Definition and Sources of Hazardous Waste

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Hazardous Waste

- Is a waste material that has the potential to harm life forms and the environment.
- Waste material that everyone wants picked up but no one wants put down.
- Hazardous material is not a hazardous waste until it is no longer useful, or has been abandoned or discarded.
- Example: toxic chemical (benzene) is not a hazards waste until it becomes part of waste stream from which it cannot be separated for reuse.

- There is a difference between hazardous substance and a hazardous waste.
- Solid waste: any discard material that is not specifically excluded by the regulation or excluded by granting of a special variance by the regulatory agency.
- Discarded material is considered abandoned, recycled, or inherently waste like.

EPA Definition

- The EPA considers a waste to be hazardous if:

1. It process certain characteristics (ignitibility, corrosivity, reactivity, or toxicity)

2. It is on a list of specific wastes that are determined by the EPA to be hazardous

- According to the EPA, a solid waste will be considered hazardous if it meet any of the following four criteria:

1. It is a listed waste, i.e., the waste material is listed as a hazardous waste in Code of Federal Regulations (CFR 40 (CFR), part 261. http://www.epa.gov/epahome/cfr40.htm
2. It is a characteristic waste, meaning that it exhibits any of the following characteristics, ignitibility, corrosivitiy, reactivity, or toxicity (ICRT)
3. It is a mixture containing both hazardous and non hazardous waste.
4. It is not specifically excluded from regulation as a hazardous waste. (Table 1)

Excluded Hazardous Wastes

1. Domestic sewage
2. Any mixture of domestic sewage and any other waste that passes through a sewer system to a publicly owned treatment works (POTW)
3. Irrigation return flows
4. Source, special nuclear, or by-product material as defined by the Atomic Energy Act (AEA)
5. Materials subjected to in situ mining techniques that are not removed from the ground during extraction
6. Certain pulping liquors used in the production of paper
7. Spent sulfuric acid used to produce virgin sulfuric acid
8. All household wastes and resource recovery facilities that burn only household waste (Hotel, motel, septic sewage, and campground wastes are all considered household waste.)
9. Materials returned to the soil as fertilizers, such as manure and crops
10. Mining overburden returned to the mine site
11. Fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels (the "utility waste exemption")
12. Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy
13. Specific wastes from the tannery industry containing primarily trivalent chromium instead of hexavalent chromium
14. Solid waste from the extraction and beneficiation of ores and minerals, including phosphate rock overburden from uranium mining (the "mining waste exclusion," or the Bevill Amendment)
15. Cement kiln dust
16. Discarded wood that fails only the Characteristic Toxicity Test (a test to determine if a waste exhibits a hazardous characteristic) for arsenic as a result of being treated with arsenical compounds

- The second category of listed wastes includes those generated by specific sources.
- These are designated by the letter K and come from various industrial materials and processes: metal processing, wood preservation, petroleum products, acids and caustic, pesticide related chemicals.
- The third category of listed waste includes commercial chemical products. These are designated by later P or U. The P wastes are acutely hazardous (contain chemicals that are fatal to human in small doses) and are subjected to more stringent for empty containers and quantity limits

- Example: 1 kg of acute hazardous waste; 1000 kg for nonacute hazardous waste.
- All P series wastes, F020-F023 and F026-F028 are acutely hazardous.
- U series wastes are non acutely hazardous.

- F- Series: include hazardous wastes from nonspecific sources (e.g. halogenated or nonhalogenated solvents, cyanide solution from plating batches. These are commonly produced from manufacturing and industrial processes.
- K – Series: from specific source
- P Seies:

Characteristic of Ignitibility

- Wastes exhibit this characteristic if…

Ignitibility relates to the potential of waste material to cause fire during storage, disposal, or transported.

It is a liquid(other than an aqueous solution containing less than 24% alcohol, and has a flash point less than 140 degrees f.

It is not a liquid and is capable under STP of causing a fire through friction, absorption of moisture, or spontaneous changes and, when ignited burns so violently that it creates a hazard.

It is a ignitable compressed gas as defined in 49 CFR 173.300.

It is an oxidizer as defined in 49 CFR 173.151.

Wastes that exhibit the characteristic of ignitability have the EPA waste code of D001.

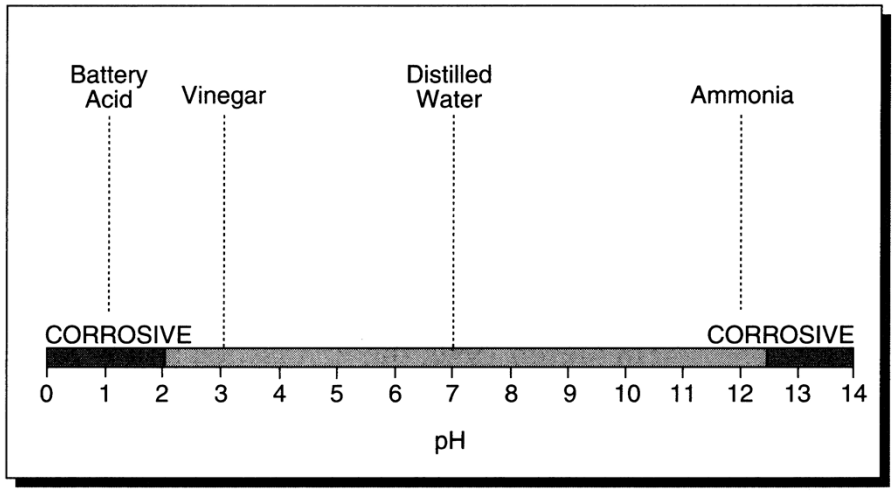
Characteristic of corrosivity

Wastes exhibit this characteristic if…

It is a liquid and has a pH less than or equal to 2 or greater than or equal to 12.5.

It is a liquid and corrodes steel(SAE 1020) at a rate greater than 0.25 inches per year at 130 degrees f.

Wastes that exhibit the characteristic of corrosivitiy have the EPA waste code D002.



pH range of corrosivity

Characteristic of reactivity

Wastes exhibit this characteristic if…

- It is normally unstable and readily undergoes violent change without detonation.
- It reacts violently with water.
- It forms explosive mixtures with water.
- When mixed with water, it generates toxic gasses, fumes, or vapors.
- It is a cyanide or sulfide bearing waste, which when exposed to corrosive conditions, can generate toxic gasses, fumes, or vapors.

Reactivity (continued)

- It is readily capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

- It is a forbidden explosive as defined in 49 CFR 173.51, or a Class A explosive as defined in 49 CFR 173.53, or a class B explosive as defined in 49 CFR 173.88.

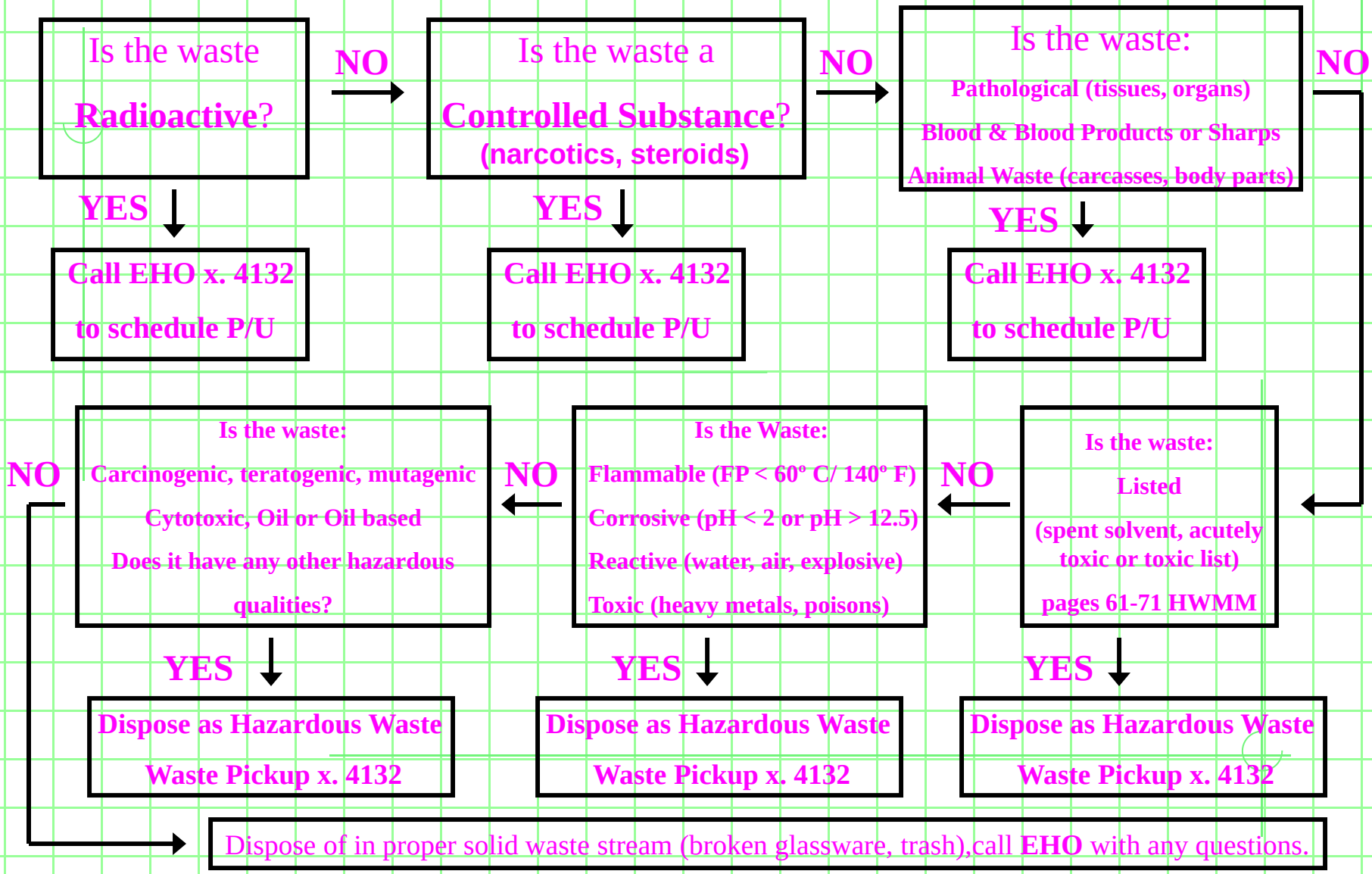
- Wastes that exhibit the reactivity characteristic have the EPA waste code D003.

Toxicity Characteristic

Waste exhibits this characteristic if…

- A sample of the waste, using the Toxicity Characteristic Leaching Procedure, the extract from a representative sample of the waste contains any of the contaminants listed in table I at the concentration equal to or greater than the respective value given in the table.
- Wastes exhibiting the toxicity characteristic have the waste codes D004-D043.

Hazardous Waste



Hazardous Waste Identification

Generators are required to Accurately determine if the wastes they generate are hazardous.

1. Determine if waste is excluded.
2. Determine if the waste is listed.
3. If waste is not listed, test it or apply knowledge of the hazard characteristics.
4. If it is hazardous, refer to parts 261, 264, 265, 266, 268, & 270 for possible exclusions.
5. Determine if waste is a special waste as designated by the state in appendix XI of 261.

Excluded wastes

- Domestic sewage.
- NPDES regulated wastewaters.
- Secondary materials that have been reclaimed & returned to original process.
- Certain wood preserving solutions.

Listed Wastes

- Hazardous wastes from non-specific sources.

Example: Spent solvents, wastewater treatment sludge from plating operations. Hazardous wastes from non-specific listed sources are F-listed.

- Hazardous waste from specific sources.

Example:Pink/red water from TNT operations(K047), or Emission control dust /sludge from the primary production of steel in electric furnaces(K061). Hazardous wastes from specific sources are K-listed.

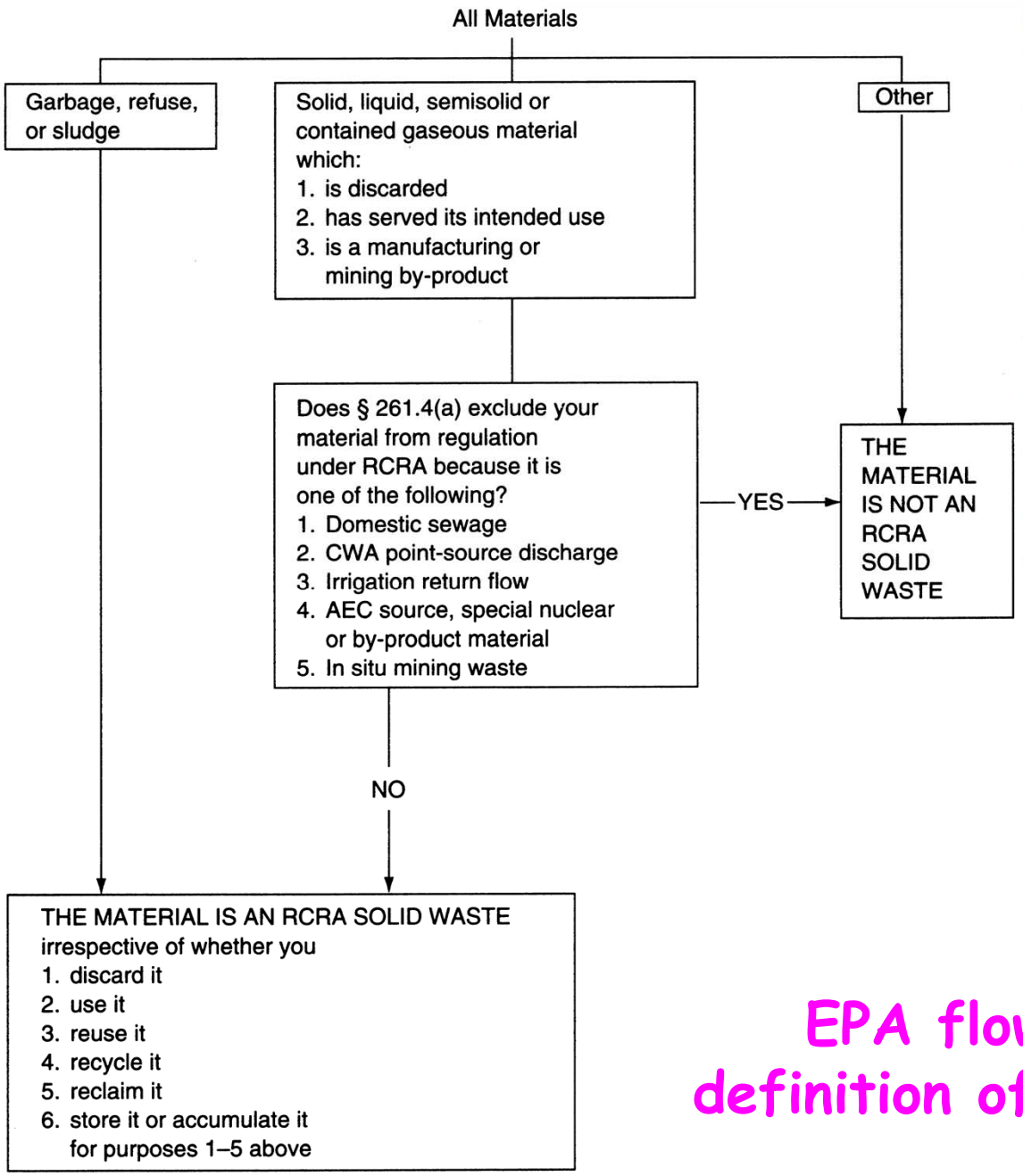
Listed wastes(continued)

- Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof.

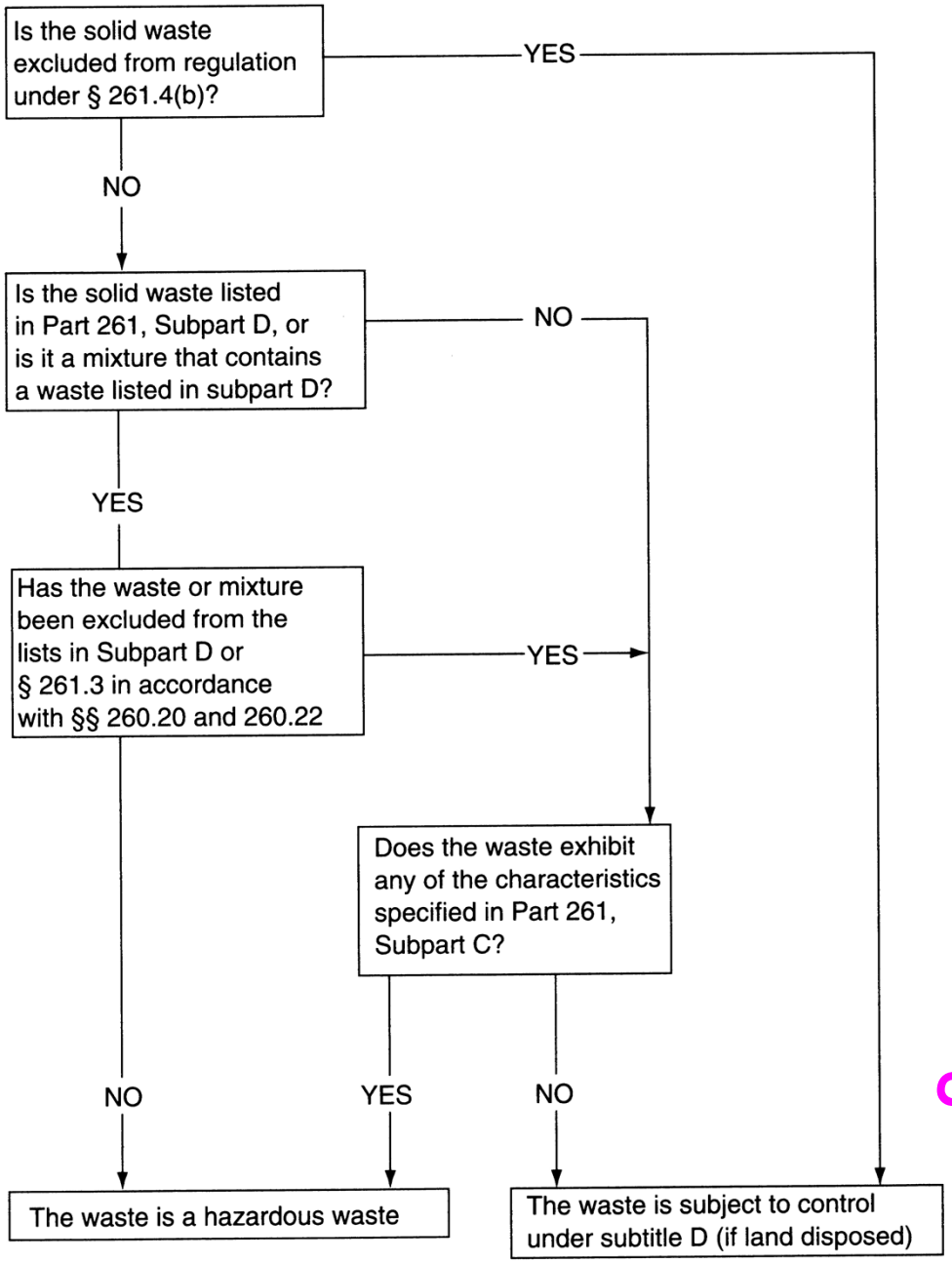
Examples: A container of Dimethoate (P044)that has exceeded shelf life or a drum of copper cyanide (P029) that you no longer intend to use. These types of waste are P-listed.

- Listed toxic wastes.

Examples: Acetone(U002), or xylene(U239). These toxic wastes are U-listed.



EPA flowchart for definition of a solid waste



EPA flowchart for definition of a solid waste

Sources and Generated of Hazardous Wastes

- In the process of producing goods and services, we also generate wastes, and in many cases these wastes are hazardous.
- The major industries that generate hazardous wastes in developed countries include:

A. Petrochemical industry: Phenols, metals, acids, caustics and organic compounds

B. Metal Industry: Heavy metals, fluorides, cyanide, acids alkali

C. Leather industry: Heavy metals and sulfides

Philosophy and Approaches to Hazardous Waste Management

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Introduction

- The philosophy and approach to management of solid and hazardous waste have undergone many changes overtime.
- These changes reflect the level of industrialization, societal attitudes, and population trends.
- *Dilute and disperse philosophy*…. During the first century (1760-1860)
- *Concentrate and contain*…….Industrial revelation ….During the second century.

- During the 1970s and early 1980s …… conservation and recycling philosophy.
- The amount of hazardous waste generated has gone up over the years, and its toxicity has attained high levels.
- The current emphasis is on pollution prevention.
- Pollution prevention: any practice that results in the *reduction or elimination* of any pollutant prior to recycling, treatment or disposal.

Chemical of concerns to the EPA (1991)

Targeted for Immediate Reduction

Metals
- Cadmium
- Chromium
- Lead
- Mercury
- Nickel

Chlorinated Compounds
- Carbon tetrachloride
- Chloroform
- Dichloromethane
- Tetrachloroethylene
- Trichloroethane
- Trichloroethylene

Other Toxic Compounds
- Benzene
- Cyanide
- Toluene
- Xylene
- Methyl ethyl ketone
- Methyl isobutyl ketone

Other Chemicals of Concern
- Acrylonitrile
- Arsenic
- Carbon disulfide
- Ethylene disulfide
- Formaldehyde
- Styrene
- Vinyl chloride

Pesticides
- Alachlor
- Carbaryl
- Captan
- Chlorpyrifos
- 2,4-Dichlorophenoxyacetic acid

Integrated Waste Management

- Is the current waste management philosophy and incorporates various options available for effective management of hazardous waste.
- It include the following components:
  - Source reduction, include elimination and substitution of toxic materials at the source
  - Recycling, includes recovery, reuse and treatment
  - Residual disposal, component of the waste stream left after recycling, which has to be disposed

- The following represent the preferred order, based on the potential impact on the environment from a particular method of disposal:

Pollution Prevention — Highest Priority

Recycling

Treatment

Disposal — Lowest Priority

- There is differences between entire manufacturing process and the end of the pipeline approach.

- The difference between the two is that an integrated philosophy allows for elimination, substitution and reduction of hazardous materials at various stages of the manufacturing process, while the end of the pipeline approach is devoid of these options and offer no choice other than to accept and manage the waste that is generated as a result of the process.
- Integrated waste management involves :
  - Identified which step of the process generate hazardous waste
  - Exploring ways to eliminate or minimize the waste

Incentives for Waste Reduction

- Federal law requires all generators of hazardous waste to implement methods to reduce or eliminate hazardous waste.
- In addition to the legal requirements, there are many reasons why a manufacturer should seek to minimize waste generation.
- These incentives could be grouped under:
  - Economic
  - Regulatory
  - Liability
  - Public relations

Economic Incentives

- Economic Incentives include:

1. Tax breaks
2. Savings on cost of land disposal
3. Avoiding expensive alternative treatment
4. Saving in cost of raw materials
5. Manufacturing cost savings

- $5 to $100/ton
- Hazardous waste more than $250/ton
- Incineration is between $500 and $1500/ton

Regulatory Incentives

- Resource Conservation and Recovery Act (RCRA) and other waste management acts require the generators of hazardous wastes to establish certification and reporting programs.
- By adopting a waste minimization policy, the generator fulfills these legal requirements.
- Another legal requirements is certification by the generator, on the hazardous waste manifest, that a waste minimization program in place.
- Another regulatory measure includes:
  - Biennial waste minimization program reporting
  - Stricter permitting requirements for waste handling and treatment
  - Land disposal restriction and bans

TABLE 6–2 Concentration Limits for Selected Chemicals in Wastewater and Nonwastewater (40 CFR, 1992)

Constituent	Wastewaters (mg/L)	Nonwastewaters (mg/kg)
Acetone (F039)	0.28	160
Chloroform (K009–K010)	0.10	6.0
Total Cyanides (F011–F012)	1.9	110
Cyclohexane (U057)	0.36	NA
Dimethyl phthalate (U102)	0.54	28
Mercury (K071)	0.030	NA
Toluene (U220)	0.080	28
Xylenes (U239)	0.32	28

Liability

- Potential reduction in the generator's liability for environmental problems at both on site and off site treatment, storage and disposal facilities is anther powerful incentive for pollution prevention.

Public Image and Environmental Concern

- Administrative incentives for pollution prevention result in a better public image of the company
- These incentives well accepted by employees, resulting in increased productivity.
- Finally these incentives enable the company to project a positive expression on its concern for the environment.

Waste Minimization Techniques

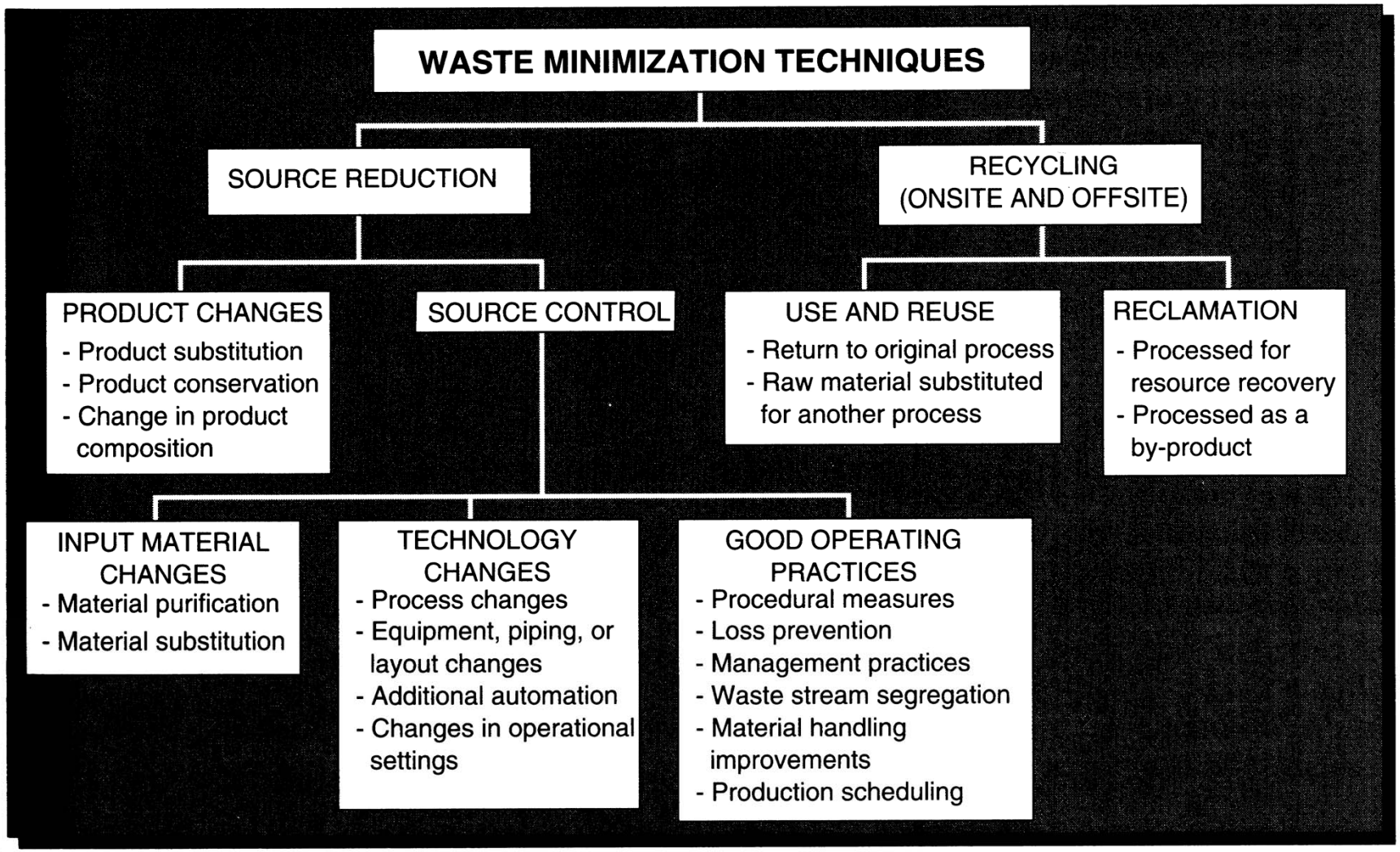

FIGURE 6–1 Waste minimization techniques (adopted from U.S. EPA, 1988)