Airborne pollutants

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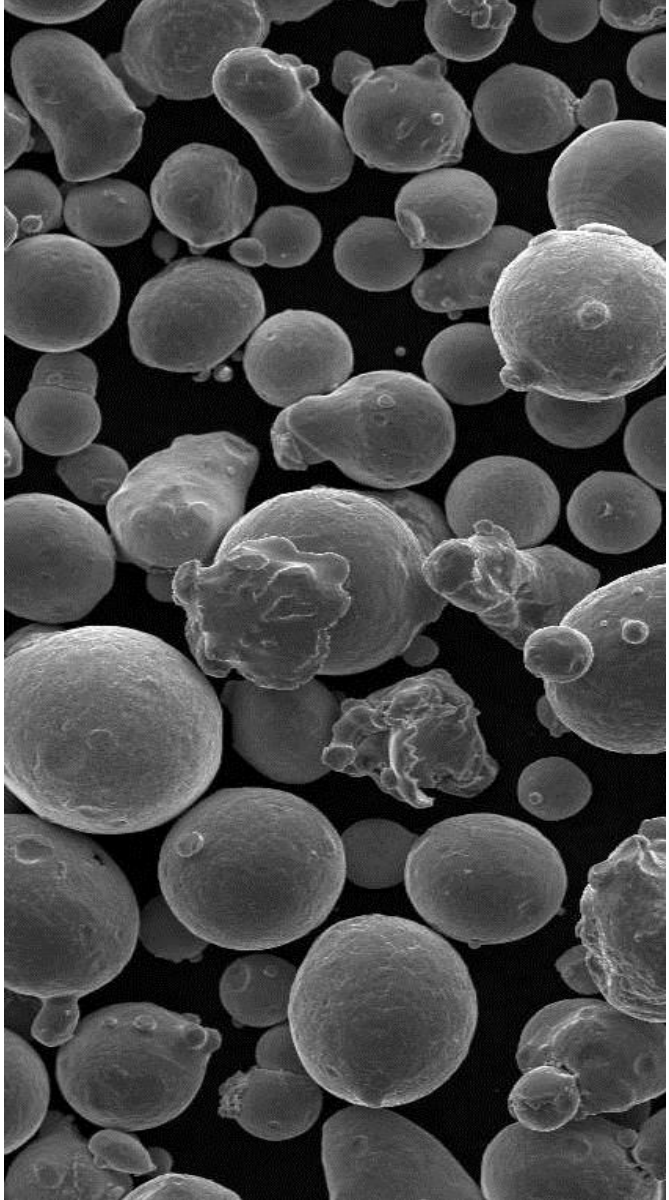

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Background

- How are workers exposed?

- What can be inhaled?
  - Particles – dust
  - Vapours – solvent
  - Fumes – metals
  - Fibers – asbestos

Background

- Toxicology - ADME
  - Absorption – how does it get in?
  - Distribution – where will it go?
  - Metabolism – how will it be broken down?
  - Excretion – how does it leave?
- Short-term (acute) vs Long-term (chronic) exposure
- Health effects
  - Short-term vs Long-term

Volatile Organic Compounds: Toluene[1,2]

- Flammable, colorless, volatile liquid
- Exposure mainly through inhalation (skin possible) to vapour
- Present in paint, thinners, glues, cleaning products, etc.
- Non-occupational exposure possible
  - Smoking (conflicting)
  - Alcohol consumption
  - Benzoate consumption
  - Substance abuse (“glue sniffing”)
- Co-exposure to other solvents

Volatile Organic Compounds: Toluene[1,2]

- Central nervous system depressant
  - Long-term, low levels = sub-clinical change in blue-yellow vision
  - Spontaneous abortion in females
  - 100 ppm exposure = intoxication and reduced performance
  - Neurobehavioral, color vision, reproductive and developmental changes
  - Higher levels
    - CNS encephalopathy (brain damage)
    - Headache
    - Depression
    - Lassitude
    - Impaired coordination
    - Impaired reaction time

Manganese[3,4]

- Accumulates in the body
- Neurotoxic
  - Long-term low level exposure
    - Sub-clinical effects - decreased co-ordination and deterioration in motor function (muscle movement)
  - Long-term exposure
    - “Manganism” – resembles Parkinson’s disease
  - Not clear if sub-clinical effects are reversible
- Cardiovascular effects – blood pressure and heart rate?

Lead[5]

- Different types of lead:
  - Inorganic lead – pigments, paints, dyes
  - Organic lead – leaded petrol
  - Lead alloys – batteries, ammunition
- Non-occupational exposure possible
  - Loading ammunition, lead-glass work, etc.
- Accumulates in body

Lead[5]

- Nervous system – peripheral neuropathy
- Blood effects – low red blood cell count, decreased oxygen
- Kidney – fibrosis, kidney failure
- Hypertension
- Bone effects – osteoporosis, substitutes calcium in bones
- Digestive system – colic
- Carcinogen (IARC)
  - Inorganic lead compounds – Probable human carcinogen (stomach)

Welding fumes[6,7]

- Complex mixture of metal oxides, silicates and fluorides.
- **Fume** – formed when metal is heated above boiling point and its vapours condense to form very small (solid) particles
- Fume composition
  - Type of welding
  - Material welded
  - Coatings on material welded

- Welding gases (shielding, fuel, process, coatings)

Welding fumes[6,7]

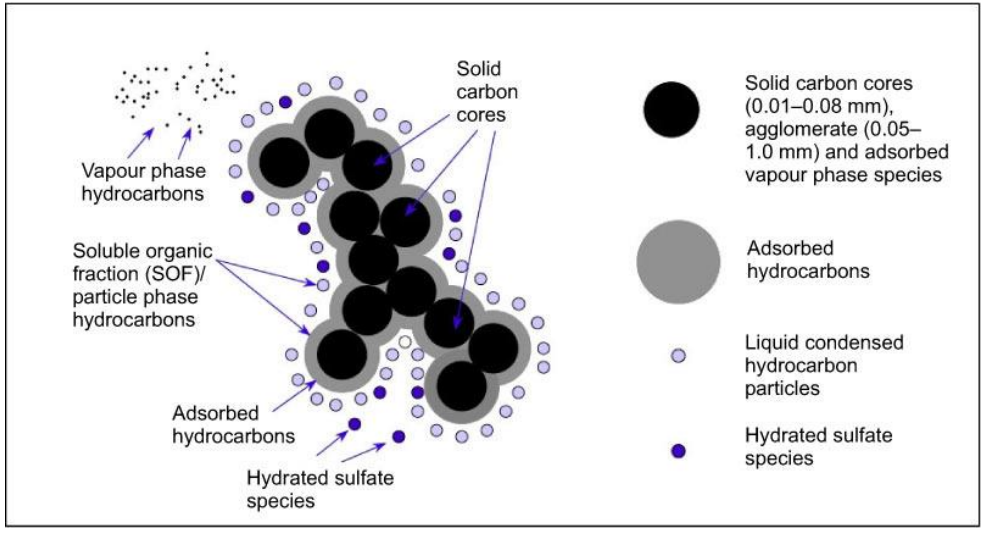
- Metals
  - Aluminium, antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, silver, tin, titanium, vanadium, zinc

- Short-term effects – eye, nose, throat irritation, dizziness and nausea, “metal fume fever”

- Long-term exposure – cancer (lung, larynx, urinary tract)

Diesel exhaust[8,9]

- **DE = Mixture of gases and very small particles (DPM)**
- DPM = soot particles (carbon), ash, metallic abrasion particles, sulfates and silicates
- Particles < 10 µm
  - Most < 1 µm
- PAHs = carcinogenic



Diesel exhaust[8,9]

- Short-term effects
  - Eye, nose and throat irritation
  - Headache
  - Dizziness

- Long-term effects
  - Increased risk of cardiovascular, cardiopulmonary and respiratory disease (asthma, COPD)
  - Cancer (lung, bladder)

Diesel exhaust[8-10]

- Exposure limits
  - OSHA (USA)
    - DPM = 160 µg/m^3 of total carbon (underground metal/non-metal mining)
    - Carbon monoxide = 50 ppm
    - Nitric oxide = 25 ppm
    - Nitrogen dioxide = 5 ppm (ceiling)
  - Is there a safe limit/threshold for exposure to a chemical carcinogen?
    - Not known
    - < 100 µg/m^3 of total carbon (< 75 µg/m^3 of elemental carbon)

Mixtures COP p.78-81

- Some mixed exposures involve substances that act on different body tissues or organs, or by different toxicological mechanisms, these various effects being **independent** of each other.
  - **Compliance if exposure < OEL of individual substance**
- Other mixtures will include substances that act on the same organs, or by similar mechanisms, so that the effects reinforce each other and the substances are **additive** in their effect. (i.e. 2 + 3 = 5)
  - **Compliance if exposure = $C_1/L_1 + C_2/L_2 + C_3/L_3 < 1$**
- In some cases the overall effect is considerably greater than the sum of the individual effects and the system is **synergistic** (i.e. 2 + 2 = 20)
- Synergistic (Potentiation) > Additive > Individual

TABLE C1: Substances which are considered to have additive or synergistic effects

IRRITATION			ORGAN DAMAGE				SYSTEMIC EFFECT		OTHERS		
Respiratory	Eye	Skin	Dermal	Lung	Liver	Kidney	Blood	CNS	Fume fever	Dyspnoea	Pneumoconiosis
Aluminium	Aluminium	Aluminium	Aluminium	Aluminium	Arsenic	Arsenic	Cadmium	Lead	Aluminium	Cadmium	Aluminium
Antimony	Antimony	Antimony	Arsenic	Arsenic	Boron	Boron	Copper	Lithium	Antimony	Cobalt	Beryllium
Arsenic	Beryllium	Arsenic	Boron	Beryllium	Copper	Cadmium	Lead	Manganese	Beryllium	Manganese	Cobalt
Beryllium	Boron	Beryllium	Chromium	Cadmium	Manganese	Chromium	Manganese	Mercury	Cadmium	Selenium	Iron
Boron	Calcium	Boron	Cobalt	Chromium	Mercury	Copper	Phosphorus	Tin	Cobalt	Vanadium	Silica
Cadmium	Chromium	Calcium	Lithium	Cobalt	Molybdenum	Manganese	Selenium		Copper	Zinc	Tin
Calcium	Copper	Chromium	Nickel	Copper	Phosphorus	Mercury	Tin		Iron		
Cobalt	Lithium	Lithium	Potassium	Manganese	Selenium	Nickel			Magnesium		
Copper	Magnesium	Mercury	Silver	Nickel		Phosphorus			Manganese		
Lithium	Mercury	Nickel	Sodium	Potassium		Selenium			Mercury		
Magnesium	Molybdenum	Phosphorus	Tin	Silica					Nickel		
Molybdenum	Phosphorus	Potassium	Zinc	Titanium					Selenium		
Phosphorus	Potassium	Selenium							Tin		
Potassium	Selenium	Sodium							Zinc		
Selenium	Sodium	Tin									
Sodium	Tin										
Tin	Vanadium										
Titanium											
Vanadium											
Zinc											

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