protection Factor)
  • Professional judgment can be explicitly factored into the calculations
  • Adjustment for censored (i.e., <LOD) data
• High resolution, customizable graphs
• Report generator and editor:

System Software
IH STAT (Example)
System Software
IHDataAnalyst V1.33 (Example)
• Bayesian Decision Analysis.

How to use statistics for decision making

• Use statistical tools to manage the removal of chemical programs
  • You can use BDA decision making for engineering fixes.
  • You can use 95%tile to determine risk and acceptable exposures.
  • You can use the Geometric Standard Deviation to determine acceptable variability.
Use Your Resources

• Use all your resources to make decisions:
  • Talk to people performing work (they know the details).
  • Speak with engineering on what you are seeing (they can help guide you).
  • Speak with other locations if possible to see if they are seeing the same thing as you are.
  • Create a progressive plan that can be achieved by everyone on the team.
    • A plan outlines what is to be accomplished so everyone knows the goal.

THANK YOU!!

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Justin.Hoover@steeldynamics.com