



Health, Safety and Environment (HSE) in Industrial Installations

**Target: 2nd Year Engineering
Students**

Instructor: Dr. GRINE Wassila



Chapter 2: Occupational Health and Environmental Protection

Description: Protecting Worker Health and Ecosystems in Industrial Operations

Five-Session Roadmap



- **Session 1:** Introduction to Occupational Health & Work-Related Diseases
- **Session 2:** Industrial Hygiene & Environmental Monitoring
- **Session 3:** Environmental Management in Industrial Facilities
- **Session 4:** Industrial Waste Management
- **Session 5:** Sustainability & Sustainable Development - Integrated Case Study

SESSION 2: Industrial Hygiene and Environmental Monitoring

Date: 11/12/2025

18H00-19H30



What is Industrial Hygiene?



- **Definition:** The science and art dedicated to the recognition, evaluation, and control of environmental factors in the workplace that may lead to illness or discomfort.
- **Goal:** Preventing occupational diseases by controlling **chemical, physical, biological, and ergonomic hazards.**
- **Comparison:** Occupational Safety = **Sudden Energy** |
Industrial Hygiene = **Chronic Exposure**



Four Major Environmental Hazards (ANTE)

1. Chemical Hazards (Aerosols, Gases, Vapors)

Aerosols, Vapors, gases, dusts, fumes, mists.

2. Physical Hazards (Noise, Radiation, Temperature)

Noise, vibration, radiation, extreme heat, cold.

3. Biological Hazards (Toxic Molds, Bacteria, Viruses)

Bacteria, viruses, fungi, toxic molds (in some industries).

4. Ergonomic Hazards (Poor Workstation Design)

Workstation design, repetitive motions, heavy lifting.



Occupational Exposure Limits (OELs) - Protection Standards

- 1. Definition:** Permissible concentrations of a hazardous substance in workplace air at which most workers are not expected to suffer adverse health effects from repeated exposure.
- 1. Permissible Exposure Limit - Time-Weighted Average (TWA-PEL):** Average concentration over an 8-hour workday / 40-hour workweek.
- 2. Short-Term Exposure Limit (STEL):** 15-minute average concentration that must not be exceeded.
- 3. Immediately Dangerous to Life or Health (IDLH):** Concentration posing an immediate threat to life or health.



Monitoring and Assessment Tools (The Hygienist's Toolkit)

1. Personal Sampling (Most Accurate):

- * Air sampling pump + tube/filter.
- * Worn on the worker's collar to simulate actual exposure.

2. Direct Reading Instruments (For Immediate Results):

- * Gas detector tubes, portable gas analyzers.
- * Sound level meter (for noise), vibration meter.

3. Biological Monitoring (Inside the Worker's Body):

- * Measuring the substance or its metabolites in blood, urine, or exhaled air (e.g., lead in blood).



Practical Activity - Interpreting Results and Making Decisions

Scenario: "Recent measurement of a worker's exposure to industrial compound X."

TWA-PEL for Compound X = 50 parts per million (ppm)

Your Sample Results:

- Sample 1 (4-hour duration): 30 ppm
- Sample 2 (4-hour duration): 70 ppm

Group Task (1 minutes):

1. Calculate the Time-Weighted Average (TWA) for the full 8-hour day
2. Did it exceed the PEL?
3. What is the next step you recommend?
4. What type of control would you implement first?



Solutions for the Interactive Activity

1. TIME-WEIGHTED AVERAGE (TWA) FORMULA

$$TWA = \frac{\sum(C_i \times T_i)}{T_{total}}$$

WHERE:

C_i = Concentration during period i
(ppm or mg/m³)

T_i = Duration of period i (hours)

T_{total} = Total work time (usually 8 hours)

EXAMPLE FOR 2 PERIODS:

$$TWA = \frac{[(C_1 \times T_1) + (C_2 \times T_2)]}{(T_1 + T_2)}$$

ACTIVITY EXAMPLE:

$$TWA = \frac{[(30 \times 4) + (70 \times 4)]}{8} = 400 \div 8 = 50 \text{ ppm}$$

2. SHORT-TERM EXPOSURE LIMIT (STEL)

STEL = Average of 15-minute samples
(NO time weighting - simple average)

3. CONVERSION FORMULAS

ppm to mg/m³:

$$\text{mg/m}^3 = \text{ppm} \times (\text{Molecular Weight} \div 24.45)$$

mg/m³ to ppm:

$$\text{ppm} = \text{mg/m}^3 \times (24.45 \div \text{Molecular Weight})$$

4. EXPOSURE ASSESSMENT DECISION RULES

CONDITION	ACTION REQUIRED
TWA < PEL	Acceptable (continue monitoring)
TWA = PEL	At limit (implement preventive controls)
TWA > PEL	Unacceptable (implement immediate controls)
Any reading > STEL	Investigate immediately
Any reading > IDLH	Evacuate immediately

5. QUICK CALCULATION TEMPLATE

Step 1: Multiply concentrations by times

Step 2: Sum all products

Step 3: Divide by total time

Step 4: Compare with PEL

MEMORY AID:

"Concentration × Time, Sum, Divide by Total Time"

6. COMMON MISTAKES TO AVOID

1. Don't use simple average (must weight by time)

2. Ensure consistent units (hours, ppm)

3. Check both TWA and STEL if applicable

4. Consider partial work shifts

5. Document all calculations

7. PRACTICE FORMULA

For the standard 8-hour shift with two measurements:

$$TWA = \frac{(4C_1 + 4C_2)}{8} = (C_1 + C_2) \div 2$$

Environmental Monitoring: From the Workplace to the Surroundings

Moving from (Internal Focus):

- Monitoring air quality inside the facility (to protect workers).

To (External Focus):

- Monitoring stack emissions (outdoor air).
- Monitoring industrial wastewater before discharge.
- Monitoring hazardous waste before disposal.
- Ambient monitoring (soil, groundwater) around the facility.

Objective: Ensuring compliance with national environmental laws and protecting the community.



Regulatory Framework in Algeria for Hygiene and Environment



- **For Occupational Health:** Executive Decree 91-05 (listing occupational diseases and exposure limits).
- **For Air Emissions:** Joint Ministerial Order 06-198 (permissible standards).
- **For Wastewater:** Joint Ministerial Order 06-199 (permissible standards).
- **Role of Inspection:** Labor Inspectorate, Wilaya Directorate for the Environment.

Modern Challenges and Trends

- ▶ **Mixed Hazards Challenge:** Concurrent exposure to multiple hazards (noise + solvents).
- ▶ **Emerging Hazards:** Nanoparticles, psychosocial health risks.
- ▶ **Trend Towards Continuous Monitoring:** Smart sensors and Industrial IoT (IIoT) for real-time data.
- ▶ **Importance of Documentation:** Records as evidence of compliance and prevention.

Session 2 Summary

Key Takeaways:

- Industrial Hygiene deals with recognizing, evaluating, and controlling chronic hazards.
- Occupational Exposure Limits (OELs) are the compass for measuring safe conditions.
- Personal monitoring is the gold standard for assessing worker exposure.
- Environmental monitoring extends from protecting the worker to protecting the community and environment.

Next Session: We will move from measurement to Environmental Management in industrial facilities.

«What you cannot measure, you cannot manage. And what

you cannot manage, you cannot improve.»

ما لا يمكنك قياسه، لا يمكنك إدارته. وما لا يمكنك إدارته، لا

يمكنك تحسينه.

Thank you all for your attention



Best Environmental Health and Safety Jobs