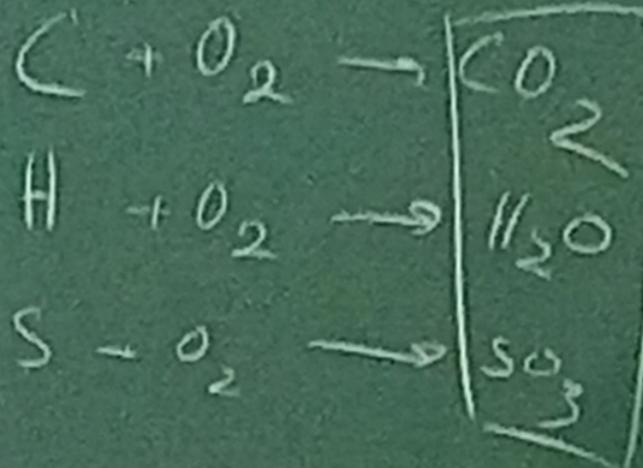


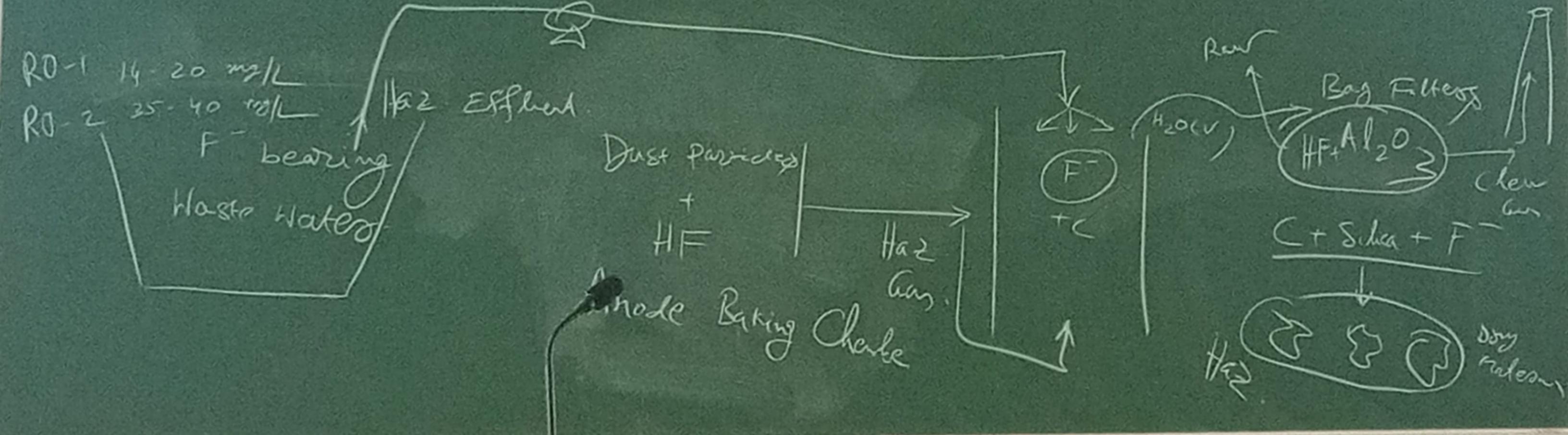
HAZARDOUS WASTE TREATMENT AND PROCESSING

Hazardous waste treatment technologies modify the physical and/or chemical properties of the waste.

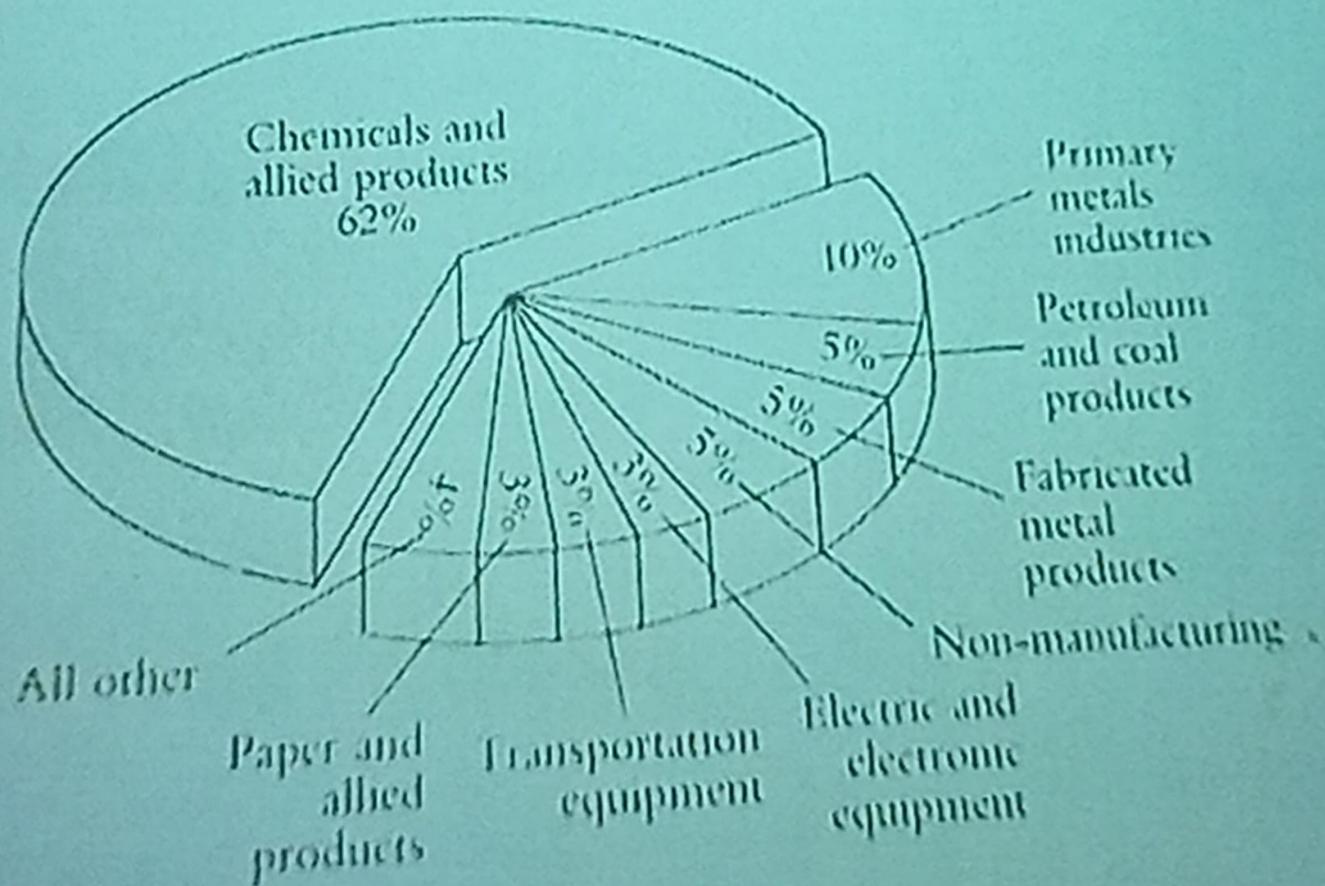
Ignitable Materials

H/C

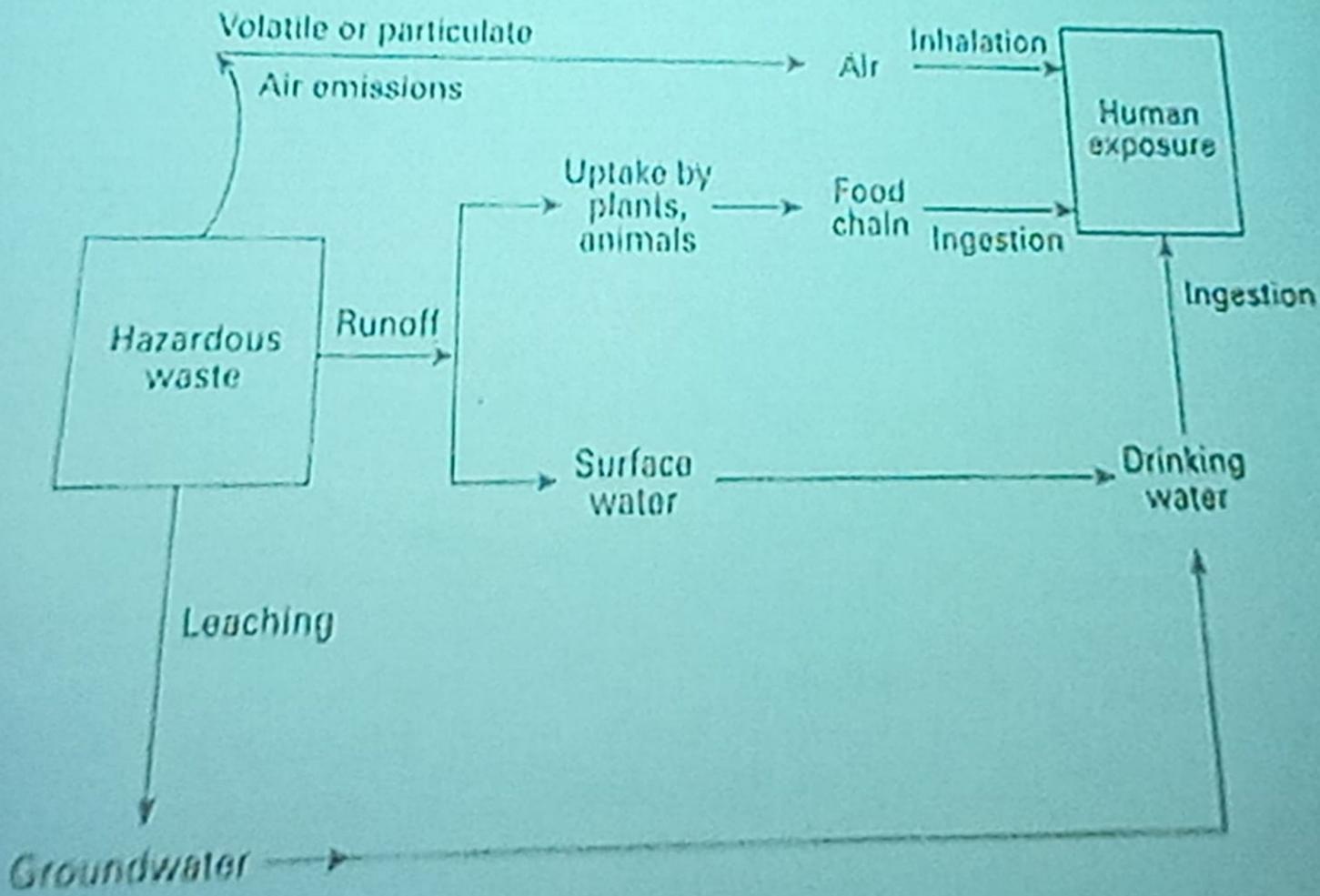




CONTRIBUTION OF HAZARDOUS WASTE GENERATION



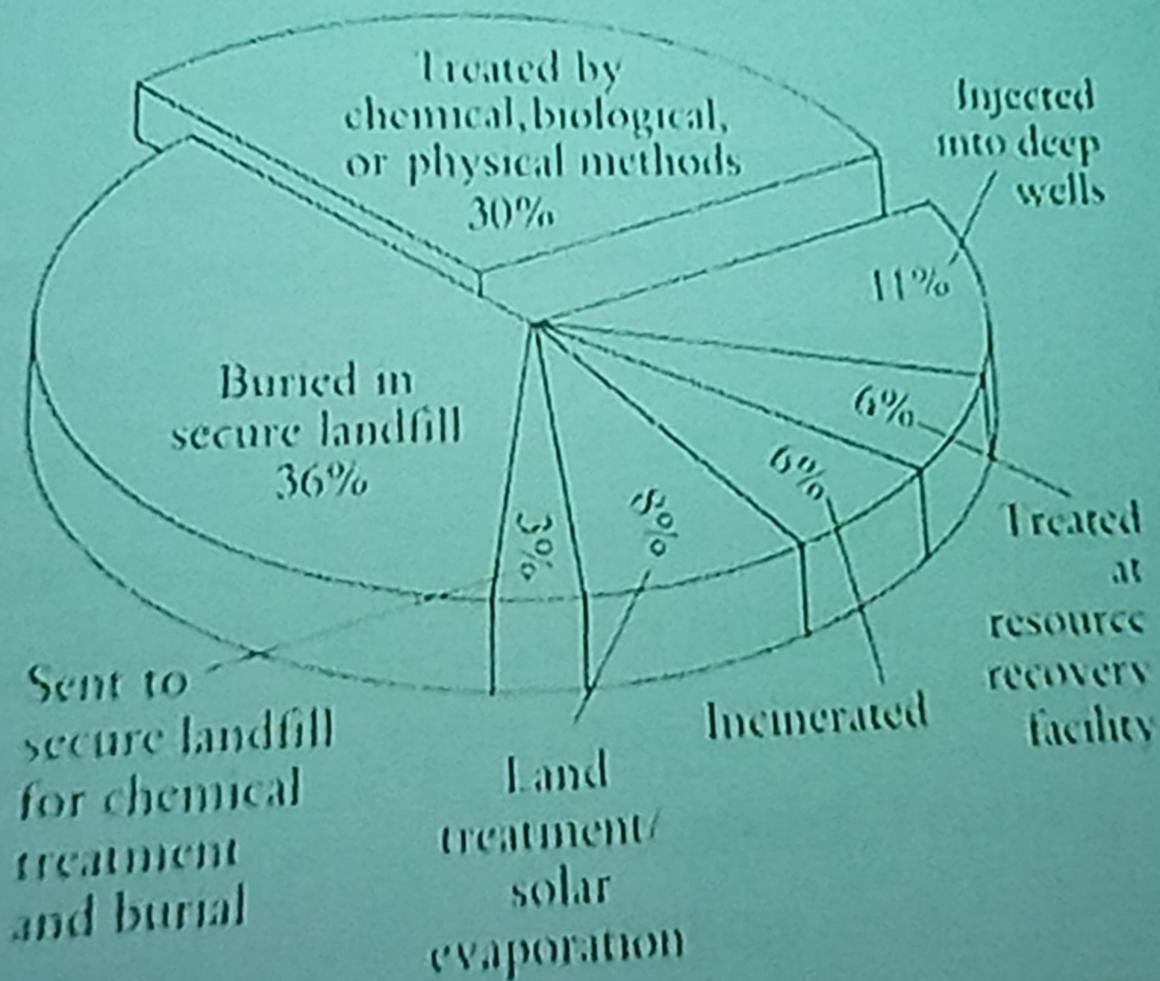
PATHS OF HAZARDOUS WASTE TRANSMISSION



Processing & Treatment Technologies

- Physical Processes
- Chemical Processes
- Biological Processes
- Integrated Processes

TREATMENT METHODS AND DISPOSAL



Waste Oil & Antifreeze

START HERE

Is the waste:
an Oil or Antifreeze?

YES

Is your waste:

- Motor Oil
- Automatic Transmission Fluid
- Power Steering Fluid
- Diesel Fuel
- Gear Oil
- Turbine Engine Oil
- Hydraulic Oil
- Fuel Oil
- Kerosene

NO

Is your waste?

- Ethylene Glycol based Antifreeze
- Coolant from Chillers / HVAC systems
- Propylene Glycol based Antifreeze (freeze protection > 0o F)

NO

Is your waste?

- Any type of oil contaminated with a hazardous chemical
- Chlorinated Solvents
- Metal working fluids
- Degreasing solvents
- Freon and Freon contaminated refrigeration oil
- Naphtha
- Transformer Oil
- Brake Fluid
- Radiator Flush
- Detergents

NO

Continue on Special Wastes Flowchart

YES

Your waste should be recycled .

YES

YES

Your waste is a:
HAZARDOUS WASTE

Radioactive Waste

START HERE

Is this symbol (with or without wording):
displayed on the
waste or waste
container?



or

Does the waste contain any:
RADIOACTIVE MATERIAL?
Does the waste contain any isotope of an
element that undergoes nuclear
transformations omitting a form of radiation?

YES

**Your waste is a
RADIOACTIVE WASTE.**

YES

YES

Does the waste contain any:
URANIUM or THORIUM COMPOUNDS?
(i.e., uranium dicarbide, uranium dioxide, uranium hexafluoride,
uranium hydride, uranium monocarbide, uranium tetrafluoride,
uranocene, Uranyl acetate, uranyl nitrate or thorium
acetylacetone, thorium carbide, thorium chloride,
thorium dioxide, thorium disulfide, thorium fluoride,
thorium nitrate, thorium oxalate, thorium sulfate)

or

Is the waste a:
**Self-illuminated Exit Sign? Smoke Detector?
Electron Capture Detector (ECD) or Static Eliminator?**

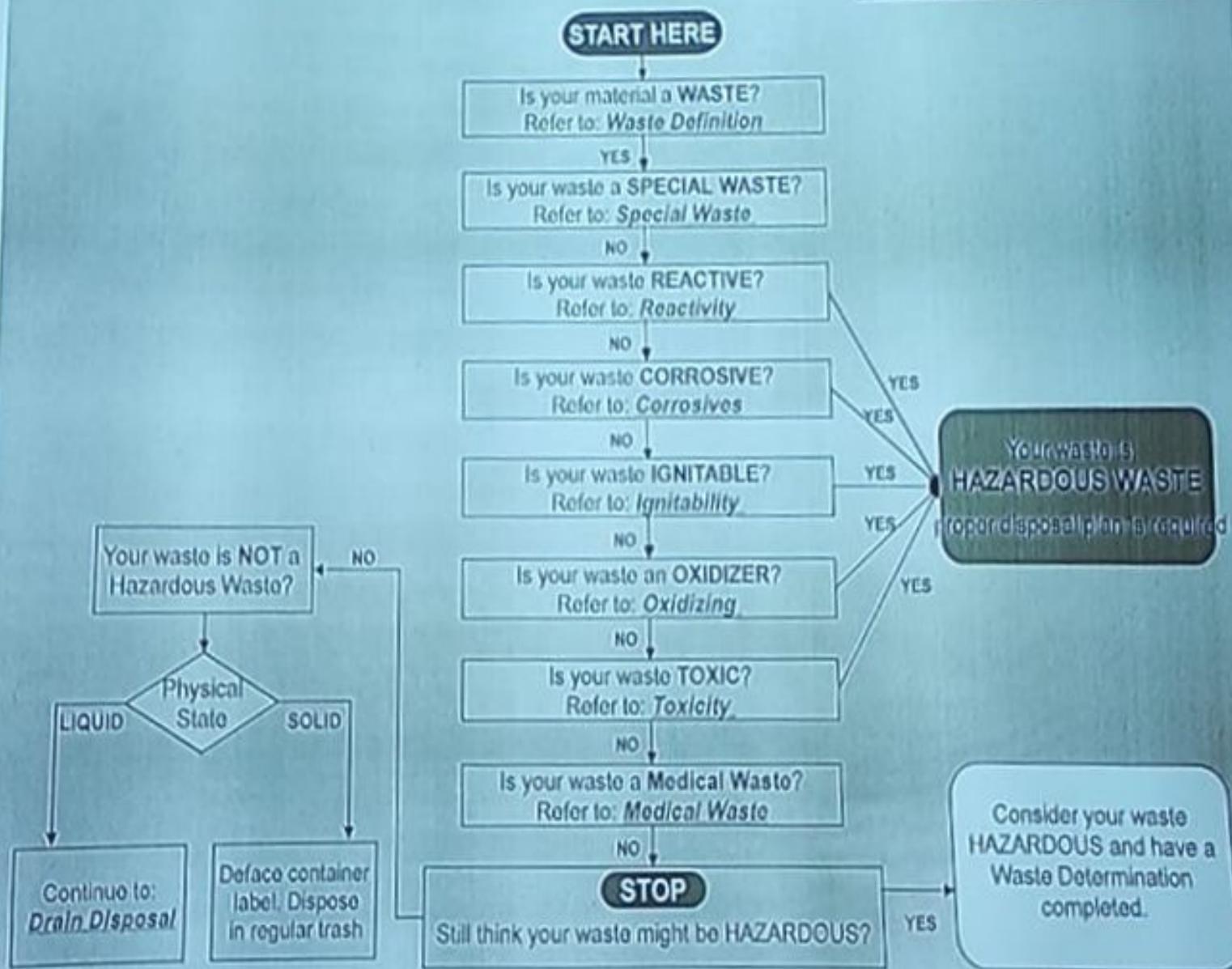
YES

**Your waste MAY BE a
RADIOACTIVE WASTE.**

NO

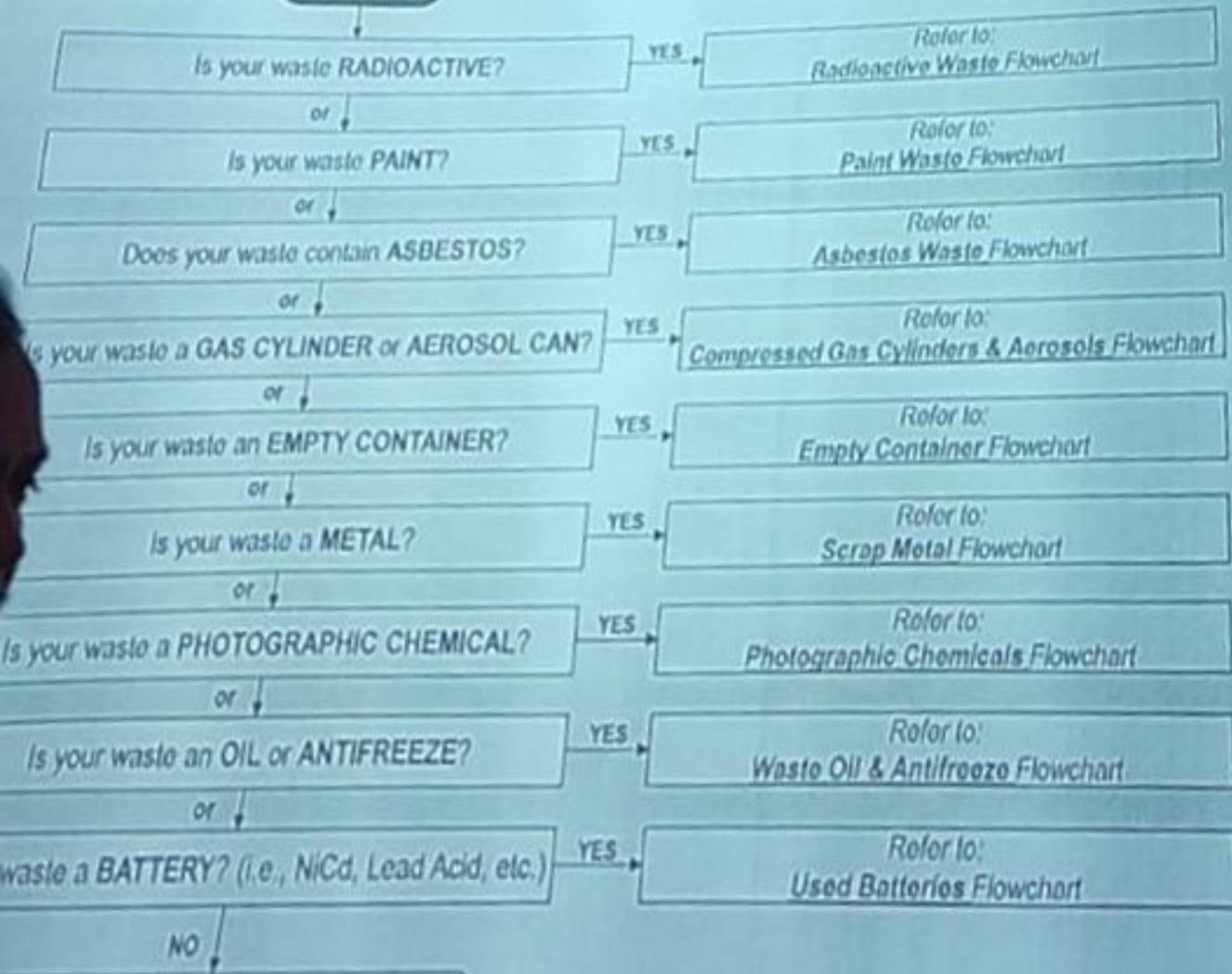
Your waste is NOT a RADIOACTIVE WASTE.
Continue on *Special Wastes Flowchart*.

Master Flowchart

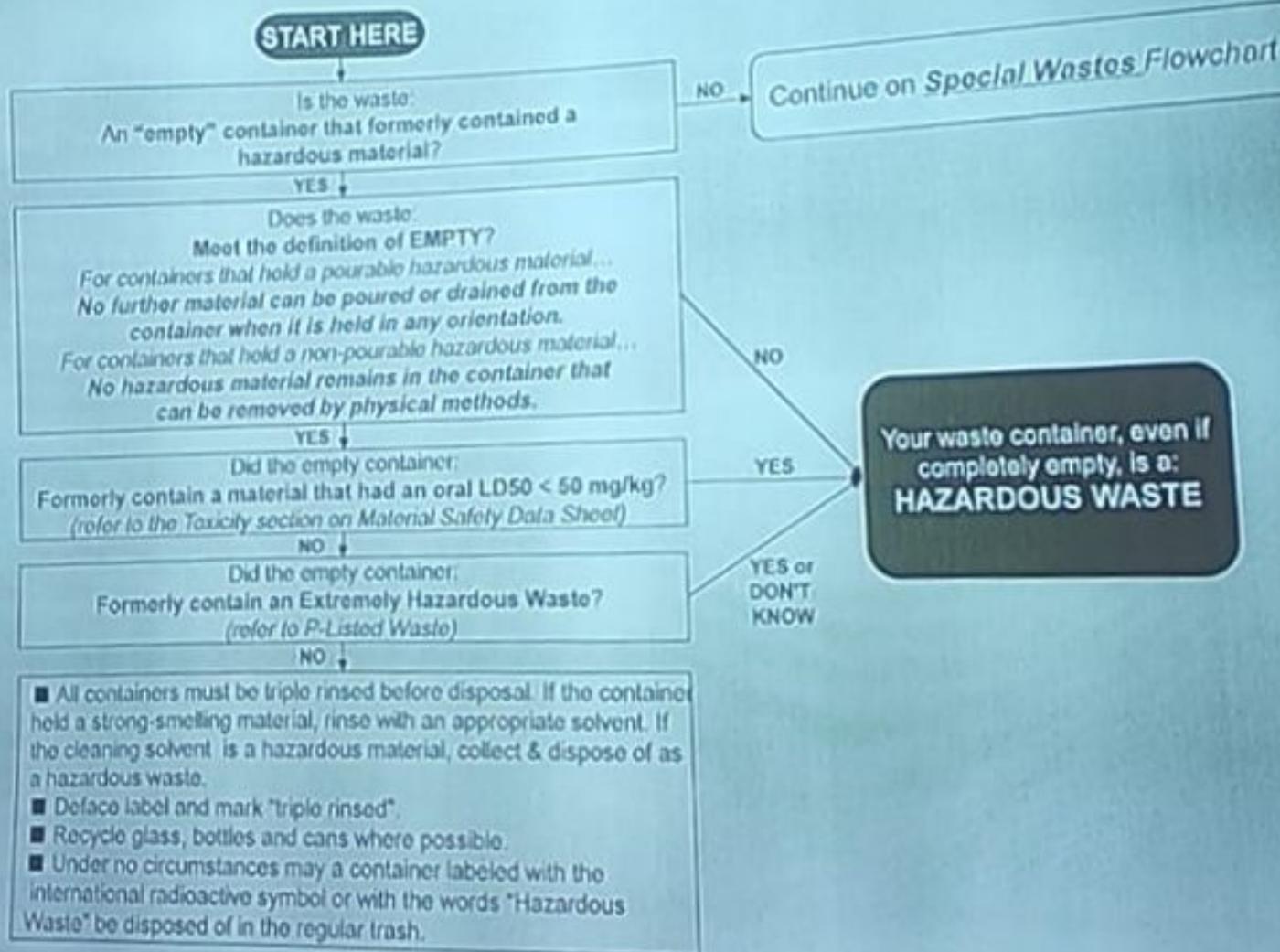


Special Waste

START HERE



Empty Containers

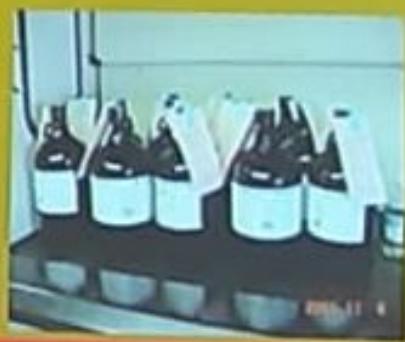




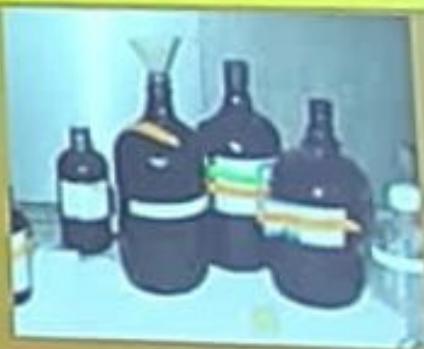
Improperly stored hazardous waste. No labels, no secondary containment, no segregation, and containers are covered with residue



Properly Stored Hazardous Waste. It is labeled, segregated by compatibility, stored in secondary containment, and in an isolated area.



Improperly Stored Hazardous Waste
No secondary containment from hood drain,
storage in high traffic area.



Improperly Stored Hazardous Waste
No label, no secondary containment,
and container not sealed properly (open funnel).

HAZARDOUS WASTE LABELING

- ❖ All waste containers must be clearly labeled with the following:
- ❖ The words "HAZARDOUS WASTE"
- ❖ Contents of the hazardous waste container (composition of the waste)
- ❖ Physical state of the waste (i.e. solid or liquid)
- ❖ The hazardous property of the waste (i.e. flammable, corrosive, reactive, toxic)
- ❖ The date the material became a waste or the date waste was first added to the waste collection container
- ❖ The person and shop/area that generated the waste

Quick Facts About Hazardous Waste Storage

- ❖ Store hazardous waste in sealed, compatible containers.
- ❖ Hazardous waste containers must be kept closed at all times except to add waste.
- ❖ Label hazardous waste containers with VEHS chemical waste tags as soon as waste accumulation begins.
- ❖ Store hazardous wastes with secondary containment.
- ❖ Segregate incompatible hazardous wastes.
- ❖ Never accumulate more than 55 gallons of hazardous waste or one quart of acute hazardous waste.
- ❖ Ensure that lab personnel are trained on proper waste handling procedures.

MIXING HAZARDOUS WASTES

- ❖ Hazardous wastes should be kept separate whenever possible. Mixing a hazardous waste with a non-hazardous waste can increase the volume of hazardous waste for disposal and increase disposal costs due to differences in disposal options for certain hazardous wastes.
- ❖ For instance, halogenated solvents such as methylene chloride and chloroform are more costly to dispose of than non-halogenated solvents such as hexane and xylene; therefore, halogenated solvent wastes should be kept separate from non-halogenated solvent wastes.

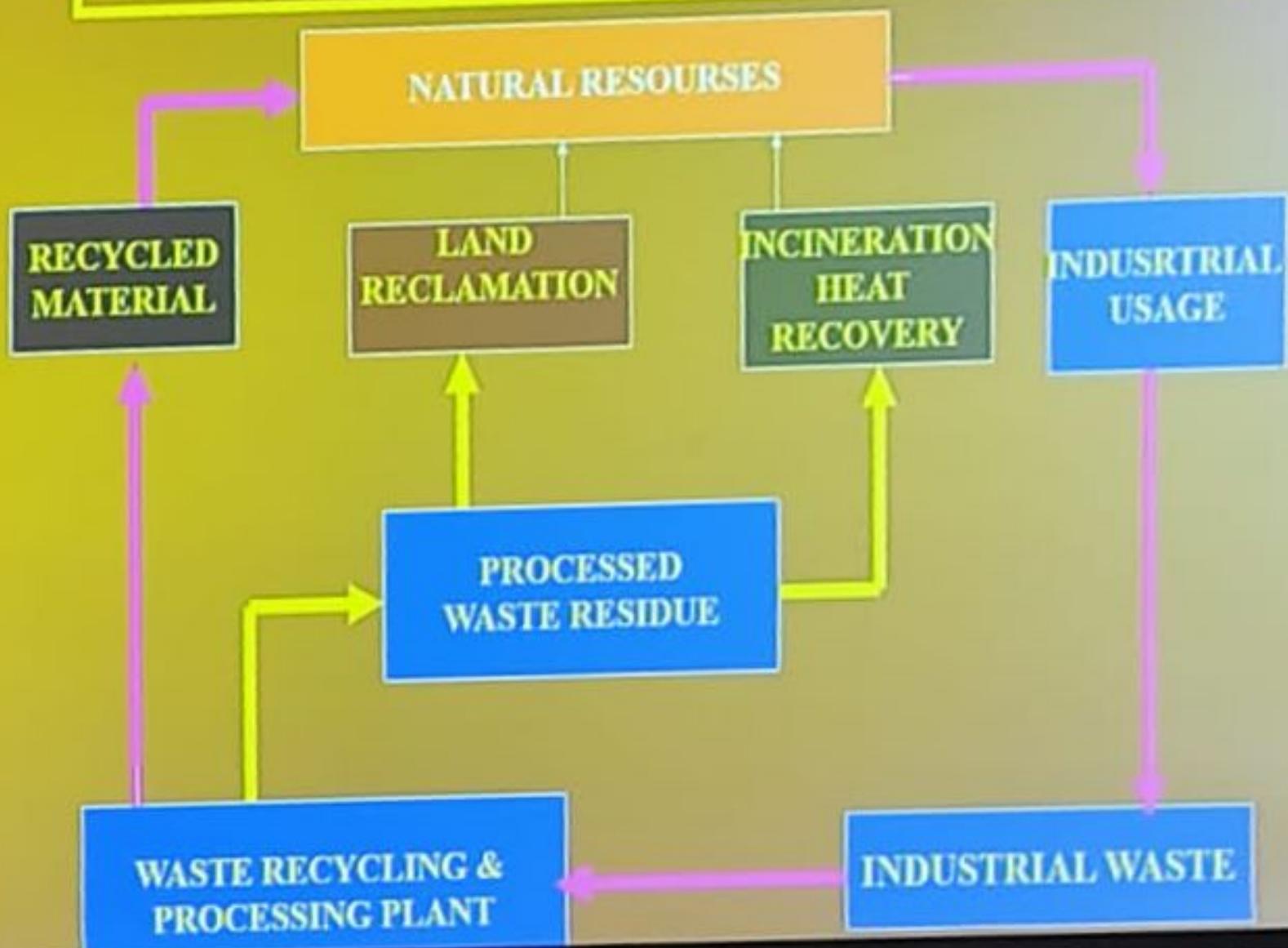
LABELING HAZARDOUS WASTE CONTAINERS

- ❖ Hazardous waste containers must be labeled with hazardous chemical waste tags as soon as the container is used to collect hazardous waste.
- ❖ These tags information including name, telephone no, building, room no, and exact contents of the container.
- ❖ Include information about the contents of the hazardous waste container, including percentages and water content.
- ❖ If a container is being used to collect hazardous waste intermittently, the tag should be filled out immediately upon use of the container and must be edited as more waste is added. A separate tag must accompany each individual hazardous waste container. Old labels that do not accurately describe the contents of the waste container must be defaced

Regulation Governing Generators of Hazardous Waste

- Preparation for Transport
- Manifest Requirements
- Record keeping and Reporting

HAZARDOUS WASTE SALVAGE & RECOVERY



CONDITION OF CONTAINER

- Containers that are deteriorating (e.g. cracked or rusted) or leaking must not be used. Waste stored in defective containers must be transferred to containers in good condition or handled in another ways that satisfies the requirements.
- Containers used to store hazardous waste must be made of or lined with materials that will not react with and are otherwise compatible with the waste in the container. In compatible wastes and materials must not be placed in the same container.

COMPABILITY WITH WASTE

The term incompatible waste refers to a hazardous waste which is unsuitable for :

- ❖ Placement in a container because it may cause corrosion or decay of the container or inner liner.
- ❖ Commingling with another waste or material under uncontrolled conditions because it might produce heat or pressure, fire or explosion, violent reaction, toxic dusts, mists, fumes or gases, or flammable fumes or gases.
- ❖ Incompatible wastes or materials can only be mixed in a manner that will not cause an adverse reaction, such as an explosion or uncontrolled flammable fumes

CONTAINERS

Containers represent one of the most commonly used and diverse forms of hazardous waste storage.

- As compared to tanks or surface impoundments, containers are less expensive and generally less difficult to manage.
- Containers are also mobile allowing an owner/operator to use only one unit for storage, transportation and disposal.
- Prior to regulation under RCRA, however containers are frequently mismanaged or abandoned. When the abandoned containers became weathered or corroded, the hazardous contents were released, posing a far reaching threat to human health and the environment.

SEALING HAZARDOUS WASTE CONTAINERS

Hazardous waste containers must be sealed to prevent leakage or spillage. Containers should be sealed with a screw-type lid or other appropriate device. Plastic wrap, aluminum foil, and other make-shift lids are unacceptable. A container holding hazardous waste must **ALWAYS** be closed during storage, except when it is necessary to add or remove waste.

HW Disposal Facilities in India in Operation

india

0 100 200 300 400 KILO METERS
0 100 200 300 HILES

PAKISTAN

HIMACHAL
PRADESH

PUNJAB

HARYANA

Uttarakhand

DELHI

UTTAR
PRADESH

RAJASTHAN

07 TSDF

MADHYA
PRADESH

02 TSDF

01 TSDF

CHINA

NEPAL

TIBET

SIKKIM

DHUTAN

ARUNACHAL
PRADESH

ASSAM

MEGHALAYA

BANGLA
DESH

TRIPURA

ORISSA

WEST
BENGAL

MIZORAM

BURMA

ARABIAN
SEA

LAKSHA
DHEEP

GOA

KARNATAKA

KERALA

CHENNAI
MAHABALIPURAM

BAY
OF
BENGAL

ANDAMAN
AND
NICOBAR
ISLANDS

SRI
LANKA

http://india.brahma.org/hazardous_waste.htm

No. of sites Notified : 64

No. of sites Identified : 21

HW Generating Industries & HW Generation – Comparative Figures

Sr. No.	State	HW generating Industries (No.s) as per HWM Rules, 2000/2003	Total HW generation in TPA
1.	AP	1532	507046
2.	Assam	23	4,000
3.	Bihar	31	-
4.	Chandigarh	271	8,425
5.	Delhi	1777	17,000
6	Goa	49	-
7.	Gujarat	6052	12,07,000
8.	Haryana	889	14,972
9.	Himachal	575	-
10.	Karnataka	1589	92,013
11.	Kerala	423	83,530
12.	Maharashtra	4571	14,07,480
13.	MP	753	-
14.	Orissa	257	74,918
15.	J & K	207	-

MANAGEMENT OF CONTAINERS

- ◆ Containers holding hazardous waste must always be closed during storage, except when waste is added or removed. In addition, containers must not be handled, opened, or stored in a manner that may cause them to leak.
- ◆ Containers holding ignitable or reactive wastes must be located at least 15 meters(50 feet) from the facility's property line. This requirement is sometimes referred to as the buffer zone requirement, because it creates a zone of protection between waste storage and adjoining properties.

Handling hazardous wastes safely

- ❖ Shippers and carriers of hazardous wastes are also responsible for applying safety marks, such as labels, placards and signs on all containers, packages, tanks and cylinders, and on all vehicles containing hazardous wastes.
- ❖ These special marks immediately identify the type of substance and nature of the hazard.
- ❖ They also provide invaluable assistance to emergency response teams in case of an accident during the transportation of hazardous waste.
- ❖ The TDG Regulations also include a requirement to train employees in the handling of hazardous wastes.

HAZARDOUS SOLID WASTE STORAGE

- It means holding hazardous waste for a temporary period at the end of which hazardous waste is treated, disposed of, or stored elsewhere. This is generally done in tanks, surface impoundments or in containers, with the later used in most of the cases.
- A container is any potable device in which a material is stored, transported, treated or disposed of or otherwise handled.
- A container may be a 55-gallon drum made from steel or plastic, a larger tanker truck, a railroad car, a small bucket or a test tube.

CONTAINMENT

Permitted container storage areas must have a secondary containment system. Secondary containment provides a backup system to prevent release into the environment should primary containment (i.e., the container) fail. This usually consists of a poured concrete pad or other impervious base with curbing to prevent releases of hazardous waste into the environment and to allow drainage of any accumulated liquid to a sump, tank, or other container.

Why Minimize Hazardous Waste?



- Reduce risk & safe for human health, property
- Reduce costs
- Increase process efficiency and productivity
- Maintain or increase competitiveness
- Decrease exposure to long-term liability
- Reduce present and future regulatory burdens
- Improve workplace safety
- Improve environmental quality
- Accidental causality reduces & maintain or improve institutional image

START HERE



Medical Waste

Is the waste:
A fluid blood or blood product?

NO

Is the waste:
A cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid visibly contaminated with blood, biological materials in labs (etiological), unfixed human tissue or organ?

NO

Is the waste:
A culture of an agent infectious to humans?

NO

Is the waste:
Generated from the treatment or immunization of animals or humans?

NO

Is the waste:
Generated by research involving live or attenuated pathogenic organisms?

NO

Is the waste:
Used or unused sharps (i.e. hypodermic needle, scalpel, razor blades, pasteur pipettes), or any glass or plastic) contacted with infectious materials?

NO

Is the waste:
Generated from work involving recombinant DNA?

NO

Is the waste:
Blood, tissue samples, organs, cadavers from infected experimental animals?

NO

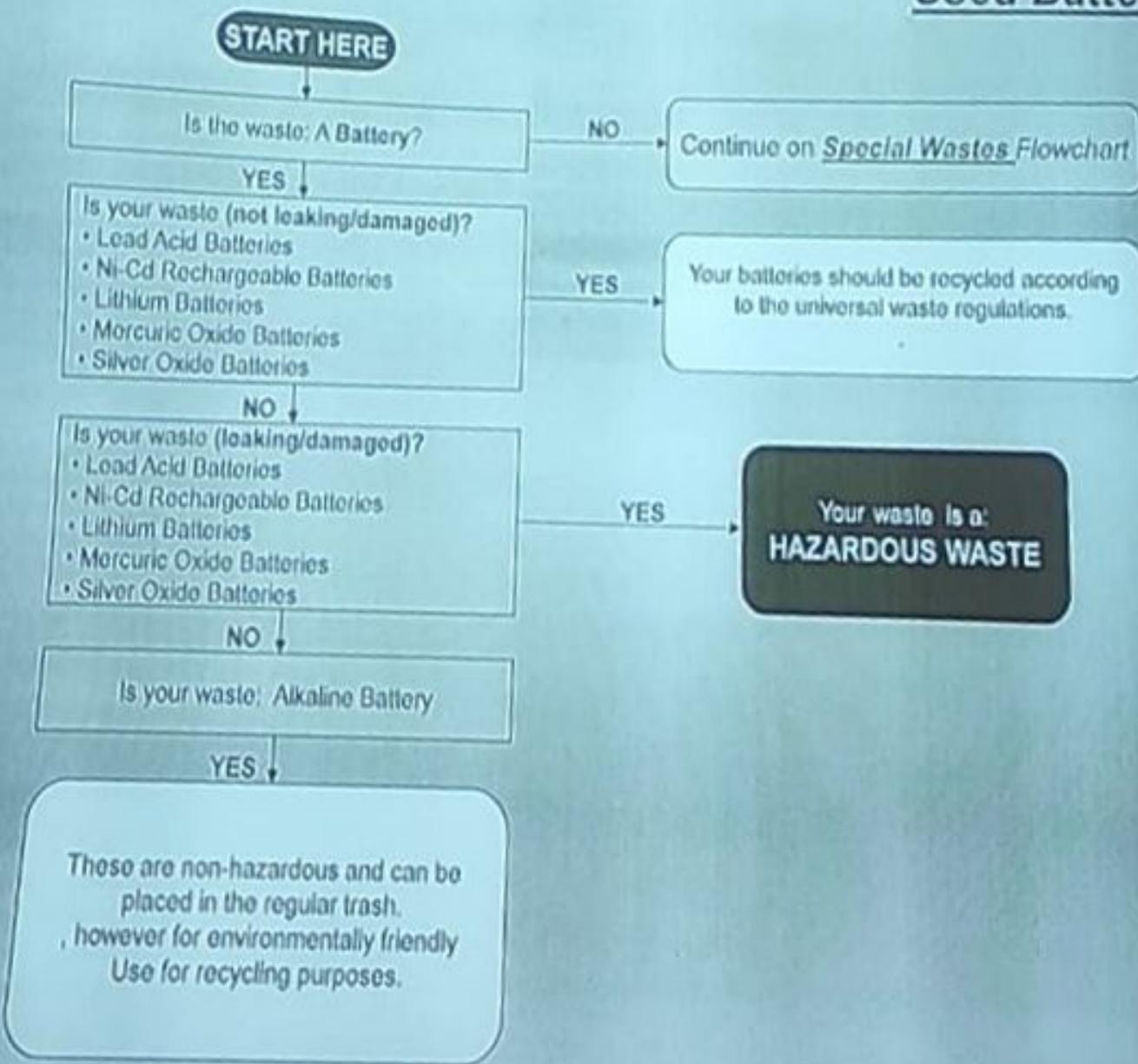
Is the waste:
Chemotherapy Wastes (Wastes with a trace (<16cc) of chemo-waste or anti-neoplastic agents?)

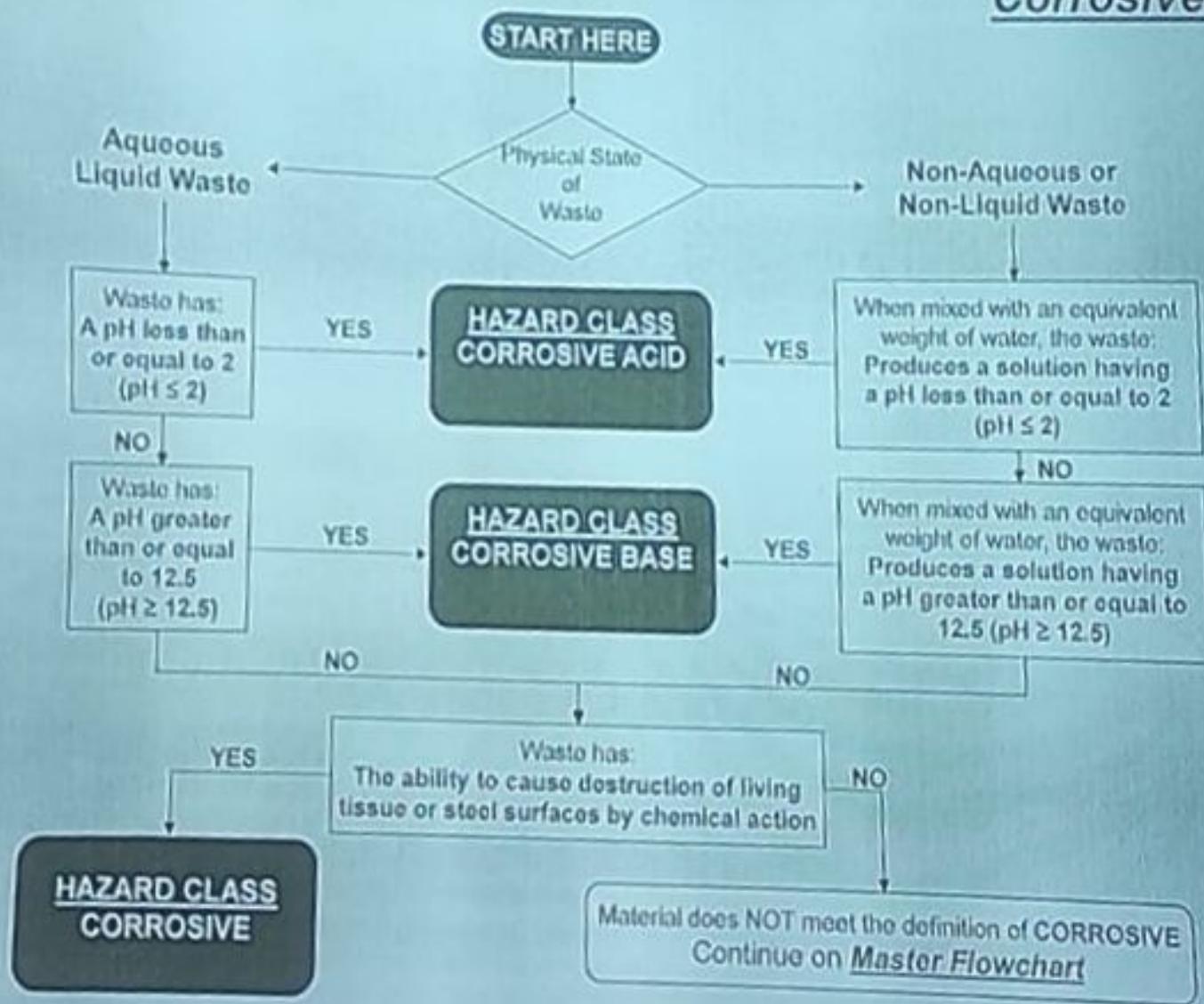
NO

Your waste is NOT a MEDICAL WASTE.
Continue on **MASTER FLOWCHART**

Your Waste is a
Regulated Medical Waste.

Used Batteries





Status on HW Generation & TSDF in Operation in Major States

S.No.	State	Total HW generation in '000 TPA	No. of TSDF in operation/under construction	No. of sites notified	No. of sites identified
1.	AP	507	01	02	02
2.	Assam	4	-	-	-
3.	Chandigarh	8	-	-	-
4.	Delhi	17	Nil	Nil	03
6.	Goa	-	Nil	Nil	Nil
7.	Gujarat	1207	07	16	22
8.	Haryana	15	-	01	01
9.	Himachal	-	-	-	02
10.	Karnataka	92	Nil	02	02
11.	Kerala	84	Nil	01	01
12.	Maharashtra	1407	02	02	06
13.	MP	-	Nil	Nil	03
14.	Orissa	75	Nil	01	01
15.	Pondicherry	30	Nil	Nil	Nil
16.	Punjab	16	Nil	01	01
17.	Rajasthan	184	Nil	01	08
18.	Tamilnadu	182	Nil	01	03
19.	Uttarpradesh	82	Nil	03	05

HAZARDOUS WASTE PROPERTIES

Hazardous materials exhibiting any of the following characteristics

- Ignitability
- Corrosivity
- Reactivity
- Toxicity

Ignitable (Petrochemicals and Refinery Products)

Ignitable chemicals (e.g. lighter fluid, solvents, friction sensitive substances) can create fires under certain conditions.

Corrosive - (Fertilizers, Acid plant, Chloro-Alkali, Inorganic basic chemicals industries)

Corrosive wastes (e.g. battery wastes) cause a chemical action that eats away materials or living tissue. They are capable of corroding metal, such as tanks, containers, drums, and barrels.

Reactive - Materials that can react violently or create toxic fumes:

Reactive materials (e.g. sodium) are unstable under normal conditions. They can create explosions and/or toxic fumes, gases, and vapors when mixed with water.

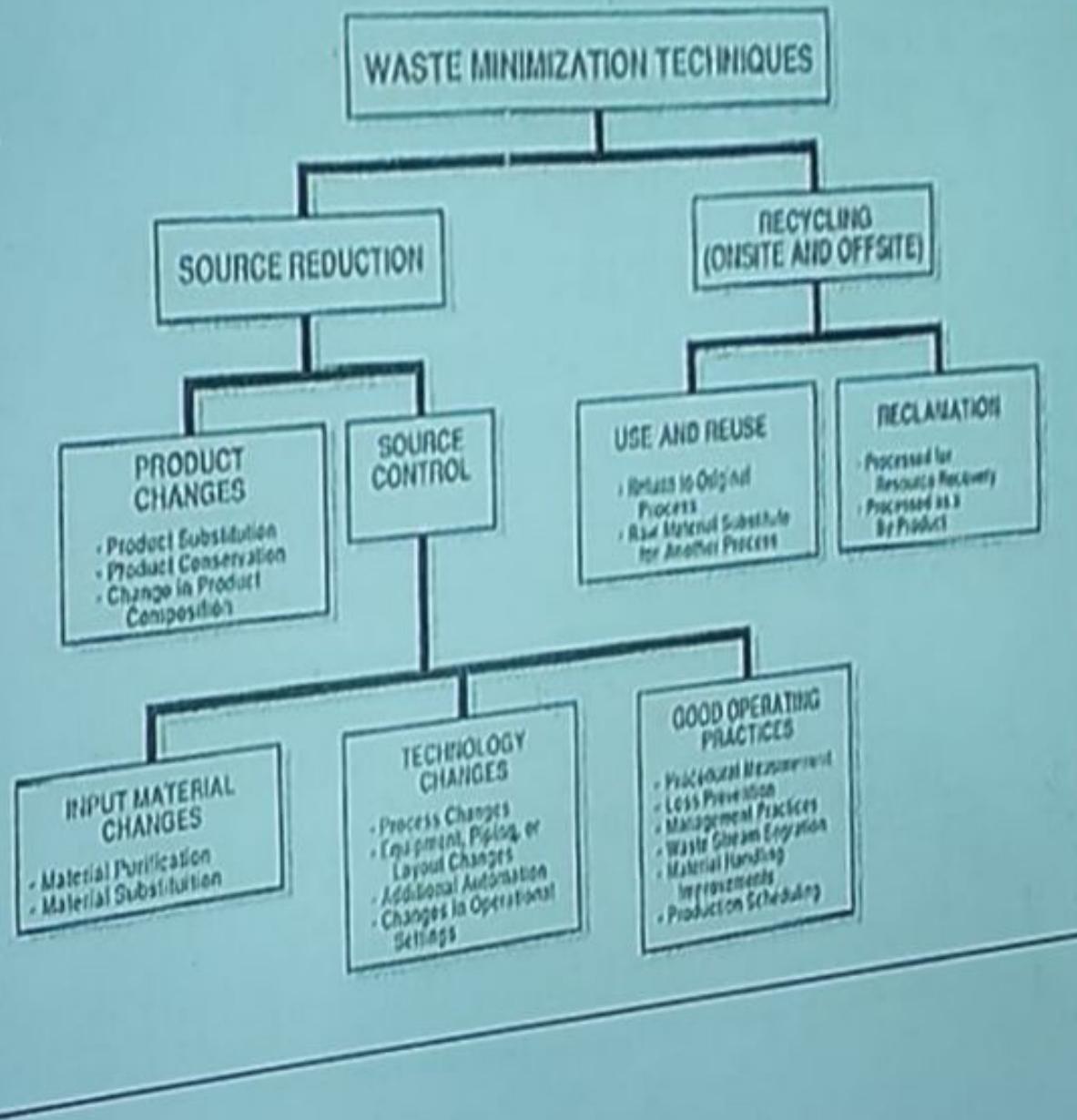
HAZARDOUS WASTES RELATED DISEASES AND CONSEQUENCE

The effect of chemical hazardous materials on the human body and safety precautions to be followed are closely related . These materials affect the body by the following way:

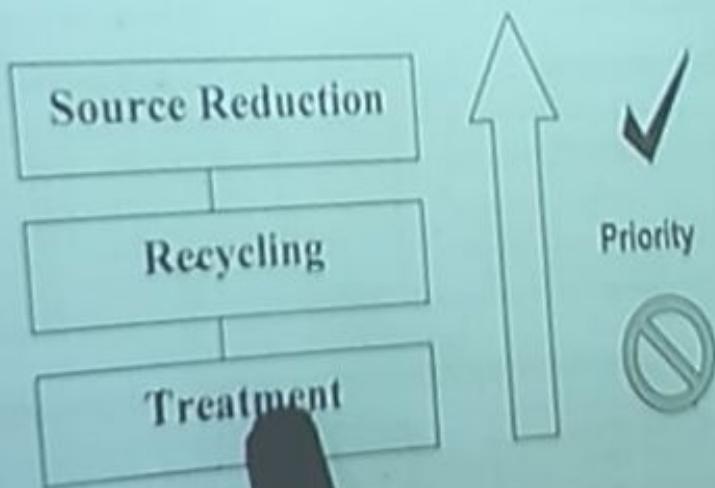
INGESTION:

INHALATION:

SKIN CONTACT:



Hazardous Waste Management Hierarchy



Source Reduction -By Substitution

Original Material

Formaldehyde

Halogenated

Sodium dichromate

Xylene or toluene

Solvent in

Scintillation vials

Substitute Material

- Formalin solution
- Non-halogenated
- Sodium hypochlorite
- Alcohols or ketones
- Non-solvent based scintillation vials

EPA's criteria for listing waste that is acute or toxic

- Acute listings

- Fatal to humans in low doses
- Certain dermal and inhalation toxicities
- Capable of causing or significantly contributing to an increase in serious irreversible, or incapacitating reversible illness

- Toxic Listings

- Pose a substantial threat to human health and the environment when improperly managed (as determined by risk factors)



Substitution (where possible)

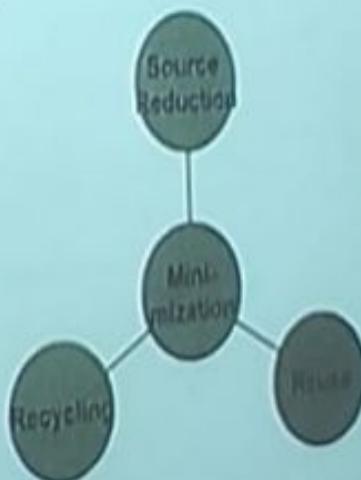


- Acetamide
- Benzene
- Benzoyl peroxide
- Chloroform
- Carbon tetrachloride
- Formaldehyde
- Mercury thermometers
- Halogenated solvents
- Stearic acid
- Alcohol
- Lauryl peroxide
- 1,1,1-trichloroethane
- Cyclohexane
- Ethanol
- Red liquid thermometer
- Nonhalogenated solvents

Minimization

Minimization of hazardous waste is done by following methods:

- Source reduction
- Reuse
- Recycling



Toxic - (pesticides and paints) are harmful or fatal when ingested or absorbed. When they are disposed of on land, contaminated liquid may drain from the waste and pollute ground water. A selected group of eight (8) heavy metals, ten (10) pesticides, and twenty-two (22) organic chemicals are classified as hazardous due to their toxicity characteristic. Any detectable amount of these chemicals must be identified on the Hazardous Waste label.

Lethal Dose:

LD₅₀

TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS

Waste Code	Contaminants	Concentration
D004	Arsenic	5.0
D005	Barium	100.0
D015	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.01
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	<i>o</i> -Cresol*	200.0
D024	<i>m</i> -Cresol*	200.0
D025	<i>p</i> -Cresol*	200.0
D026	Total Cresols*	200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.005
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	1.0
D003	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D015	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silver)	1.0

Chemical Processes

Precipitation

Neutralization

Calcinations and
sintering

Oxidation

Catalysis

Ozonolysis

Chlorinolysis

Photolysis

Electrolysis

Microwave Discharge

Hydrolysis

Reduction

Physical Processes

Sedimentation	Crystallization
Clarification	Frooze DryIng
Air Stripping	High gradlont magnotto
Steam Stripping	Separation
Steam Distillation	Electrophoresis
Ion Exchange	Liquid Ion Exchange
Carbon Adsorption	Electro dialysis
Centrifugation	Resin Adsorption
Dialysis	Reverse Osmosis
Distillation	Liquid-Liquid Extraction
Evaporation	Ultra filtration
Filtration	Zone Refining
Flocculation	Suspension Freezing
Flotation	Sorption