Loss Control

Quarterly Update

Occupational Exposure Limits

When employees work with hazardous or toxic substances it is important to quantify exposures and determine whether the exposures pose a health risk. Personal monitoring in the breathing zone of employees is used to characterize exposures. Samples may be collected for short periods or for the full work shift depending on the chemicals is question and their exposure limits. It is important to understand and interpret exposure data in relation to occupational exposure limits when making decisions for controlling exposures in the workplace.

History

Recognition of diseases associated with certain occupations began in ancient times. Lead poisoning in miners was recognized by Hippocrates in 370 BC and by 1700 Ramazzini published Diseases of Workers. Establishment of occupational exposure limits began in the early part of the 20th century with the recognition of work related diseases relating to chemicals and hazardous substances and methods for measuring exposures were developed. Rapid development of respirators began during World War I and by the 1920s and 1930s research on chemical toxicology was conducted by the Bureau of Mines. The Bureau published a table of hazardous air concentrations for 33 compounds in 1930. By the 1940s information was being gathered by many sources on concentrations of hazardous substances that cause injury but information wasn't widely available until the ACGIH (American Conference of Governmental Industrial Hygienists) published its first list of "Maximum Allowable Concentrations" (MACs) of air contaminants in 1946. The MACs became the "Threshold Limit Values" (TLVs) in 1950. Today there are approximately 700 TLVs for hazardous substances even though there are thousands of chemicals in the workplace.

Inside this Issue

Produced by Erik Goplin-CIH, CSP

608/825-5644

Erik.Goplin@us.qbe.com

ACGIH TLVs

The ACGIH TLVs are consensus standards that are published on a yearly basis and reflect the most recent toxicological data for a particular substance based on industrial experience, and experimental studies. These TLVs are intended as recommended guidelines to control potential health hazards. There are three types of TLVs. These include the TLV-TWA (time weighted average) TLV- STEL (Short-term exposure limit) and TLV-C (Ceiling limit). It is important to have an understanding of the various types of TLVs and their limitations.

The definition of TLV-TWA are "… the time-weighted average concentration for a conventional 8-hour workday and 40 hour workweek to which it is believed that nearly all workers may be repeatedly exposed, day after day, for a working lifetime without adverse health effects". A couple of factors are very important to note in this definition. First, the values relate to a conventional workweek. If employees work more than 8 hours per day or more than 40 hours per week, additional considerations may apply. Secondly, the definition specifies the levels are safe for "nearly all" workers. TLVs are not fine lines between safe and unsafe levels and TLVs will not adequately protect all workers. Some individuals may experience discomfort or health effects below the TLVs. Additional considerations need to be made for individuals based on health considerations, age, gender, medications, etc. For example individuals who have been sensitized to certain chemicals or have liver or kidney damage that affects their body's ability to detoxify or eliminate certain chemicals may have health effects well below the TLV-TWA.

A TLV-STEL is an airborne concentration of a substance averaged over a 15 minute period to which " …workers can be exposed continuously for a short time without suffering irritation, chronic or irreversible tissue damage, dose-rate-dependent toxic effects or narcosis provided that the daily TLV-TWA is not exceeded…" STELs relate to transient high exposures and usually supplement the TLV-TWA where there are acute effects from a substance whose toxic effects are usually chronic. Exposures to the TLV-STELs should be less than 4 times per day and should be at least 60 minutes apart.

A TLV-C is a ceiling limit that should not be exceeded even instantaneously. Ceiling limits apply to substances that produce effects only after acute exposure. They are often irritants that affect the eyes, mucous membranes and upper respiratory system.

OSHA PELs

This is a good opportunity to explain the relationship between the ACGIH TLVs and the OSHA PELs (Permissible Exposure Limits). The ACGIH is a committee that started developing exposure limits as guidelines intended for use by industrial hygienists to be interpreted and applied by persons in that discipline. They are not developed as legal standards although the US government, several states and many other countries have adopted some or all of the TLVs as their official limits. The Occupational Safety and Health Act of 1970 authorized the federal government to establish mandatory health and safety standards through the Occupational Safety and Health Administration (OSHA) in the US Department of Labor. In 1971, OSHA established Permissible Exposure Limits (PELs) for airborne contaminants by adopting the ACGIH TLVs that were published in 1968. These PELs are found in the 29 CRF 1910.1000 Air Contaminants Standard and are the legal exposure limits that employers must comply with. In 1989, OSHA reviewed health and risk data for these substances and updated the PELs. In 1993, the changes to the PELs were thrown out by a US Appeals Court and the PELs reverted back to the 1968 levels. MSHA (Mine Safety and Health Administration) uses the same PELs as OSHA.

OSHA has also developed specific standards for about 25 carcinogens. OSHA uses "significant risk" defined as 1 excess cancer in 1000 exposed workers over a working lifetime when establishing PELs in these substance specific standards. OSHA

must also consider economic and technical considerations when promulgating standards so exposure limits may not reflect the most current toxicity information available for a particular substance.

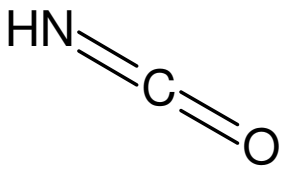
Some chemicals are designated with skin notations because absorption of the substances through the skin can make a significant contribution to overall exposure. Control of this exposure route is critical to protect employees using these chemical.

Since there are thousands of chemicals but only a few hundred with TLVs or PELs, additional occupational exposure limits (OELs) may need to be consulted for a particular chemical. NIOSH (National Institute for Occupational Safety and Health) was established under the provisions of the OSHA act. NIOSH provides research, education and training related to occupational safety and health standards. NIOSH develops RELs (Recommended Exposure Limits) that may be used by OSHA when developing regulations. The RELs are a good source for additional exposure limits. The American Industrial Hygiene Association (AIHA) has developed Workplace Environmental Exposure Levels (WEELs) for a number of substances and these can also be used where there is no TLV or PEL for a particular chemical. When no other sources are available, manufactures of chemicals often develop recommended exposure limits that can be found on SDSs (Safety Data Sheets).

Remember that you may find different OELs for the same chemical. Good industrial hygiene practice and risk management involves making decisions on the best available data. Values tend to be reported for only the most common industrial chemicals. The lack of published data does not mean that hazards do not exist. The OSHA PELs for most substances are over 40 years old and are out-of-date with the most current toxicological information and health data. The ACGIH TLVs or other OELs, for the most part, are lower than the OSHA PELs and reflect the most up-to-date information concerning health effects for a particular substance and should often be used when making the best risk management decisions.

Isocyanates

Isocyanates are chemicals widely used in manufacturing of products like flexible foams used in furniture and automotives; rigid foams used for thermal and sound insolation; packaging materials; binding agents; elastomers; laminates in printing and in paints and coatings. Exposure occurs from spraying materials and from volatilization that occurs when pouring and handling liquids containing isocyanates. Isocyanates are a common cause of occupational asthma and sensitivity and control of exposure to these chemicals is essential.



Isocyanates are a group of chemicals with the nitrogen, carbon and oxygen structure above. These chemical have two of these isocyanate groups (diisocyanate) per molecule which reacts with polyester or polyether polyols forming polymers. There are a wide number of isocyanates used in industry. Some of the more common isocyanates are:

- TDI- 2,4 or 2,6- toluene diisocyanate
- MDI- 4,4'-Methylene diphenyl diisocyanate
- HDI- Hexamethylene diisocyanate
- IPDI- Isophorone diisocyanate
- NDI- Naphthalene diisocyanate

An important factor with potential airborne exposure is weight of the chemical molecule (molecular weight). The first isocyanates developed were MDI and TDI. These are lower molecular weight forms of isocyanates and consequently, vaporize more easily and become more of a health concern. TDI is the most hazardous isocyanate followed by MDI then HDI. Historically, many cases of asthma and sensitivity occurred in spraying of urethane paints in the automotive industry due to TDI. Due to the higher potential for exposure to MDI and TDI, the other less volatile isocyanates were developed. Many formulations now contain polymeric forms of HDI and MDI which reduce the potential for exposure even lower. Look at the SDS (Safety Date Sheet) and determine the type of isocyanate that is present in a particular product.

Health Effects

Contact with isocyanates can cause sensitivity and allergic type reactions. Once sensitized, individuals can develop more severe conditions including asthma attacks which may be life threatening. Sensitization may occur within days of exposure or may take months or years depending on the level of exposure and individual susceptibility. Contact with the skin can cause rashes and blisters and can also lead to sensitization and dermatitis. Isocyanate sensitization through dermal contact can also lead to respiratory sensitization so all skin contact must be avoided. Once sensitized, individuals can develop symptoms at extremely low levels of exposure. These levels may be so low that they cannot be measured. Sensitized individuals must be removed from areas where isocyanates are present and often must be moved to a different work environment entirely. Studies have shown that when employees are removed from exposure there still may be ongoing asthma symptoms and bronchial hyperreactivity in as many as 50% of cases. It is therefore critical that employees do not become sensitized.

It should be noted that isocyanates are only a concern until the isocyanate containing product is cured. A chemical reaction takes place during curing that changes these chemicals into the polymers. There is no release of isocyanates unless the materials are then heated to high temperatures (fire) where they may breakdown into the original components.

Exposure Limits

Exposures in the work environment can be analyzed by personal exposure monitoring. The ACGIH TLV was established at 5 ppb (parts per billion) as an 8 hour TWA for TDI and MDI. ACGIH also has a STEL of 20 ppb for TDI. OSHA has a PEL of 20 ppb as a ceiling limit for MDI and TDI. ACGIH also has a TLV-TWA of 5 ppb for HDI and IPDI. There are no OSHA PELs for HDI or IPDI. There is no ACGIH TLV or OSHA PEL for NDI but the NIOSH REL is 5 ppb as a TWA. There are no established exposure limits for the polymeric forms of the isocyanates but the manufacturers of these chemicals recommend that exposure be kept below 0.5 mg/m^3 (milligrams per cubic meter of air) as a TLV-TWA and 1 mg/m^3 as a ceiling limit.

Controls

Substitution of isocyanate containing products with other less hazardous materials is the best solution for control of exposure but is not always possible. Products containing lower amounts of isocyanates or polymeric forms may also be substituted for TDI or MDI in some situations.

Engineering controls such as closed systems, local exhaust ventilation and isolation of workers from these chemicals during processing and handling are important controls. All paint and adhesive spraying with products containing isocyanates should be done in an enclosed paint spray booth.

Air supplied respirators should be used when spraying these materials. Full-face air purifying respirators may also need to be worn in other operations where these materials are mixed and poured. Other PPE when spraying these materials should include:

- Safety glass or chemical goggles
- Chemical resistant gloves (Viton, Butyl Rubber or Polyvinyl Alcohol)
- Chemical resistant coveralls with long sleeves
- Chemical resistant overboots
- Hood or head protection

Employees should be provided with information concerning the hazards of isocyanates as part of the Hazard Communications Program. This should include information on where isocyanates are used and in which products, the hazards of working with isocyanates, signs and symptoms of exposure, labelling, work practice controls, storage, PPE and emergency procedures should also be covered.

A spill response plan should be developed for isocyanates. The spill area should be evacuated and employees responding to spills must wear protective clothing including respiratory protection. Consult the SDS (Safety Data Sheet) for specific clean-up procedures.

OSHA Isocyanate National Emphasis Program

Due to serious health effects associated with exposure to isocyanates. OSHA issued a National Emphasis Program for these chemicals on June 20, 2013. The directive targets industries by SIC code where isocyanates are potentially used for inspections and evaluations of exposures and controls of these chemicals. The OSHA inspections include review of the operations where isocyanates are used, include exposure monitoring, review of PPE, Hazard Communications and controls. OSHA also recommends that a medical monitoring program be developed for employees using these chemicals. Specific information can be found on OSHA's isocyanate web page.

https://www.osha.gov/SLTC/isocyanates/index.html

We know how important it is for you to have a safe and efficient work place for employees. Be sure to check out our QBE loss control website at http://qbena.com/for-policyholders/loss-control.aspx Find safety training information, webinars and other resources to help your efforts. If you need more help, be sure to reach out to your QBE loss control consultant! Made possible by QBE.