Technologies in Hazardous Waste Management

Presented by

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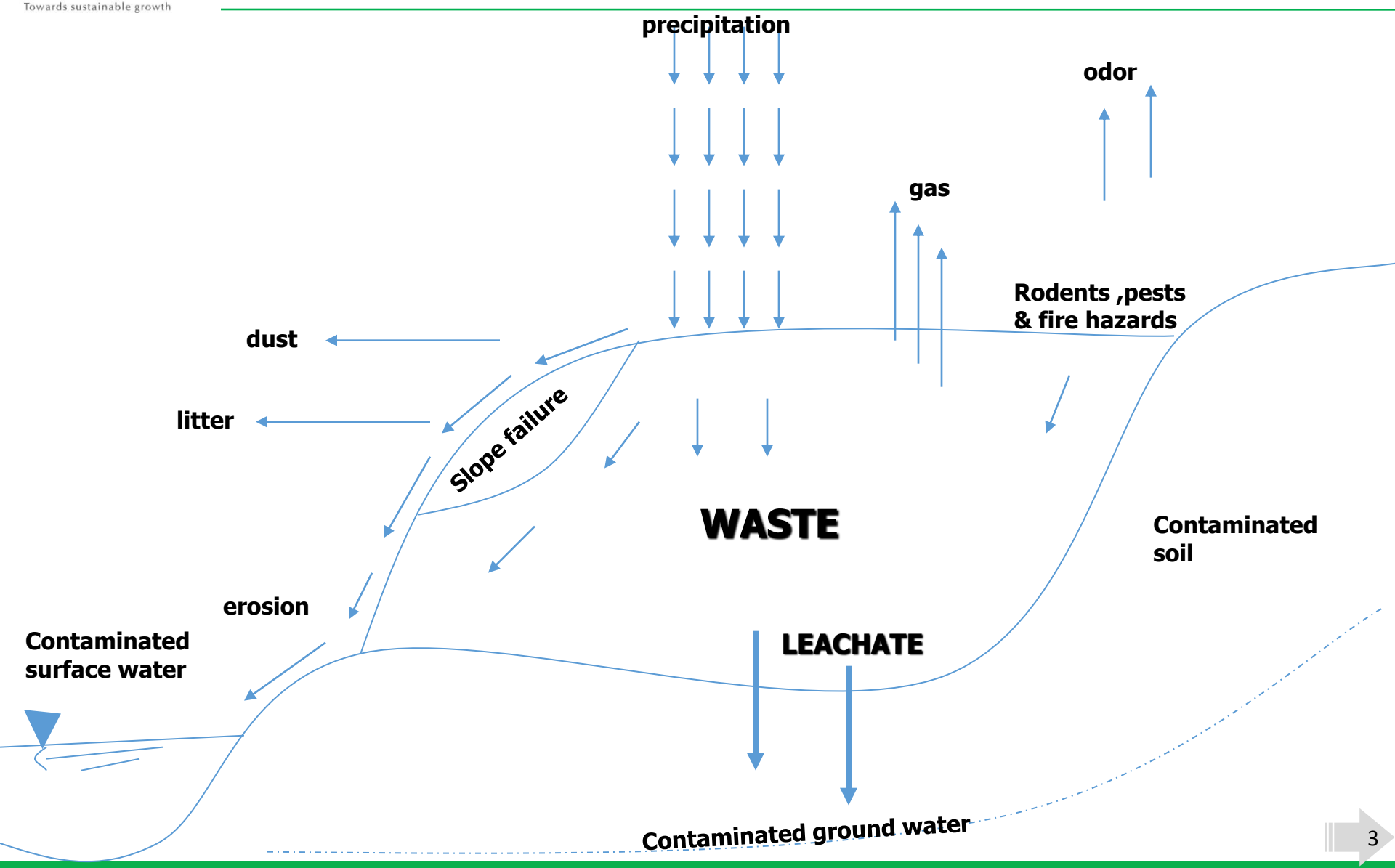
Hazardous Waste

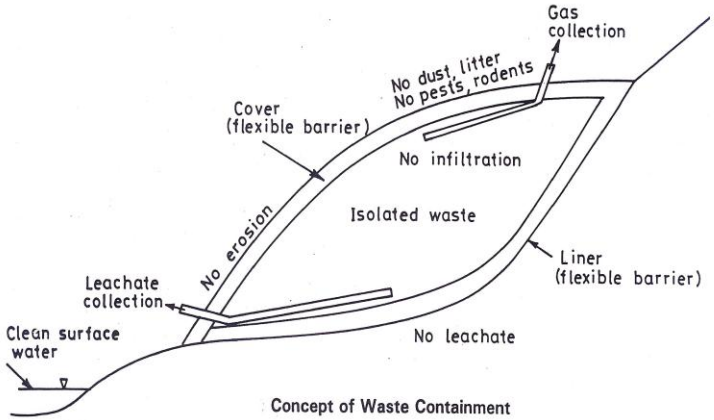
- Waste
  - Lack of Value/ Use
  - Restore Value
- Solid Waste
  - Not Flowable
  - Spreadable
  - Non-Liquids/ Gases
- Hazardous Wastes
  - Irreversible Damage
  - Incapacitative Illness
  - Human Health and/or Environment

Fate of Waste

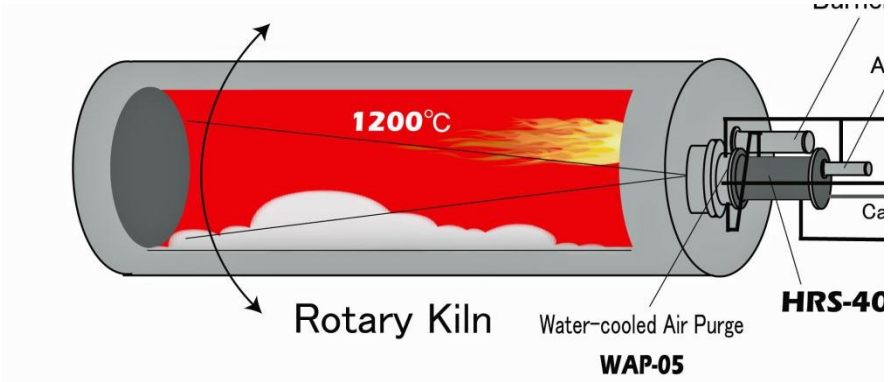


Solution

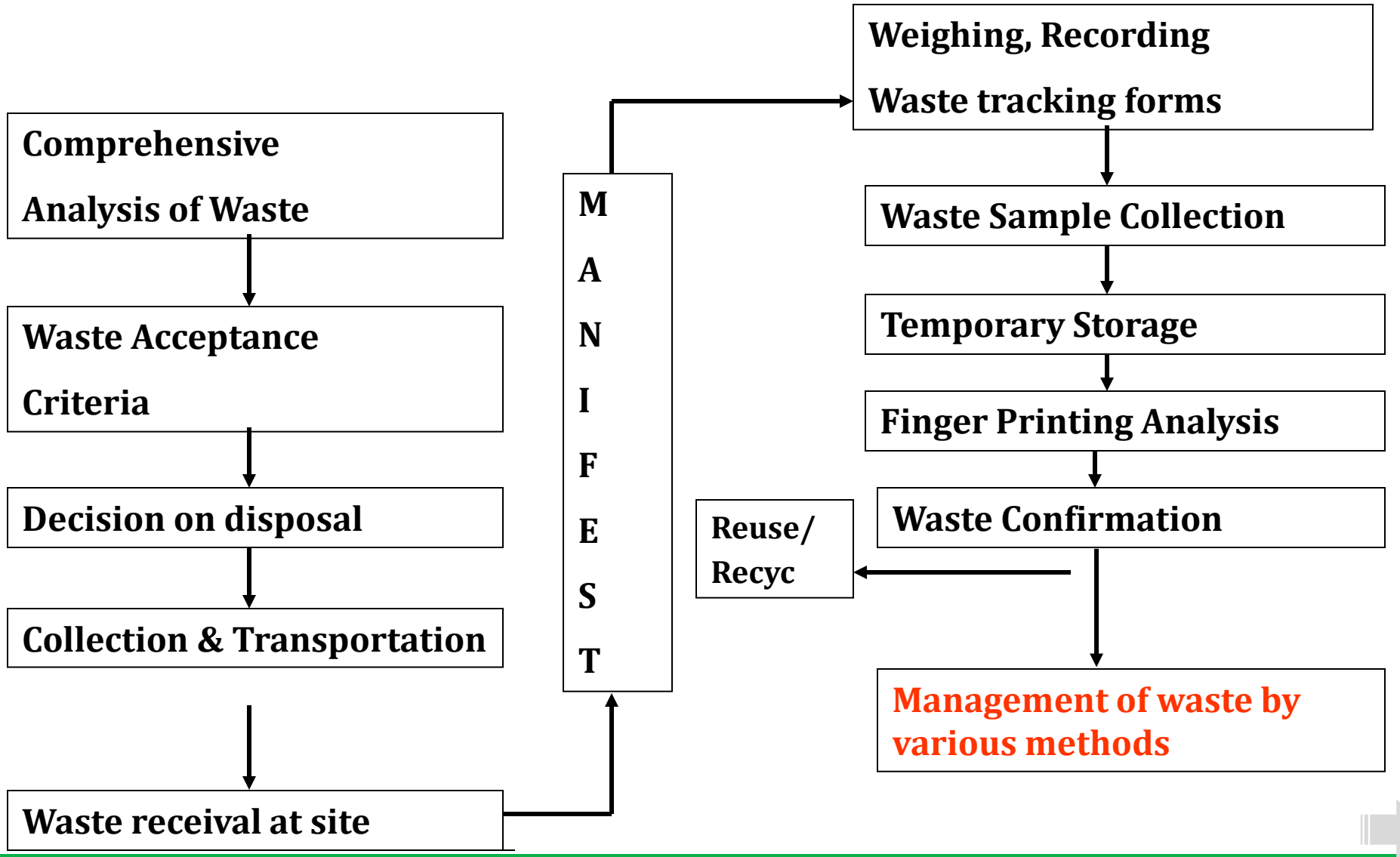
- Reduce, Reuse and Recycle remain high priority in Waste Management
- Treatment to Detoxify:
  - Biological Treatment
  - Physical, Chemical by limited molecular arrangement to recover valuable materials
  - On site, off site Remediation
- However, Waste remains hence
  - Bury/ Burn (Thermal Destruction)
  - Landfill/ Destruction either directly or after treatment becomes necessary



Concept of Waste Containment



Flowchart


Comprehensive Analysis of Waste
Waste Acceptance Criteria
Decision on disposal
Collection & Transportation
Waste receival at site
MANIFEST
Weighing, Recording Waste tracking forms
Waste Sample Collection
Temporary Storage
Finger Printing Analysis
Waste Confirmation
Reuse/ Recyc
Management of waste by various methods

Thermal Destruction

- Advantages
  - Hazard reduction is Permanent
  - Can be applied to waste mixes
  - Significant volume reduction to be landfilled
  - Energy can be recovered most of the times
  - End materials (Ash, Slag) can be used for other purposes. Ex; stabilization of other wastes
- Disadvantages
  - Not economical for all wastes
  - Monitoring methods are still evolving
  - Not enough knowledge about the formation of Toxic compounds

Thermal Destruction - Technologies

- Incineration
  - Rotary Kiln (Widely used across the globe)
  - Multiple Hearth
  - Cement Kiln
  - Fluidized bed
- Plasma Arc
- Molten Salt
- Ocean Bed Destruction
- Radiation (High Temp Fluid Wall)
- Electron Bombardment

Cement Kiln

- Attractive for destruction of harder to burn waste due to very high residence times, good mixing and high temperatures
- Alkaline Environment neutralizes chlorine

Disadvantage

- Burning of Chlorinated waste limited by operating requirements and cement quality
- Need to have specialized feeding systems
- Could require retrofitting of pollution control equipment and of instrumentation for monitoring to bring existing facilities to compliance level

Plasma Arc

Plasma Arc

- Very high energy radiation breaks chemical bonds directly without series of chemical reactions
- Extreme DREs possible with no or little chance of PICs,
- Mobile units planned

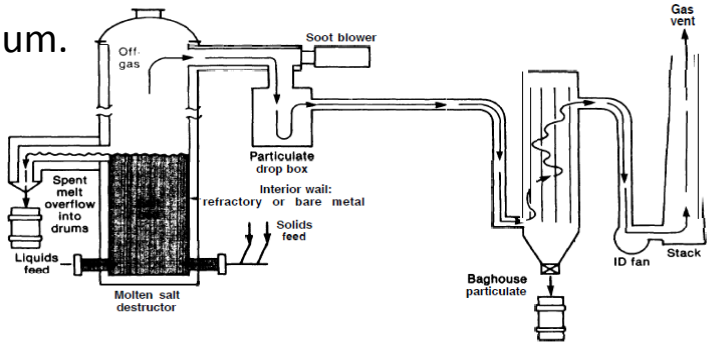
Disadvantages

- Difficult to handle heterogeneous wastes
- Limited throughput
- High use of NaoH for scrubbers

Molten Salt Reactor

Molten salt Reactors

- Achieve rapid heating and thorough mixing of waste in a fluid heat
- Molten Salt act as a catalyst and efficient heat transfer medium.
- Self sustaining for some wastes
- Units are compact potentially portable
- Needs Minimum air pollution controls
- Some combustion products e.g., ash and acidic gases are retained in the melt.



SOURCE Adapted from S. Y. Yosim, et al., Energy Systems Group, Rockwell International, "Molten Salt Destruction of HCB and Chlordane," EPA contract No 68-03-3014, Task 21, final draft, January 1983

Disadvantage:

- Commercial –scale applications face potential problems with regeneration or disposal of as-contaminated salt
- Not Suitable for high ash wastes
- Chamber corrosion can be a problem
- Avoiding reaction vessel corrosion may imply tradeoff with DRE

Ocean Disposal Incineration

Sea Incineration : Shipboard

- Scrubbing of Exhaust gases not required on assumption that ocean water provides sufficient neutralization and dilution.

Advantage:

- Economic advantage over land based incineration
- Occurs away from human populations
- Greater combustion rate 10MT/hr.

Disadvantage:

- Regulations are not prescribed yet
- Not suitable for waste that are shock sensitive,
- capable of spontaneous combustion or chemically or thermally unstable due to the extra handling and hazard of shipboard environment.
- Potential for accident release of waste held in storage.

Others

Radiation

- High Energy Consuming
- Commercial Scale not available
- Used for Destruction of Defense substances

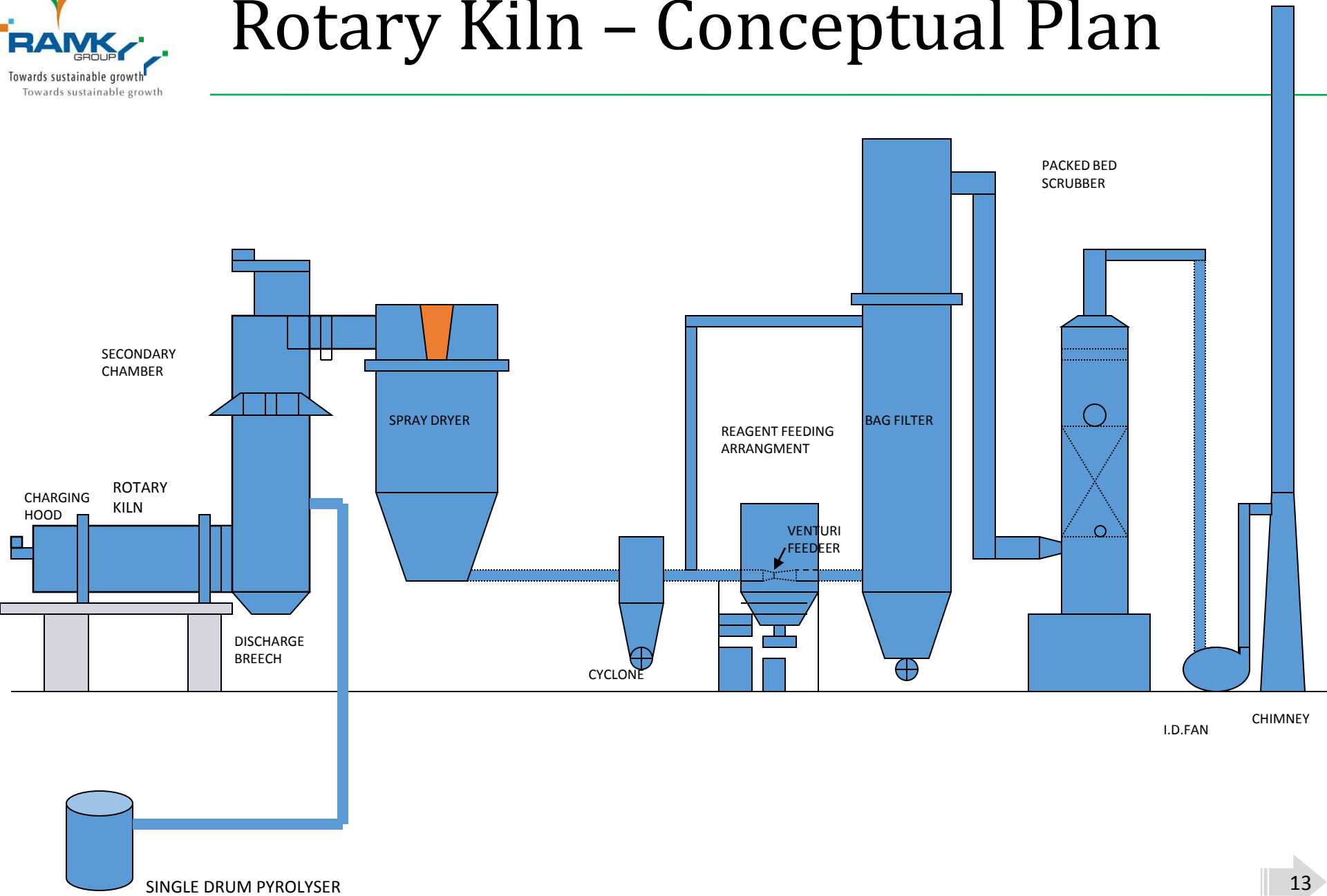
Electron Bombardment

- Expensive
- Used for Destruction of Defense substances

Rotary Kiln Incinerator

- **Widely used across the world**
- Can be used for most kinds of waste
- Robust and can achieve 99.99% DRE

Rotary Kiln – Conceptual Plan



Rotary Kiln

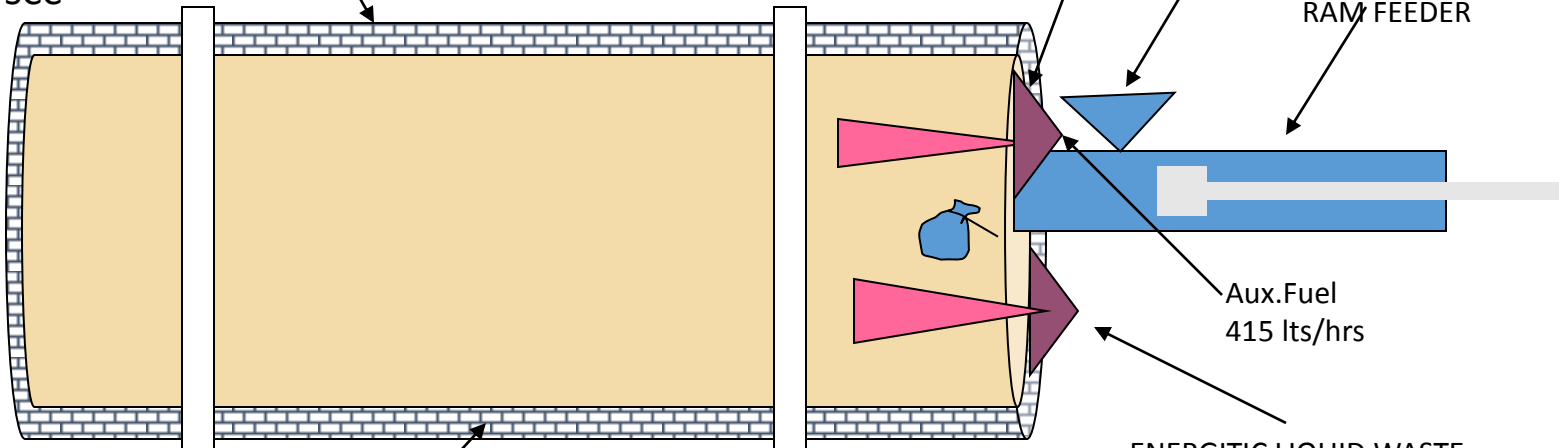
ROTARY KILN
THERMAL OXIDATION
TEMP :850 +_50 DEG.C
DESIGN TEMP :1200 DEG.C
RPM : 0.5 TO 1.5
MAX CAP : 3.04 MKCAL/HR
WASTE IN PUT : 1 – 1.5MT/HRS

AQUEOUS WASTE
LANCER
MAX CAP : 454 KG/HRS

SOLID WASTE:600-900
KGS/HR

RAM FEEDER

FLUE GAS TO SCC



Aux.Fuel
415 lts/hrs

ENERGITIC LIQUID WASTE
LANCER
MAX CAP : 454 KG/HRS

ASH

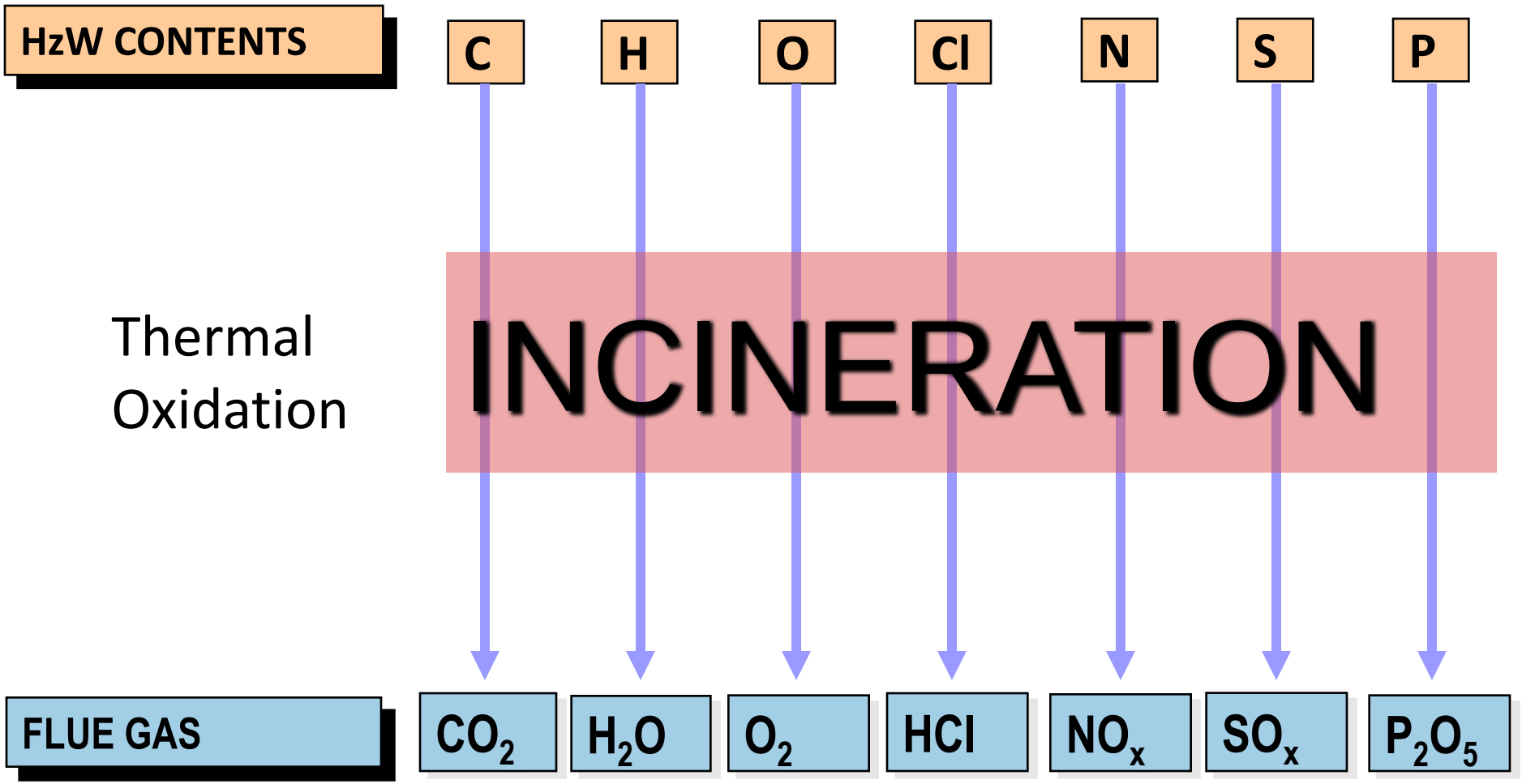
RIDING RINGS

KILN BRICKS: 70% HIGH ALUMINA

RIDING RINGS

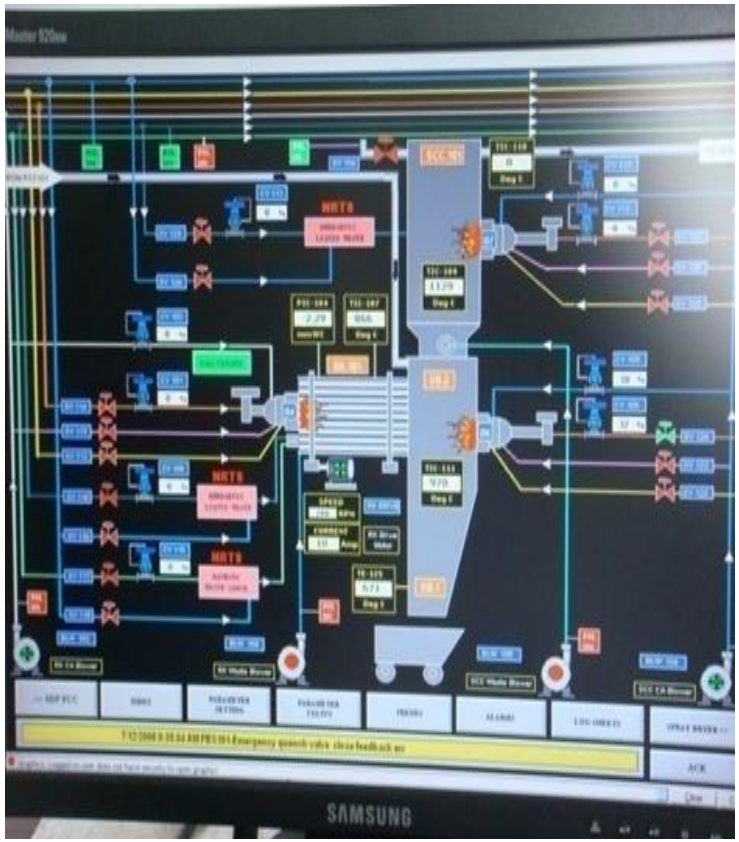
Flue Gas Treatment

Contents & Flue gas



Incinerator Parameters

Temperatures:	
Rotary kiln	850 ± 50°c
SCC outlet	1100 ± 100 **°c**
Spray dryer o/l	190 – 240 **°c**
bag filter inlet	190 – 240 **°c**
Scrubber inlet	100 - 150 **°c**
Idfan inlet	50 -70 **°c**
Pressures:	
Rotary kiln	5-10 mm/wc
Scc outlet	40 -50 mm/wc
Sd outlet	50- 100 mm/wc
bag filter	45mm/wc dp
Scrubber inlet	150 – 200 mm/ wc
Idfan inlet	150 - 400 mm/wc



Disposal Options

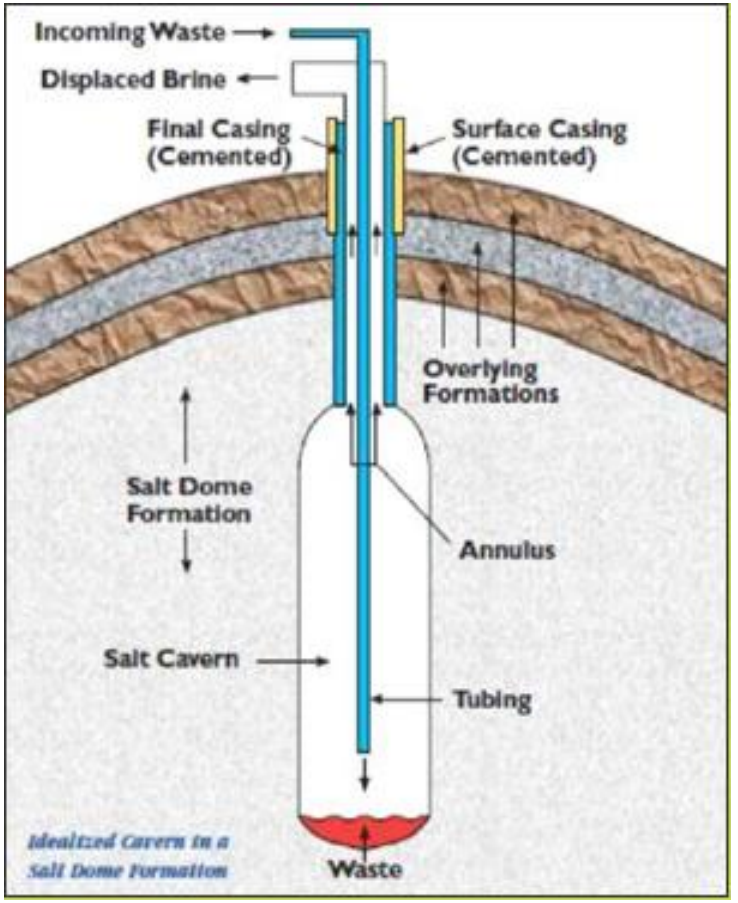
- Advantages
  - Compared to Thermal, cheaper
  - Robust for short term
  - Wide variety of waste can be landfilled directly or after treatment
- Disadvantages
  - Not a long term solution
  - Required monitoring for Long periods.
  - the post-closure, liability, and corrective action requirements will have a greater effect on land-based disposal options relative to treatment or incineration, and
  - Not many sites have gone through a life cycle of monitoring to know the effects

Landfills

- Non-scientific landfills
  - Usually far away places from habitation. Ex: Middle of deserts
- Deep well injection
- Scientific landfills
  - Single Layer
  - Double Layer
  - Triple Layer

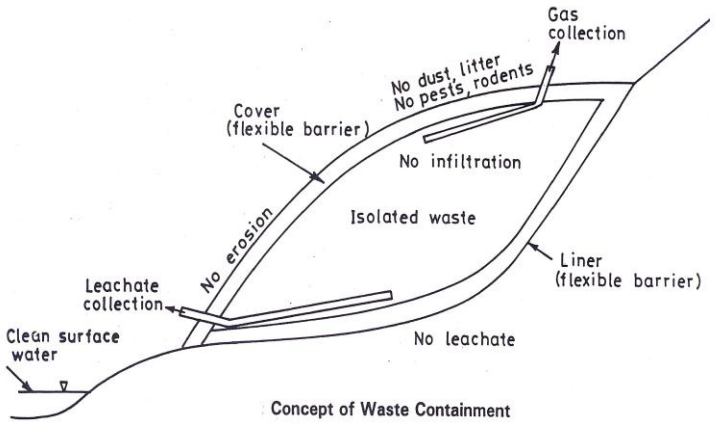
Deep well Injection

- Injection occurs at depths far below fresh water zones and at low enough pressures to completely isolate the Injection zone from any underground source of drinking water or the surface.
- Safest method for waste disposal
- Unlike the landfill, this method enables the land surface to be used again in the future.
- Proper plugging is necessary to prevent cross contamination



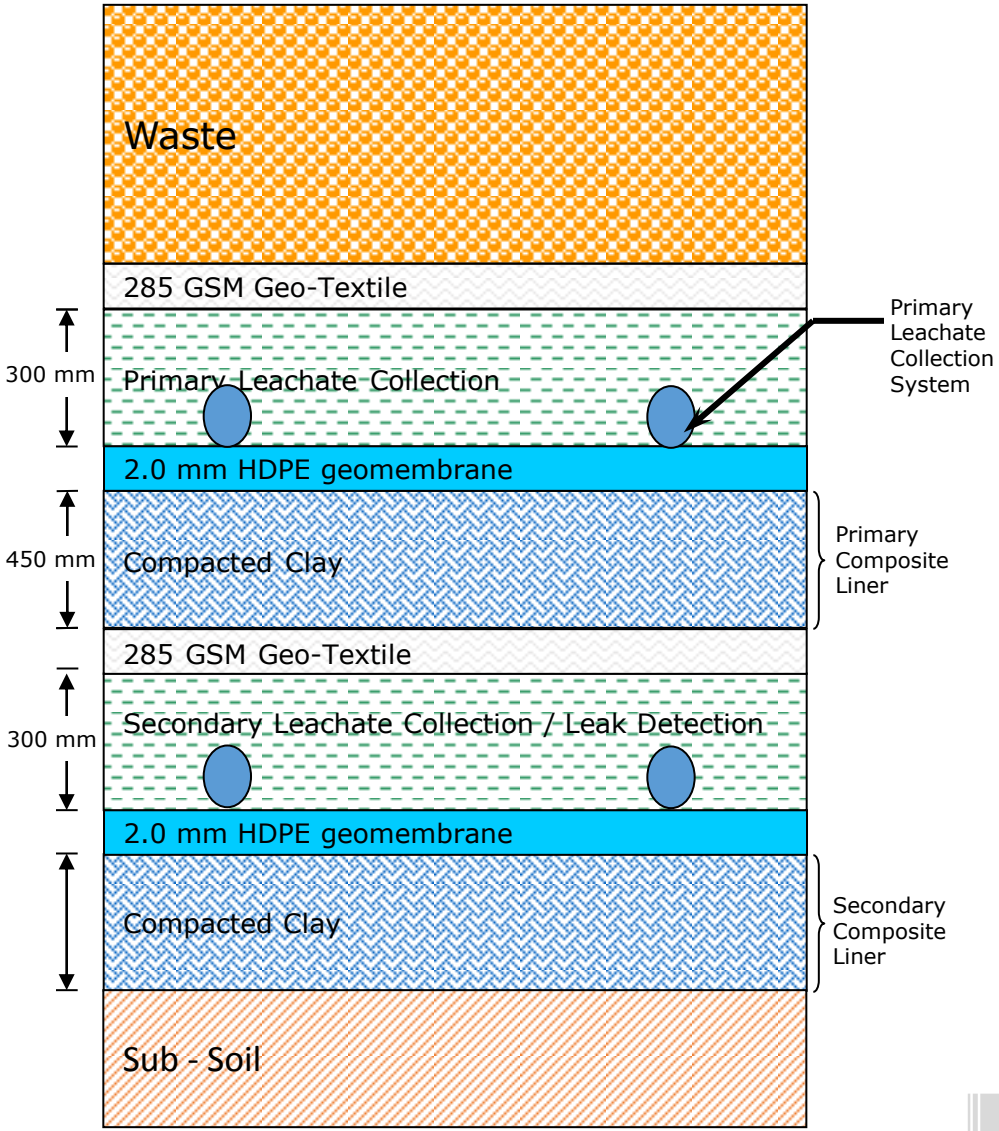
What is a Scientific Landfill

- A Containment system which separates the waste from the surrounding environment.
- Objective: To Mitigate the migration of leachate and minimize emissions.
- Concept: Place the waste in isolation from the environment.



Components of a Landfill

- Base Liner System
- Leachate Collection System
- Gas Collection System (Optional)
- Final Cover/ Cap
- Surface Water Drainage System
- Environmental Monitoring System
- Closure and Post-Closure



Liner System

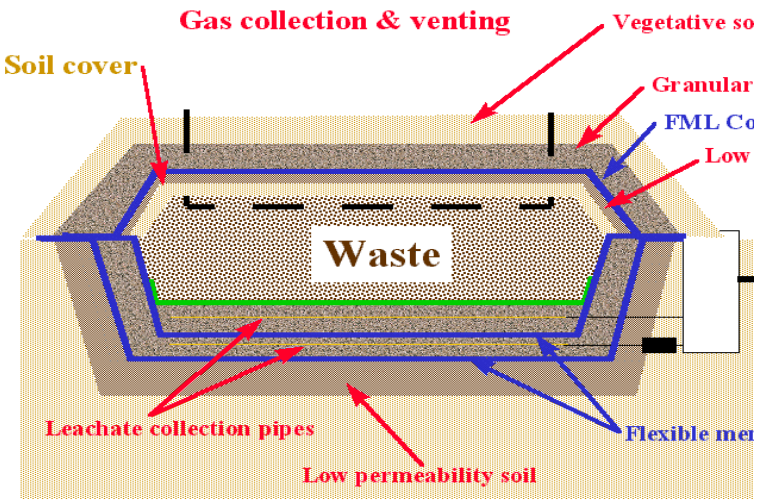
- **HDPE Liners**
  - Preventive Membrane
  - Impervious
  - Extremely low permeability
  - Low Time of Travel
  - Thickness = Load, Anchorage Distance, Angle of Friction, Stressess
- **Clay Liners**
  - Protective Membrane
  - Low Permeation
  - High Time of Travel
  - Time of Travel
- **Composite Liners**
  - Clay and HDPE in Combination
  - GCL and HDPE in Combination

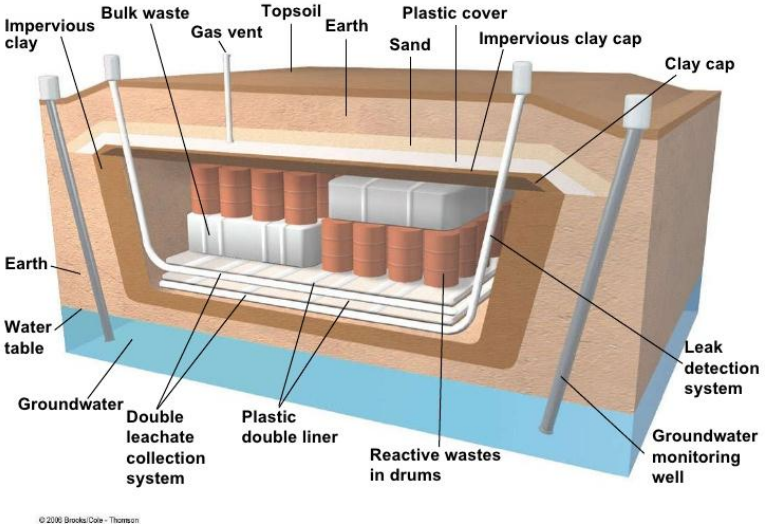





Filling up of Landfills

- Co-disposal of waste after meeting disposable criteria
  - Complex Leachate
  - Risk of reaction by mixing of waste
  - Cheaper
- Disposal in Containers
  - No Leachate generation
  - Safest way of disposal
  - Comparatively expensive





Summary

- Reduce, Reuse and Recycle remain high priority in Waste Management
- Rotary Kiln incinerator remains to be the most suitable economically and widely used technology for Thermal destruction
- Double Layered scientific landfills are predominantly used to dispose of wastes with low calorific values
  - Containerized disposal will be a better option than co-disposal
  - However, this is a short term solution
  - Long term Liability are not known

Thank You