Hazardous Waste Management

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Hazardous Waste

Definition of Hazardous Waste:

Any waste or combination of wastes that poses a substantial danger, now or in the future to human, animal, and plant

Characteristics of Hazardous Waste

1. Flammable

- Liquid containing less than 24% alcohol by volume and has a flash point less than 60^0 C
- Not a liquid and capable under standard temperature and pressure of causing fire through friction, absorption of moisture or spontaneous chemical changes and when ignited burns so vigorously and persistently, thus creates hazard
- An ignitable compressed gas
- An oxidizer

(Examples: Waste oils, used organic solvents, PCB-Polychlorinated biphenyls)

Characteristics of Hazardous Waste

2. Corrosive

- A solution that has a pH less than or equal to 2 or greater than or equal to 12.5
- A liquid that corrodes steel at a rate greater than 6.35 mm per year at a test temperature of 55^0C

(Examples: Strong acids, strong bases)

Characteristics of Hazardous Waste

3. Toxic

- It poses danger to human, plant, and animal health through digestion, inhalation or surface contact

(Examples: DDT-dichlorodiphenyltrichloroethane, dioxins)

Characteristics of Hazardous Waste

4. Unstable/reactive

- It is normally unstable and readily undergoes violent changes without detonating.
- It forms potentially explosive mixture with water.
- When mixed with water, it generates toxic gases, vapor or fumes in a quantity sufficient to present danger to human health and the environment.
- Capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

(Examples: Cyanide solvents, explosives)

Examples of Industrial Hazardous Wastes

Acids	• Sources : Petroleum & chemical industries, incinerator ash
Cyanide	• Sources : Metal and chemical industries
Arsenic	• Sources : Glass manufacturing processes, pesticides
Cadmium	• Sources : Paint and plastic industries, battery manufacturers

Examples of Industrial Hazardous Wastes

Lead	• Sources : Electronic industry
Infectious waste	• Sources : Hospitals, clinics
Organic solvent	• Sources : Plastic, adhesive, cosmetic industries
Radio-active waste	• Sources : Nuclear power plant

Domestic / Household Hazardous Waste

1. Batteries (lithium, nickel cadmium, or button cell batteries) - corrosive, toxic
2. Automotive wastes - used oil - flammable, toxic
3. Empty insecticide spray can – unstable, toxic
4. Mercury-containing wastes (thermometers, switches, fluorescent lighting, etc)-toxic
5. Unused drug or medicine - toxic
6. Floor detergents – corrosive, toxic
7. Cigarette lighters – flammable

Domestic / Household Hazardous Waste

8. Paint and solvent
9. Pesticides (insecticides, herbicides, fungicides, etc.) –toxic
10. Electronics (computers, televisions, cell phones)
11. Radioactive waste (some home smoke detectors are classified as radioactive waste because they contain very small amounts of a radioactive isotope of americium (radioactive metallic element).

Hazardous Waste Management

Reduce the amount of hazardous waste generated

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'Waste exchange method' – one factory's hazardous waste can be utilized by another factory

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Detoxify and **neutralize** liquid hazardous waste by chemical and biological treatment

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Destroy combustible hazardous waste in high temperature incinerators equipped with proper pollution control systems

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Recycle metals or others useful materials contained in hazardous waste

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Disposal of hazardous waste in secure landfills, injection pits or underground vaults

Secure Landfill

- Secure landfills are those where hazardous waste is disposed of by burial, in holes or trenches in ground lined with impervious plastic sheeting to prevent leakage or leaching of dangerous substances into soil and water supply.

- The landfill must have at least 3 metres (10 feet) of separation between the bottom of the landfill and the underlying bedrock or groundwater table.

Secure Landfill (Cont')

- Land filling of hazardous solid or containerized waste is regulated more stringently than land filling of municipal solid waste.

- A secure hazardous-waste landfill MUST have two impermeable liners and leachate collection systems. The double leachate collection system consists of a network of perforated pipes placed above each liner.

Secure Landfill (Cont')

- A groundwater monitoring system that includes a series of deep wells drilled in and around the site is also required. The wells allow a routine program of sampling and testing to detect any leaks or groundwater contamination.

Treatments at Secure Landfill

Physical Treatment

- Involve process such as concentrates, solidifies, or reduces the volume of the waste.
- Physical processes include evaporation, sedimentation, flotation, and filtration.
- Solidification - encapsulating the waste in concrete, asphalt, or plastic. Encapsulation produces a solid mass of material that is resistant to leaching.
- Waste can also be mixed with lime, fly ash, and water to form a solid, cement like product.

Treatments at Secure Landfill

Biological Treatment (Bioremediation)

- Used for treating certain organic wastes, eg: waste from the petroleum industry

- Landfarming.
  - The waste is carefully mixed with surface soil on a suitable tract of land.
  - Microbes that can metabolize the waste may be added, along with nutrients. In some cases a genetically engineered species of bacteria is used.

Chemical Treatment

- Chemical methods include ion exchange, precipitation, oxidation and reduction, and neutralization.

Treatments at Secure Landfill

Thermal Treatment

- Thermal methods is high-temperature incineration
- Able to detoxify certain organic wastes and also can destroy the substances.
- Special types of thermal equipment are used for burning waste in either solid, liquid, or sludge form.
- Eg: The fluidized-bed incinerator, multiple-hearth furnace, rotary kiln, and liquid-injection incinerator.
- Problem posed by hazardous-waste incineration is the potential for air pollution.

Deep-well Injection

- A procedure that involves pumping liquid waste through a steel casing into a porous layer of limestone or sandstone.
- High pressures are applied to force the liquid into the pores and fissures of the rock, where it is to be permanently stored.
- The injection zone must lie below a layer of impervious rock or clay, and it may extend more than 0.8 km (0.5 mile) below the surface.

Deep-well Injection

- Deep-well injection is relatively inexpensive and requires little or no pretreatment of the waste, **BUT** it poses a danger of leaking hazardous waste and eventually polluting subsurface water supplies.

THE END