



Health, Safety and Environment (HSE) in Industrial Installations

**Target: 2nd Year Engineering
Students**

Instructor: Dr. GRINE Wassila

The background is a collage of four images. Top-left: A hand holding a globe of the Earth. Top-right: A worker in a white lab coat and blue gloves. Middle-right: Two workers in grey shirts and yellow hard hats looking at a tablet. Bottom: A worker in a blue uniform and yellow hard hat working on a blue structure.

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 4: Industrial Waste Management

Date: 19/12/2025

18H00-19H30



Industrial Waste: Challenge and Opportunity

Scale and Problem:

Industrial facilities generate **40-60% of solid waste in industrial cities**

Hidden Cost: Material purchase + manufacturing energy + disposal cost

Intellectual Shift:

Traditional View: Waste = burden + additional cost

Modern View: Waste = inefficiency indicator + wasted resources

Smart Management Hierarchy:

Prevention → Reduction → Reuse → Recycling → Recovery → Treatment → Disposal



Classification of Industrial Waste

Classification by Hazard:

1. Hazardous Waste (Primary Focus)

Characteristics: Flammable, corrosive, toxic, reactive

Examples:

- ❑ Used solvents (acetone, toluene)
- ❑ Concentrated acids and alkalis
- ❑ Used lubricating oils
- ❑ Lead-acid batteries
- ❑ Industrial medical waste

2. Non-Hazardous Waste (Ordinary)

Examples:

- ❑ Uncontaminated metal scrap
- ❑ Paper and cardboard waste
- ❑ Clean plastic residues
- ❑ Packaging waste



3. Inert Waste

Examples:

- ❑ Construction and demolition debris
- ❑ Some types of ash



Integrated Waste Management Hierarchy

From Best to Worst:

1. Prevention (Prevention) – Smartest

- ✓ Designing processes that don't generate waste from the outset

Example: Modifying product design to reduce material usage

2. Reduction (Reduction) - Most Practical

- ✓ Improving efficiency to reduce waste quantity

Example: Improving cutting precision to reduce scraps

3. Reuse (Reuse) - Most Cost-Effective

- ✓ Using waste for the same purpose without treatment

Example: Reusing containers and packaging

4. Recycling (Recycling) - Most Common

- ✓ Treating waste to extract raw materials

Example: Recycling metals, recovering solvents

5. Recovery (Recovery) - Most Intelligent

- ✓ Extracting energy from waste

Example: Using waste as alternative fuel

6. Treatment (Treatment) - Before Disposal

- ✓ Reducing waste hazard

Example: Solidification/Stabilization, chemical treatment

7. Disposal (Disposal) - Last Resort

- ✓ Landfilling in secure facilities

Example: Licensed hazardous waste landfills



Hazardous Waste Responsibility Chain

"Cradle-to-Grave" Principle:

1. Producer (Your Facility) - Primary Responsibility

Obligations:

- Correct identification of waste
- Accurate classification and labeling
- Safe temporary storage
- Selection of licensed transporter and processor

2. Transporter (Collector) - Secondary Responsibility

Obligations:

- Obtaining transportation license
- Using safe transport means
- Maintaining transport documents

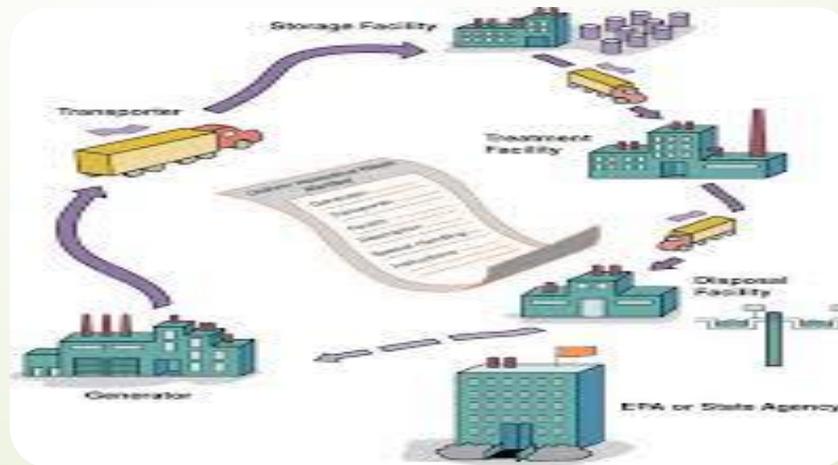
3. Processor/Disposer - Final Responsibility

Obligations:

- Safe and effective treatment
- Responsible final disposal
- Issuing disposal certificates

Tracking Document (Waste Manifest):

- **Waste passport** from origin to disposal
- Signed by all parties
- Kept for at least 10 years



Interactive Activity - Developing a Waste Management Plan

Scenario: "Metal forming factory."

Types Produced:

A: Wastewater treatment sludge containing heavy metals

B: Used lubricating oils contaminated with metals

C: Clean iron scrap

D: Plastic packaging waste

Task (20 minutes):

1. Classify each type (hazardous/non-hazardous)
2. Suggest two hierarchy options for each type
3. Design a safe temporary storage area for types A and B
4. Identify required tracking documents



Brief Solution for Waste Management Interactive Activity

1. Classification:

A: Heavy metal sludge ← **Hazardous** (toxic)

B: Contaminated oils ← **Hazardous** (toxic + flammable)

C: Iron scrap ← **Non-hazardous**

D: Plastic ← **Non-hazardous**

2. Treatment Options:

Type	Optimal Choice	Alternative Option
A	Extraction of valuable metals	Solidification with cement for blocks
B	Re-refining of oils	Use as alternative fuel
C	Sale to recycling companies	Internal use in the factory
D	Reduce packaging quantity	Sale for plastic recycling

4. Required Documents:

1. Daily internal waste log
2. Official tracking form signed by all parties
3. Transporter and processor licenses
4. Final disposal certificate

3. Temporary Storage Design:

Location: Separate covered area

Containers: Leak and corrosion resistant

Safety: Impermeable floor + emergency collection basin

Documentation: Clear warning labels

5. Timeline:

Weeks 1-2: Design and equipment purchase

Week 3: Employee training

Week 4: Implementation and review

Expected Results:

- Save 40% of disposal costs
- Reduce 25% of waste quantity within 6 months
- Ensure 100% compliance with Law 01-19

Safe Temporary On-Site Storage

Basic Requirements:

1. Separation and Classification

- ▶ Preventing mixing of incompatible wastes
- ▶ Designating separate areas for each type

2. Appropriate Containers

- ▶ Leak and corrosion resistant
- ▶ Tightly sealed
- ▶ In good condition (no rust or cracks)

3. Clear Labeling

- ▶ Waste name and composition
- ▶ International hazard symbols
- ▶ Generation date and quantity

4. Designated Location

- ▶ Covered area with impermeable flooring
- ▶ Away from ignition and reaction sources
- ▶ Equipped with secondary containment (berms)

5. Records and Management

- ▶ Daily log of incoming and outgoing quantities
- ▶ Regular inspection program
- ▶ Spill emergency plan



Pre-Disposal Treatment Techniques

To Reduce Hazard and Volume:

1. Solidification/Stabilization

- ❑ Mixing liquid waste with binding materials (cement, gypsum)
- ❑ Producing solid blocks resistant to leaching

Example: Stabilizing metal-containing sludge

2. Chemical Treatment

- ❑ Neutralizing acids and alkalis
- ❑ Precipitating metals from solutions
- ❑ Oxidizing or reducing toxic compounds

3. Thermal Treatment (Incineration)

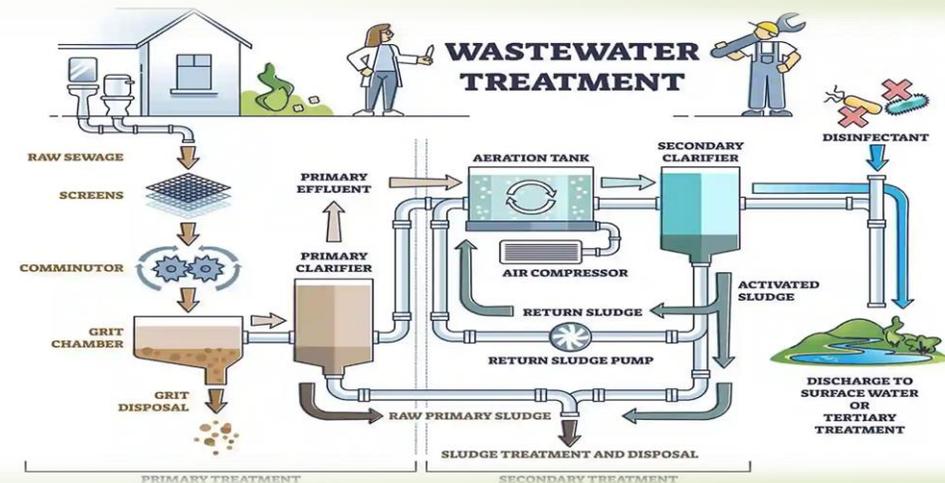
- ❑ In licensed furnaces with control systems
- ❑ With exhaust gas treatment equipment

Conditions: 99.99% destruction efficiency for organic pollutants

4. Biological Treatment

- ❑ For some organic wastes

Example: Food waste treatment



Law 01-19: Your Professional Protection Shield

Warning Scenario:

A chemical plant disposed of hazardous waste illegally, Discovered by the Ministry of Environment during a surprise inspection

Question: What consequences will you face as a responsible engineer?

➤ 3 Devastating Consequences:

1. **Fine:** 10 million dinars ← Cost of a new production line!
2. **Shutdown:** 6-12 months ← Complete loss of market and clients
3. **Imprisonment:** Criminal liability ← End of your professional career

✓ 3 Protections Provided by the Law:

1. **Immunity:** Your legal documents protect you from accountability
2. **Distinction:** 87% of companies prefer the compliant engineer
3. **Savings:** Law compliance saves 15-30% of costs

Conclusion:

"**Law 01-19:** Not an obstacle, but a **success map for the smart and responsible engineer**"

Circular Economy: Strategic Vision

Traditional Linear Model:

Take → Make → Use → Dispose

- Resource depletion
- Waste accumulation
- High environmental costs

Ambitious Circular Model:

Design → Make → Use → Reuse/Remanufacture/Recycle

- Resource preservation
- Waste reduction
- Added economic value

Engineer's Role in Circular Economy:

- 1. Design:** Products easy to disassemble and recycle
- 2. Operations:** Closed-loop systems for materials and energy
- 3. Innovation:** New business models (leasing instead of selling)

Successful Initiatives:

- Industries:** Metal recovery from electronic waste
- Services:** Chemical leasing instead of selling
- Products:** Modular design for repair and upgrade

Session 4 Summary

Key Points:

1. Conceptual Shift

Waste is not a final problem, but an efficiency indicator and economic opportunity

2. Practical Priority

Management hierarchy is the action guide: start with prevention, end with disposal

3. Legal Responsibility

Responsibility chain is unbroken: producer responsible until final disposal

4. Future Vision

Circular economy is not an option, but a necessity for competitive survival

5. Required Skills

Successful engineer combines technical knowledge, legal understanding, and economic vision

Most Important Lesson:

"The real cost is not in purchasing materials, but in losing their value as waste"

«Successful waste management combines technical wisdom, ethical responsibility, and economic vision.»

إدارة النفايات الناجحة تجمع بين الحكمة التقنية والمسؤولية الأخلاقية والرؤية الاقتصادية

Thank you all for your attention



Best Environmental Health and Safety Jobs