August Mack
ENVIRONMENTAL

Industrial Hygiene Monitoring and Exposure Limits

Greater Lafayette Area Safety Council

August Mack Environmental

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EXPERTISE. INNOVATION. COMMITMENT.

Definitions -Industrial Hygiene

- The American Industrial Hygiene Association (AIHA) defines Industrial Hygiene as:

The science and art devoted to the anticipation, recognition, evaluation, and control of environmental factors or stresses arising in or from the workplace which may cause sickness, impaired health, and well-being, or significant discomfort and inefficiency among workers or among citizens in the community.

Definitions-Industrial Hygienist

- The AIHA defines an Industrial Hygienist as an occupational safety and health professional concerned with the control of environmental stresses or occupational health hazards that arise as a result of or during the course of work.

Critical nature of an Effective Industrial Hygiene Monitoring Program

- An Industrial Hygiene Monitoring Program allows safety professionals to scientifically quantify worker exposures at the job site, and then base each hazard control upon this actual exposure data.

Importance of an Effective Industrial Hygiene Monitoring Program

- Companies in the automotive, beverage, chemical, construction, maritime, and service industries all expose employees to hazards.
- An effective Industrial Hygiene Monitoring Program will serve to identify, quantify, and prioritize workplace hazards.

Industrial Hygiene Monitoring Program

- Industrial Hygiene includes the development of corrective measures to control health hazards by either reducing or eliminating the exposure.

Industrial Hygiene Monitoring Program Controls

- Once the exposures are quantified, then all of the engineering controls, administrative controls, and Personal Protective Equipment (PPE) are developed based on the actual exposure levels, in order to control and eliminate hazards and prevent injuries and illnesses.

Four Elements of Industrial Hygiene

- The four elements of Industrial Hygiene and an organization's Occupational Safety and Health Program are:
  - Anticipating
  - Recognizing
  - Evaluating

Anticipating Hazards

- Anticipating Health hazards before they occur allows a more efficient use of resources by minimizing costly retrofits and renovations needed to protect the health of workers.

Hazard Recognition and Evaluation

- An unrecognized hazard cannot be controlled , evaluated or eliminated.
- Upon recognition of a hazard, the Industrial Hygienist or monitoring consultant identifies a set of measures necessary for proper evaluation of the hazard:
  - Combustible dust study
  - Ventilation study
  - Noise mapping

Sources of Hazard Information

- General Knowledge of Chemicals and Processes
- General Knowledge of Raw Materials Purchased and Used
- Observations of Work Practices
- Safety Data Sheets (SDS)

Sources of Hazard Information

- Conversations with Workers
- Objective Data
- Review of Plans for New Facilities and Renovations

Review of Company Data and Safety Data for Hazard Sources

- Types of Processes
- Number of Employees/Shifts/Overtime
- Types of Exposures
- Historical Injury/Incident Data-OSHA 300 log/EMR

Review of Technical IH Data for Hazard Sources

- Test Reports/Chemical Analyses
- Earlier Monitoring Data
- Information from Professional Associations, Universities, and Federal and State government documenting Previous Studies, Results, and Findings
- Research Data from private IH studies

Additional Hazard Source Data

- Discussions with Medical Personnel
- Production/Process Review
- Environmental Analysis Data
- Process Flow Diagrams
- Job Safety Analysis (JSA)

Preliminary Survey

- Compile preliminary hazard source information and create an initial Preliminary Industrial Hygiene Survey Report

Industrial Hygiene Monitoring Plan

- Using hazard and source information obtained during the preliminary survey, the Industrial Hygiene Monitoring plan can be formulated
- The Industrial Hygiene Monitoring is performed to evaluate the degree of employee exposure to hazards in the workplace.

Industrial Hygiene Monitoring Plan

- Industrial Hygiene Monitoring is a continuous program of observation, measurement, and judgement to evaluate the potential hazards present in the workplace and the effectiveness of each hazard control.

Industrial Hygiene Monitoring Plan

- The Industrial Hygiene Monitoring Plan establishes what we will measure, how we will measure it, how we will analyze the data, and how we will report the findings of our analyses.
- Our Industrial Hygiene Monitoring Plan is made up of objectives that will allow us to systematically reach our monitoring goal.

Measurable Hazards

- Common Workplace Hazards include:
  - Industrial Noise Exposure
  - Exposure to Heat
  - Exposure to Cold
  - Biological Exposures

Measurable Hazards

- Additional Workplace Hazards Include:
  - Exposure to Chemicals in the Air that are Inhaled
  - Exposure to Chemicals that Contact the Skin
  - Exposure to Chemicals that are Ingested
  - Potential “Injection” Exposures

Additional Measurable Hazards

- Exposure to Vibration
- Exposure to Low or High Illumination Levels
- Exposure to Radiation (Ionizing and Non-Ionizing)

Chemical Hazards

- Chemicals pose a wide range of health hazards:
  - Irritation
  - Disease
  - Sensitization
  - Carcinogenicity

Chemical Hazards

- Chemicals pose a wide range of Physical Hazards:
  - Flammability
  - Corrosivity
  - Reactivity
  - Toxicity

Chemical Hazards

- Chemical Hazards can be found in many forms:
  - Dusts
  - Liquids
  - Fumes
  - Mists
  - Gases
  - Vapors
  - Smoke

Physical Hazards

- Ionizing radiation
- Non-ionizing radiation
- Noise
- Vibration
- Heat
- Cold

Radiation

- Ionizing and Non-ionizing radiation should be monitored by an Industrial Hygienist with specialized training, methods, and instrumentation.

Noise

- Noise Surveys Determine:
  - Sources of Noise
  - Amount of Noise
  - Exposure Population
  - Duration of Exposure
  - Proper PPE
  - Attenuation

Temperature

- Guidelines for Evaluation:
  - Occupational Exposure Limits are designed to protect industrial workers from temperature-related illnesses
  - Thermal Comfort Limits are used to ensure productivity and quality of work.

Biological Hazards

- Sources of Biological Hazards (biohazards) include:
  - Bacteria
  - Viruses
  - Insects
  - Plants
  - Birds
  - Animals
  - Humans

Ergonomic Hazards

- Ergonomics is the science of fitting the job (task) to the worker. Ergonomic hazards include:
  - Repetitive Motion Injuries
  - Musculoskeletal Disorders

Toxicity Versus Hazardous

- Toxicity is the ability of a substance to produce an unwanted effect when that material has reached a sufficient concentration at a certain site in the body.
- A Hazard is the practical likelihood that exposure to the toxic material will cause harm.

Routes of Entry into the Body

- Inhalation
- Absorption
- Ingestion
- Injection

Personal Monitoring

- Personal Monitoring is the measurement of a particular employee's exposure to a workplace hazard.
- Personal Monitoring is performed using personal monitoring devices such as portable and battery powered air sampling pumps that do not interrupt the employee's job tasks.

Area Monitoring

- Area Monitoring measures the ambient concentration of a hazard or contaminant in a given area during a given period of time.
- Area sampling is often performed utilizing portable sampling devices that may or may not be battery powered.

Personal and Area Monitoring

- Personal and Area Monitoring are often combined to determine employee's Time Weighted Average (TWA) Exposure
- A Time Weighted Average (TWA) is required to determine if the exposure exceeds the Permissible Exposure Limit (PEL)

Personal and Area Monitoring

- Personal and Area Monitoring Samples are collected and then subsequently submitted to a laboratory for analysis
- The lab analyzes each sample by accepted analytical methods and then reports the results of the analysis.

Direct Reading Instruments

- Certain types of analyses are performed using a Direct Reading Instrument that performs the analysis onsite and provides the data directly.
- Examples include Noise Dosimeter, which are capable of performing all analyses onsite and provide results immediately.

Biological Monitoring

- Biological Monitoring is a tool that can be used to assess worker's total exposure to chemicals.
- Exhaled air, blood, and urine can be analyzed in order to determine the worker's exposure.

Biological Monitoring

- Three main types of Biological Monitoring include:
  - Measurement of the contaminant itself (directly)
  - Measurement of a metabolite of the chemical
  - Measurement of enzymes or functions that reflect harm caused by a hazardous exposure

Medical Surveillance

- Medical Surveillance is performed in order to determine employee's exposure to chemicals in order to track exposure and to provide for early detection of disease.
- Over 20 OSHA standards now have requirements for Medical Surveillance.

Sampling Strategy

- The Industrial Hygiene Sampling Plan devises the strategy that will be utilized in order to determine the intensity of the hazards, the source of the contaminants, and the adequacy of current hazard controls.

How to Sample

- The Industrial Hygiene Samples should represent each worker's exposure
- The National Institute for Occupational Safety and Health has developed the NIOSH analytical methods that will provide you with the correct method to collect and analyze each sample.
- Example: NIOSH method 7600 for hexavalent chromium sampling

Methods of Air Sampling

- Charcoal Tubes
- Cassettes
- Sorbent Tubes
- Passive Sampling
- Direct Reading Instruments
- Personnel Sampling
- Area Sampling
- Grab Samples
- Time Weighted Average (TWA) Samples

Where to Sample

- Personal or Area Sample: Determine which method of sampling and what sampling technology will work best in each situation with the Industrial Hygiene Sampling Plan

Whom to Sample

- Use the results of the preliminary investigation and observations to determine which personnel are the most likely to be exposed to each hazard
- Examine regulatory requirements
- Study processes and air movement patterns
- Study differences in work patterns, habits, tasks

When to sample

- Sampling should be performed at different times depending on the conditions:
  - Study temperature patterns
  - Study ventilation patterns
  - Study Work Flow
  - Study Work Load

Length of Sampling

- Each NIOSH Analytical Method prescribes the type of sampling media to utilize and the recommended duration of the sampling event:
  - Flow Rates
  - Sampling Times
  - Expected Concentration Ranges
  - Duration of the Sampling Event

Time Weighted Average (TWA)

- Measuring the exposure over an eight (8) hour period, typically the entire work shift
- The TWA is the average concentration for a conventional 40 hour a week work week, to which it is believed that nearly all workers may be repeated exposed day after day, without adverse effect.
- TWA data is compared to the Permissible Exposure Limit (PEL)

Short Term Exposure Limit (STEL)

- STEL is the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from:
  - Irritation
  - Chronic or irreversible tissue damage
  - Narcosis of sufficient degree to increase the likelihood of accidental injury or impair self-rescue

Short Term Exposure Limit (STEL)

- A STEL is a 15-Minute TWA exposure that should not be exceeded at any time during the workday
- Exposures above the TLV (Threshold Limit Value)-TWA up to the STEL should be no longer than 15 minutes and should not occur more than 4 times per day

Ceiling (TLV-C)

- The Ceiling Concentration is the concentration that should not be exceeded during any part of the working exposure.
- An airborne concentration of a toxic chemical in the workplace that should never be exceeded.

Documenting Sampling Activities

- Accurate Recordings of these items are critical when performing Industrial Hygiene Monitoring:
  - Time Sampled
  - Flow Rates
  - Sample Locations
  - Sample Identifications
  - Parameters
  - Engineering Controls Present
  - Sketches/Maps of Sampling Areas
  - Chain of Custody Forms

How many Samples should be collected?

- Each sampling project will require a different number of samples collected based on the parameters and sampling type
- Examine all factors to determine number of samples
- Try to represent each Job Description/Area

How Many Times Should We Sample?

- OSHA or MSHA Regulated Chemicals will require that monitoring is performed on a routine basis
- Monitoring should be performed whenever materials, processes, or equipment are changed
- Monitoring should be repeated if the results, analyses, or the sampling media are compromised or questionable

How Many Times Should We Sample?

- Monitoring should be repeated if previous results indicate that corrective actions are required based on regulatory guidance-to evaluate if the corrective actions are effective

Who should sample?

- An Occupational Health and Safety Team may consist of many members depending on the organization:
  - Industrial Hygienist
  - Safety Professional
  - Occupational Health Nurse
  - Occupational Physician
  - Employees
  - Managers and Supervisors

Sampling Considerations

- Sampling Equipment
- Sampling Methods
- Sampling Plan
- Sampling Media
- Chemistry
- Laboratory
- Data Analysis
- Reporting
- Suggested Corrective Actions

Analytical Chemists

- Industrial Hygiene Analytical Laboratories general seek and gain accreditation through a third party such as AIHA, ISO, or many other third party registrars
- Analytical Chemists analyze the Industrial Hygiene Samples submitted to the laboratory by the project manager and the laboratory produces the lab report (sample results)

Regulatory Limits for Hexavalent Chromium

- OSHA Toxic and Hazardous Substance Standard for Hexavalent Chromium (29 CFR 1910.1026)
- OSHA PEL TWA for Hexavalent Chromium: 5.0 ug/m3
- OSHA Action Level for Hexavalent Chromium: 2.5 ug/m3
- NIOSH Method 7600 for sampling

Regulatory Limits for Lead

- OSHA Toxic and Hazardous Substance Standard for Lead (29 CFR 1910.1025)
- OSHA PEL for Lead: 50 ug/m3
- OSHA Action Level for Lead: 30 ug/m3
- NIOSH Method 7300 for sampling

Regulatory Limits for Respirable Crystalline Silica

- OSHA Toxic and Hazardous Substance Standard for Respirable Crystalline Silica (29 CFR 1910.1053)
- OSHA PEL for Respirable Crystalline Silica: 50 ug/m3
- OSHA Action Level for Respirable Crystalline Silica: 25 ug/m3
- NIOSH Method 7500 for sampling

Regulatory Limits for Noise Sampling

- OSHA Limits for Noise Sampling (29 CFR 1910.95 Appendix G)
- OSHA PEL for Noise: 90.0 dBA
- OSHA Action Level for Noise: 85.0 dBA
- Method: Noise Dosimeter-Edge 4

Scheduling Sampling

- Request a Proposal
  - Project Information
  - Scope of Services
  - Agree to Fees/Expenses
  - Agree to Scheduling
  - Check References
- Written Authorization
  - Manage project/consultant(s)

Questions?

Michael Gagermeier
Compliance Manager
August Mack Environmental
mgagermeier@augustmack.com
317-916-3123

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