Industrial Hygiene Exposure Predictor Model

2009 DOE Integrated ISM Conference
August 26-27, 2009

Saul J. Chessin, CIH
Idaho National Laboratory

Idaho National Laboratory

Saul J. Chessin - Biography

- **Saul received an MS in Biology from Washington State University in 1985. He began his career in Industrial Hygiene at the Idaho National Laboratory in 1991, and received his certification in the comprehensive practice of industrial hygiene (CIH) in 1997. He has provided support to a variety of organizations, including nuclear operations, waste operations, maintenance, and laboratory R&D. He has served as the technical point of contact for numerous IH programs, including exposure assessment, nanotechnology, and chemical hygiene. His research interests include exposure assessment concepts, laboratory fume hood performance, and nanomaterial health and safety issues.**

Aspects of an Industrial Hygiene Exposure Assessment

1. Qualitative Review of Hazards
2. Risk Assessment
3. Establishing preliminary control sets
4. Establishing Sampling/Monitoring Requirements, as necessary
5. Prioritizing Sampling/Monitoring, as necessary
6. Verification of appropriate control sets through observation and possibly sampling

Risk Assessment Considerations

- How much exposure? (i.e., frequency and duration)
- Potential for exposure? (i.e., due to controls, agent characteristics, amounts, routes of likely exposure, etc.)
- Health consequences of exposure?

NOTE: Risk does not necessarily correlate to a need for sampling data.

When is sampling appropriate and pertinent to the exposure assessment?

- Sampling method and exposure standard exists
- Compliance must be established
- The sampling is pertinent to the primary route of exposure
- Sampling data would help in the performance of the risk assessment

NOTE: This is not necessarily the case for most IH hazards encountered in the work place.

Challenges with sampling/monitoring (collecting data)

- Numbers of chemical/physical agents, especially in an R&D environment
- Resources/time
- How to prioritize

How an exposure predictor model may help

- Establishes predicted exposure levels into one of the following categories: < ACL, ACL-AL, AL-OEL, >OEL
- Predicted exposure levels help focus resources on
  - verification of the adequacy of control measures (e.g., predicted levels are >OEL)
  - verification of “uncertain” exposure levels (e.g., ACL-OEL)

NOTE: ACL = Administrative Control Level
AL = Action Level
OEL = Occupational Exposure Limit

Model Requirements

- **Must be based on information that is pertinent only to exposure levels (not risk)**
- **Must use only information that is readily available to the Industrial Hygienist**
- **Must be based on objective data (reduce bias)**
- **Must be simple to use (e.g., excel spreadsheet)**
- **Must be reasonably accurate**

Model Concepts

- Begin at “unity” (i.e., 100% of OEL)
- Apply “corrections” for
  - Engineering controls in place, or lack thereof
  - Process factors (activities/tasks)
  - Amounts
  - Vapor Hazard Ratio or OEL ratings
  - Duration of exposure relative to OEL
- Interpretation of results
  - A result of “1” – predicted exposure level = OEL
  - A result of “<1” – predicted exposure level <OEL
  - A result of “>1” – predicted exposure level > OEL

Model Demonstration (Liquids) - Engineering multipliers

Engineering multipliers
Glove box – 0.001
Lab hood – 0.01
Local exhaust – 0.1
Welding hood – 0.5
Outdoors – 0.8
Gen. dilution ventilation – 1
Indoors, no ventilation – 2
Confined space - 3

Model Demonstration (Liquids) - Process/Handling multipliers

Process/Handling multipliers
Syringe or pipette – 0.015
Open container – 1
Pouring or scooping – 1.5
Agitation – 2
Heating, less than boiling – 2.5
Heating above boiling – 5
Spraying or misting -10

Model Demonstration (Liquids) - Amount multipliers

Amount multipliers
<10 ml – 0.01
10-100 ml – 0.1
100-500 ml – 0.5
500-1000 ml – 0.75
1-10 L – 1
>10 L – 1.2

Model Demonstration (Liquids) - VHR/OT, VHR, or OEL multipliers

VHR/OT, VHR, or OEL multipliers
VHR/OT or VHR <100; or OEL > 20 ppm – 0.1
VHR/OT or VHR 100-1000; or OEL 1-20 ppm – 0.5
VHR/OT or VHR 1000-10,000; or OEL 0.2-1.0 ppm – 1
VHR/OT or VHR 10,000-100,000 – 1.5
VHR/OT or VHR >100,000; or OEL <0.2 ppm – 2

Model Demonstration (Liquids) - OEL & duration multipliers

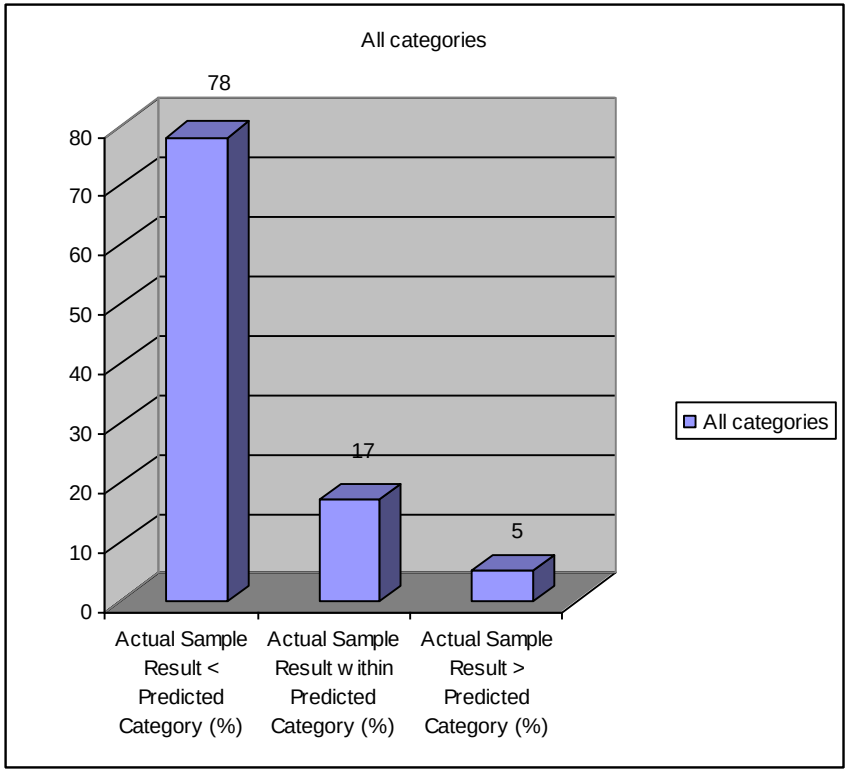
OEL & duration multipliers
Ceiling; DR instrument available; <5 min exp. – 0.5
Ceiling; DR instrument available; >5 min exp. – 1
Ceiling or STEL; need 15 min reading; <5 min exp. – 0.33
Ceiling or STEL; need 15 min reading; 5-10 min exp. – 0.67
Ceiling or STEL; need 15 min reading; 10-15 min exp. – 1
8-hr TWA; <15 min exp. – 0.05
8-hr TWA; 15-59 min exp. – 0.1
8-hr TWA; 60-239 min exp. – 0.4
8-hr TWA; 240-420 min exp. – 0.6
8-hr TWA; >420 min exp. - 1

Demonstration of model

- **Link to excel spreadsheet**

Summary of data validation

Data from 151 samples taken during various processes involving the use of liquid chemicals



Conclusion

- **May provide Industrial Hygienists with a useful tool for prioritizing sampling**
- **However, model requires further validation and may require adjustments to the weighting factors**

- **Questions??**