**CHEMICAL AND BIOLOGICAL EXPOSURES**

*Chemical*
- Majority of OHS hazards are chemical
- Solvents - commonly used; acute and chronic effects
- Toxicity - ability of the material to do harm

*Biological*
- Bacterial
- Viral
- Engineered
- Fungi
- Allergens
- Water fountains
- Physical
- Ergonomic/mechanical

**Health Effects Depend on Several Factors**
- The contaminant
- The amount of the contaminant present
- The length of time a person is exposed to the contaminant
- The vulnerability of the person

**Regulations and Standards**
- Outdoor airborne contaminant levels
  - Environmental Protection Agency (EPA)
  - National Ambient Air Quality Standards (NAAQS)
- Indoor airborne contaminant levels in the workplace
  - Occupational Safety and Health Administration (OSHA)
  - Object is to satisfy 60% of the occupants

**Problem - Causing**
- Chemicals
- Combustion products
- Respirable particles
- Biological aerosols

**Volatile Organic Compounds (VOCs)**
- Found in workplaces and in indoor environment
- Carbon-containing compounds that evaporate rapidly
- Decay life
- Examples
  - Benzene
  - Toluene
  - Styrene
  - Perchloroethylene
  - Pesticides

*WARNING: AVOID CONTAMINATION WASH YOUR HANDS*
### Volatile Organic Compounds (Sources)
- Paints, stains, varnishes
- Waxes
- Polishes
- Solvents
- Pesticides
- Adhesives
- Wood preservatives
- Cleansers
- Lubricants
- Air fresheners
- Fuels
- Plastics
- Copy machines, printers
- Tobacco products
- Perfumes
- Dry cleaned clothing

### Pesticides - Symptoms
- Headache
- Dizziness
- Lack of coordination
- Nervousness
- Irritability
- Insomnia
- Confusion
- Loss of concentration
- Speech difficulties
- Depression
- Impaired judgment
- Memory deficits
- Visual disturbances
- ECG changes
- Weakness
- Fatigue
- Paralysis

### Formaldehyde
- Used in plywood, particleboard, wallboard, fiberglass adhesives
- Sometimes in ceiling tiles, wallpaper, furniture, draperies, clothing
- Even low levels can cause difficulties in breathing, burning of eyes nose and throat, coughing; a human carcinogen
- PEL 0.75 ppm; TLV ceiling limit 0.3 ppm

### Perchloroethylene
- Solvent used in dry cleaning, metal cleaning and degreasing
- Can cause irritation of eyes, nose, throat and skin, liver and kidney damage, CNS depression
- Considered an animal carcinogen and probable human carcinogen
- PEL 100 ppm; TLV 25 ppm

### Respirable Particles
- Asbestos
- Fiberglass
- Silica
- Metal dust
- Tobacco smoke
- Organic dust
  - Pollen
  - Mold spores
  - Paper dust
- Radon
- Household dusts

### Asbestos
- Indestructible highly fibrous minerals
- Fibers are long, thin, flexible, heat resistant, able to be spun and woven
- Health effects: lung cancer, mesothelioma, asbestosis, pleural plaques
- Airborne concentration in homes, schools and businesses 30 to 6,000 fibers/cm³
- PEL 0.1 fibers/cc; TLV 0.1 fibers/cc
ASHARA
1989, required accreditation of asbestos abatement training programs for abatement contractors, educators, and managers.
- Asbestos Model Accreditation Plan (40 CFR Part 763, Appendix C) required the use of accredited inspectors, workers, supervisors when conducting asbestos activities in schools, public and commercial buildings.
- EPA strongly recommends asbestos-abatement related activities conducted at public and commercial buildings follow the protocol for management and removal of asbestos-containing materials described in the Asbestos-Containing Material Standards Rule (40 CFR part 763).

ALARA
- Always lower the asbestos levels in the workplace to the lowest level that is feasible through the use of engineering controls and personal protective equipment.

SILICA
- Reduce PEL to airborne Silica to half to 0 microgram/m3, which would be standard in all industries.
- 29CFR1926.1153 new standard for construction?
- Creates Action Level of 25 ug/m3
- ASTM standard for analysis of mass concentration of respirable crystalline silica in workplace air using infrared spectrometric methods.

Combustible Dust
- 1987, OSHA promulgated the Grain Handling Facilities standard (29 CFR 1910.272). Role in reducing the occurrence of explosions in this industry, as well as mitigating their effects.
- Lessons learned in the grain industry can be applied to other industries producing, generating, or using combustible dust.
- Needed to be combustible:
  - Combustible dust (fuel); Ignition source (heat); and, Oxygen in air (oxidizer); Dispersion of dust particles in sufficient quantity and concentration; and, confinement of the dust cloud.

Combustible Dusts
- The primary factor in an assessment of hazards is whether the dust is combustible.
- Combustible dust is defined by NFPA 654 as: "Any finely divided solid material that is 420 microns or smaller in diameter (material passing a U.S. No. 40 Standard Sieve) and presents a fire or explosion hazard when dispersed and ignited in air."
- One possible source for information on combustibility is the Material Safety Data Sheet (MSDS) for the material. In some cases, additional information such as test results will be available from chemical manufacturers.

Combustible Dust
- Variety of industries, including: food (e.g., candy, starch, flour, feed), plastics, wood, rubber, furniture, textiles, pesticides, pharmaceuticals, dyes, coal, metal, (e.g., aluminum, chromium, iron, magnesium, and zinc), and fossil fuel power generation.
- The vast majority of natural and synthetic organic materials, as well as some metals, can form combustible dust.

Lead
- Indestructible, non-biodegradable, adaptable metal.
- Buildings constructed before 1978 most likely has paint that contain lead.
- Environmental Protection Agency (EPA) is now considering whether to extend requirements to commercial buildings.
- TSCA requires EPA to assess the threat lead-based paint has on public and commercial buildings built prior to 1978.
- July 1, 2015.
Lead – Chronic Exposure Health Effects
- Loss of appetite
- Metallic taste in mouth
- Anemia
- Constipation
- Nausea
- Prolonged fatigue
- Excessive tiredness
- Weakness
- Insomnia
- Headache
- Nervous irritability
- Muscle and joint pain or soreness
- Fine tremors
- Numbness
- Dizziness
- Hyperactivity
- Colic, with severe abdominal pain

Bioaerosols
- Substances that are living or were released from a living organism
- Possible to develop illness from exposure to single agent
  - no TLV's
  - Examples
    - Bacteria
    - Fungi
    - Pollen
    - Viruses
    - Dust mites

Hanta Virus
- Rodents, especially deer mice
- Respiratory failure and death
- 40% of diagnosed cases have been fatal
- Inhalation of airborne particles of infected urine, droppings or saliva from infected animals

Bacteria in Indoor Environments
- Higher concentrations indoors than outdoors
- Majority of bacteria in air are shed from human skin and respiratory tracts
- Examples of infectious bacteria
  - Legionella spp.
  - Staphylococcus aureus
  - Mycobacterium tuberculosis

Molds and Growing Conditions
- Optimum water activity
  - Above 0.90 in substrate, for most species
- Optimum temperature range
  - 56° F to 86° F, for most species
- Light
  - Inhibits growth of some types of molds
  - Stimulates spore production in many species

Fungal Metabolism
- Enzymes secreted to digest external food sources, which are then absorbed
- Must have adequate moisture available
- Metabolic products
  - Carbon dioxide, water, ethanol
  - Microbial Volatile Organic Compounds (MVOCs)
  - Mycotoxins and antibiotics
MVOVs
- VOCs with distinctive offensive odors
- Possibly responsible for some illnesses
- Different compounds emitted on different media
- Type and quantity change with phases of growth
- Highest MVO production is prior to and during spore production and mycotoxin production

Mycotoxins
- Produced to inhibit or kill competitors
- May cause serious short term and long term health effects
- Over 200 recognized mycotoxins and many more not yet discovered
- Toxins production varies with the species, the conditions and the substrate

General Health Effects
- Sinus congestion
- Sneezing
- Coughing
- Eye irritation
- Asthma
- Bronchitis
- Hyperreactivity pneumonitis
- Infectious diseases, e.g. ringworm, athlete's foot, nail infections, Histoplasmosis, Valley Fever

Mycotoxin Health Effects
- Mucous membrane irritation
- Cold and flu symptoms
- Sore throat
- Headache
- Fatigue
- Diarrhea
- Skin rash
- Dizziness
- Nausea
- Immunosuppression
- Birth defects
- Tremors
- Hemorrhaging
- Cytotoxicity
- Hepatotoxicity
- Nephrotoxicity
- Cancer

Aflatoxin
- One of the most potent carcinogens known to man
- Linked to a variety of health problems
- FDA maximum allowable level is 20 ppb
- Produced by some species of Aspergillus

T-2 Toxin
- A trichothecene toxin
- Produced by species of Fusarium mold
- One of the more deadly toxins
- Ingestion in sufficient quantity can cause rapid death due to internal hemorrhage
- Implicated in alimentary toxic aleukia and pulmonary hemosiderosis
- Damage is often permanent
**Fumonisn**
- Associated with some species of Fusarium mold
- Commonly found in corn
- Has resulted in dozens of deaths of horses and swine
- Causes "crazy horse disease" or leukoencephalomalacia, a liquefaction of the brain
- Chronic low-level exposure in humans has been linked to esophageal cancer

**Difficulties in Mold Sampling**
- No TLVs or PELs
- Fungus might not be producing spores at the time of sampling
- Spores might be adhering to surfaces rather than airborne
- Spores might not survive impaction
- Spores might not grow on the media used
- Colonies might be overgrown by others and not detected
- Organism might be very slow growing

**Thank you!**

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