



# TOXICOLOGY

# *OCCUPATIONAL HAZARDS*



**CHEMICAL**

**PHYSICAL**

**ERGONOMIC**

**PSYCHOLOGIC**

**BIOLOGIC**

## ☐ Toxicology:

The study of the **adverse effects** of chemicals on living organisms & the assessment of the probability of their occurrence.

## ☐ Hazard:

When a chemical is used in a closed space without appropriate protection.



□ Exposure:

The amount or concentration of a pollutant present in air, water, soil, or other medium that potentially can be transferred to a subject.

□ Dose:

The quantity of material that has actually passed from the medium into the organism.

The National Institute for Occupational Safety and Health (**NIOSH**) and the American Conference of Governmental Industrial Hygienists (**ACGIH**) are organizations that sponsor chemical hazard research and recommend occupational exposure limits.

The U.S. Environmental Protection Agency (**EPA**) and the Occupational Safety and Health Administration (**OSHA**) set and enforce permissible chemical exposure limits.



# AIRBORN CHEMICALS



**GASES & VAPORS**

**AEROSOLS**

\* **DUST**

\* **MIST**

\* **FUME**

\* **SMOKE**

# AIRBORN CHEMICALS

**GASES & VAPORS**

**AEROSOLS**



# *CLASSIFICATION OF TOXIC AGENTS*



- Physical State of the Agent
- Chemical Structure of the Agent
- Medium of the Agent
- Site of Injury by the Agent
- Mechanism of Action of the Agent
- Clinical Effects of the Agent

(Onset & Reversibility of Effects)



# *FACTORS AFFECTING CLINICAL RESPONSE TO A TOXIC AGENT*



- Duration of exposure
- Frequency of exposure
- Route of exposure
- Environmental Factors
- Individual Factors

# *TOXICOKINETICS*



- Bioavailability
- Cell Membrane Permeability & Cellular Barriers
- Reservoir Tissues
- Absorption
- Distribution
- Metabolism
- Excretion

# ***CHEMICAL AGENTS IN WORKPLACE***



- **Gases**
- **Metals**
- **Solvents**
- **Pesticides**
- **Plastics**
- **Rubber**
- **Others**

# *OCCUPATIONAL EXPOSURE LIMIT STANDARDS*



## Threshold Limit Value (TLV)

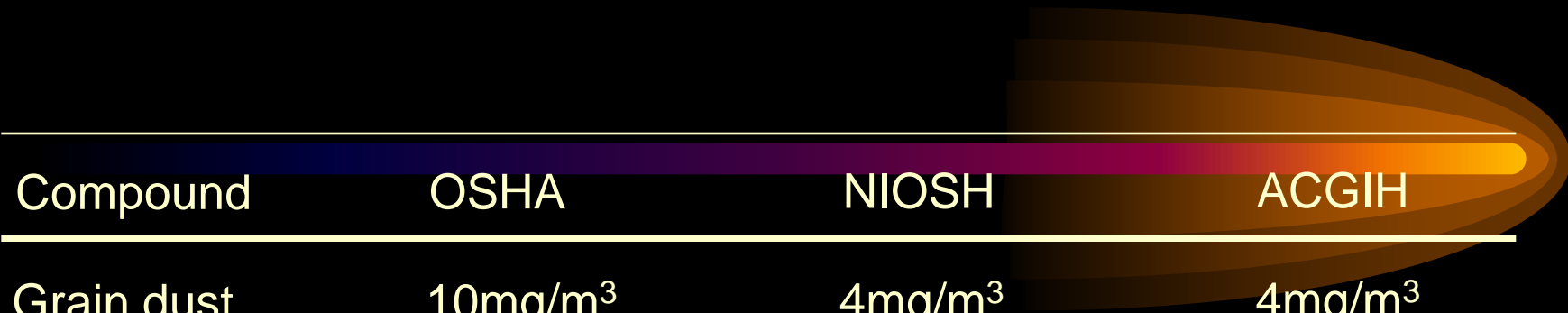
- Threshold Limit Value - Time Weighted Average (TLV - TWA)
- Threshold Limit Value - Short Time Exposure Limit (TLV - STEL)
- Threshold Limit Value - Ceiling (TLV-C)

- Short-Term Exposure Limit (**STEL**) understood to be a 15-minute average unless stated otherwise.
- Ceiling (**C**) - a level that should never be exceeded

Permissible Exposure Limits (**PELs**),  
Recommended Exposure Limits (**RELs**)  
and Threshold Limit Values (**TLVs**)  
are limits considered safe for most people  
exposed to a chemical agent 8 hours per  
day, 40 hours per week, 50 weeks per year

# CHEMICALS

- $\text{mg/m}^3 \times 24.45 = \text{ppm} \times \text{MW}$
- Where: MW = compound molecular weight
- 24.45 is the molar volume of air at 25°C



Compound	OSHA	NIOSH	ACGIH
Grain dust	10mg/m <sup>3</sup>	4mg/m <sup>3</sup>	4mg/m <sup>3</sup>
Uranium	0.25mg/m <sup>3</sup>	0.20mg/m <sup>3</sup>	0.20mg/m <sup>3</sup>
Acrylamide	0.03mg/m <sup>3</sup>	0.03mg/m <sup>3</sup>	0.03mg/m <sup>3</sup>
Propane	1000ppm	1000ppm	2500ppm
Ethanol †	1000ppm	1000ppm	1000ppm
Benzene	1ppm	0.1ppm	0.5ppm

•8-hour time-weighted average



**LD<sub>50</sub>** values are reported in milligrams toxin administered to the test animal per kilogram of body weight. A lower LD<sub>50</sub> value means that it takes less material to induce a toxic effect, that is, the toxin is potentially more harmful.

**LC<sub>50</sub>** values are reported in milligrams toxin per cubic meter of air (mg/m<sup>3</sup>) or in parts per million (ppm). As with LD<sub>50</sub> values, a lower LC<sub>50</sub> means that the material has a higher toxicity.



## Acute Toxicity Hazard Levels

Toxicity Rating	Oral LD <sub>50</sub> (Rats, per kg)	Skin contact LD <sub>50</sub> (Rabbits, per kg)	Inhalation LC <sub>50</sub> (Rats, ppm, 1 hr)	Inhalation LC <sub>50</sub> (Rats, mg/m <sup>3</sup> , 1 hr)
high	<50mg	<200mg	<200	<2,000
medium	50-500mg	200-1,000mg	200-2,000	2,000-20,000
low	500-5,000mg	1-5g	2,000-20,000	20,000-200,000

## Probable Lethal Dose for Humans

Toxicity Rating	Animal LD <sub>50</sub> (per kg)	Lethal Dose When Ingested by 70-kg (150lb) Human
extremely toxic	<5mg	less than 7 drops
highly toxic	5-50mg	7 drops to 1 teaspoonful
moderately toxic	50-500mg	1 teaspoonful to 1 ounce
slightly toxic	500-5,000mg	1 ounce to 1 pint
practically nontoxic	above 5,000mg	above 1 pint

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# Lethal dose and lethal concentration examples

Compound	Animal	Route	LD <sub>50</sub> /LC <sub>50</sub>
Ethanol	Rat	Inhalation	20,000ppm
Ascorbic Acid*	Rat	Oral	11,900mg/kg
Acetone $\Omega$ $\Omega$	Rat	Oral	5,800mg/kg
Acetic Acid $\Omega$	Rat	Oral	3,310mg/kg
Aspirin	Rat	Injection	1,450mg/kg
Formaldehyde	Rat	Oral	800mg/kg
Atrazine (herbicide)	Rat	Oral	672mg/kg
Phenol	Rat	Oral	317mg/kg