University of Salahaddin - Erbil
College of Science
Env. Science and Health Dept.

Introduction to Industrial Hygiene

Fars Zedan

Section A

Definition of Industrial Hygiene

What Is Industrial Hygiene?

- Definition
  - Science and art devoted to the anticipation, recognition, evaluation, and control of those workplace environmental factors which may cause sickness, impaired health and well-being, or significant discomfort and inefficiency among workers or among citizens of the community

What Is an Industrial Hygienist?

- A person who by study, training, and experience can:
  - Anticipate
  - Recognize
  - Evaluate
  - Control

  workplace environmental hazards

Some Occupational Hazards

- Chemical agents
  - Gases, vapors and particulate aerosols
- Physical (energy) agents
  - Noise, ionizing / non-ionizing radiation, heat and cold stress
- Biological agents
  - Infectious agents, allergens
- Psychological stressors
- Ergonomic/safety

Industrial Hygiene Concepts

- Anticipation/recognition of potential or actual hazards through knowledge of:
  - Materials
  - Operations
  - Processes
  - Conditions
- Scope of IH activities encompasses the “cradle-to-grave” concept (research through waste disposal)

Continued

Industrial Hygiene Concepts

- Evaluation of environmental factors through:
  - Measurement of exposure intensity
  - Determination of exposure frequency, and duration
  - Comparison with regulatory, professional, and internal standards
  - Judgement: weigh all factors

Control of Exposures

- Employ methods to eliminate or reduce exposure resulting in elimination or reduction of the occurrence of occupational disease through:
  - Engineering (including process) interventions
  - Administrative/programmatic measures
  - Personal protective equipment

Opportunities for Control

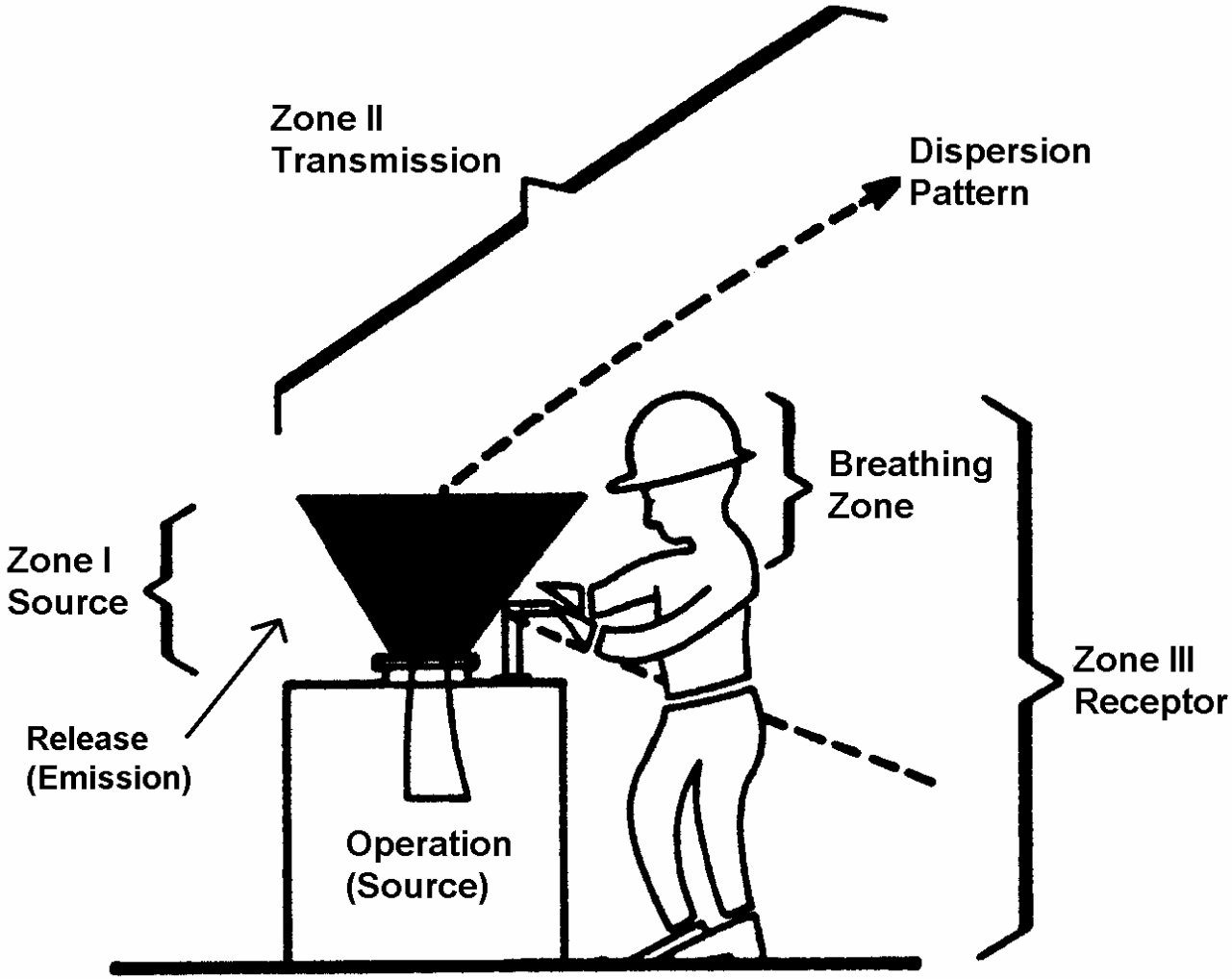


Illustration by Patrick Breysse

Section B

Environmental/Occupational Health Paradigm

Environmental/Occupational Health Paradigm

Grinding
Chipping
Milling
Sawing
Sweeping
Heating
Welding

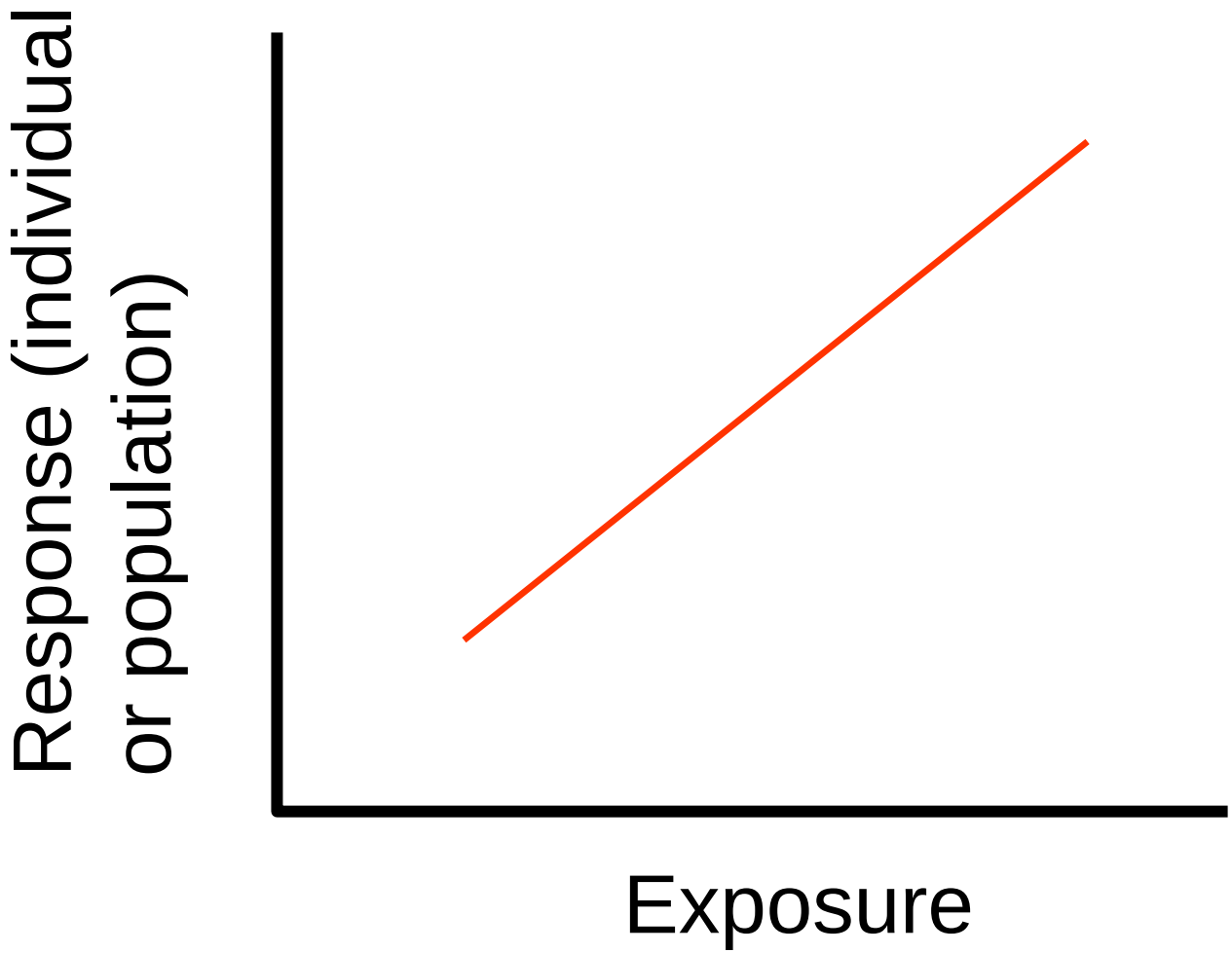
Exposure Assessment

Biomarkers

Biomarkers
Clinical Manifestation

Disease
Death

IH in the Exposure-Response Paradigm



Exposure
Definitions and Concepts

- Contact between outer boundary of the human body (skin, nose, lungs, GI tract) and a pollutant or mixture of pollutants
- Requires the presence of a pollutant and the contact between the person and that medium (vs. potential exposure)
- Quantified by concentration of the contaminant and the time of contact

Exposure Assessment

- Route of exposure: Inhalation, ingestion, dermal, injection
- Magnitude of exposure: Concentration in media (ppm, mg/m^3, f/cm^3)
- Duration of exposure: Minutes, hours, days, lifetime
- Frequency of exposure: Daily, weekly, seasonally

Education of an Industrial Hygienist

- Usually requires advanced education in engineering and/or science
- A combination of education and experience is necessary in order to take the American Board of Industrial Hygiene (ABIH) exam for certification in industrial hygiene (CIH)

Who Is an Industrial Hygienist?

- Employed by
  - Industry (47%)
  - Consulting (23%)
  - Government (14%)
  - Academia (5%)
  - Insurance (3%)
  - Labor (1%)

Source: Taken from AIHA membership survey, 2000

Section C

Risk Assessment and Industrial Hygiene

Risk Assessment

- *Risk assessment* is usually considered to be an environmental term, but it is an essential part of the industrial hygiene profession
- Broadly defined as the methodology that predicts the likelihood of unwanted events (explosions, injuries, natural catastrophes, diseases, death)

Risk Assessment Comparison of Terminology

Industrial Hygiene	**Environmental**
Anticipation and Recognition	Hazard identification
Evaluation	Exposure and toxicity assessment and Risk characterization
Control	Risk management
Hazard communication	Risk communication

Risk Assessment

- The act of comparing exposure measurements with exposure limits (TLVs, PELs, etc.) is a fundamental aspect of risk characterization which is the final step in the risk assessment process

Continued

Risk Assessment

- Risk assessment Equation 1:

$$\text{Risk} = \left(\frac{\text{Prob. of Health Effect}}{\text{Unit of Exposure}}\right) \times (\text{Level of Exposure})$$

Continued

Risk Assessment

- Another form of Equation 1:

$$\text{Risk} = \left(\frac{\text{Prob. of Health Effect}}{\text{Absorbed Dose}}\right) \times (\text{Absorbed Dose})$$

Continued

Risk Assessment

- Equation 1: Determining the probability of a negative health effect by combining the dose-response and exposure assessment over some relevant period of time
- Exposure is an approximation for dose
- Absorbed dose is the relative or specific amount of material that gets into the body and therefore can do harm

Role of Risk Assessment

Estimated Asbestos Related Cancer Mortality per 100,000 by Number of Years Exposed and Exposure Level [1]

Asbestos fiber concentration (f/ml)	Cancer mortality /100,000 exposed			
	Lung	Mesothelioma	Gastrointestinal[2]	Total
	45 years exposure			
0.1	231	82	23.1	336.1
0.2	460	164	46.0	670.0
0.5	1143	407	114.3	1664.3
2.0	4416	1554	441.6	6411.6
4.0	8441	2924	844.1	12209.1
5.0	10318	3547	1031.8	14896.8
10.0	18515	6141	1851.5	26507.5

[1] Assumes exposure begins at age 25. Risks are calculated using U.S. male lung cancer background rates for 1977.

[2] Estimated as 10% of lung cancer risk rather than calculated using dose-response information.

Source: The Federal Register, 2 August 1986