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Toxic Use Reduction:

- Product changes, raw materials change
- Reclaimation of products

Source Reduction
Recycle, Reuse
Treatment
disposal

Source Reduction:

Product change

- new product design
- extension of product life
- halogenated → non-halogenated
- formaldehyde → formalene sol^n

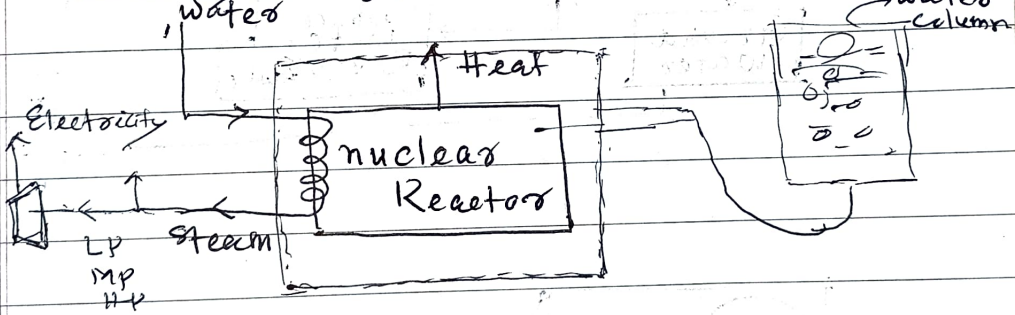
Process change

material change
Technology change
Operational change

material change:

- Sponge iron instead of iron ore
- H. instead of coke

Technology change



Operational change:

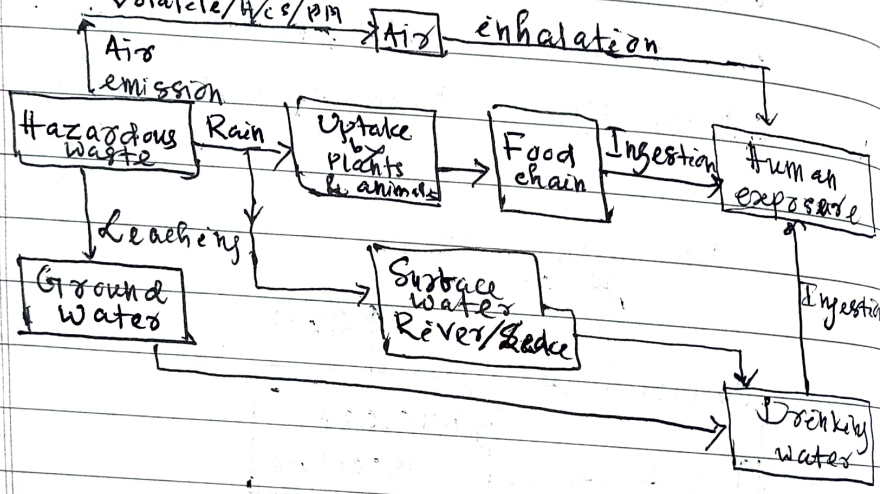
- Cleaning of water scrubber
- Replacement of nozzles
- increased automation
- new technology
- improved equipment
- Layout change
- material handling improvements
- stream segregation.

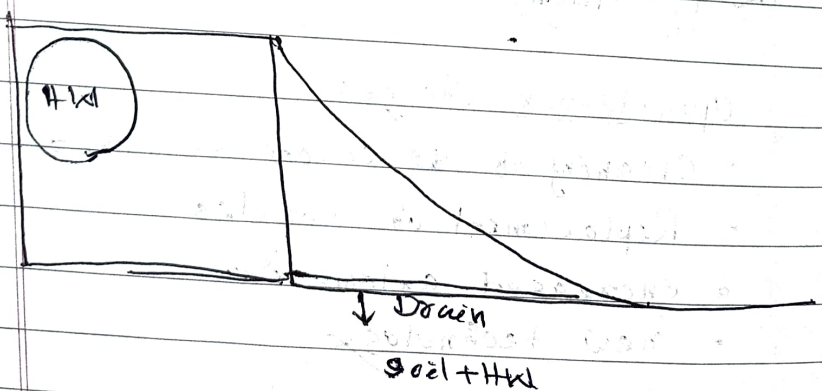
Production scheduling: materials are not stored for long period of time

inventory control: product scheduling is done according to it.

Waste Treatment and Processing:

- Physical
- Chemical
- Biological
- Integrated





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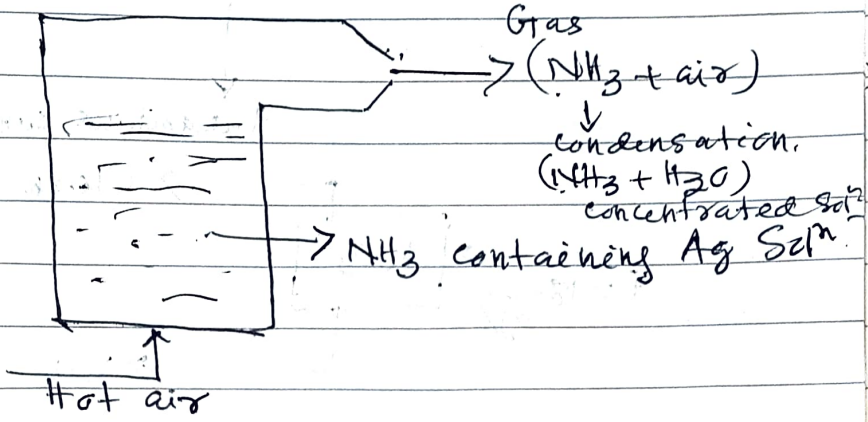
Physical processes

- Sedimentation, distillation, absorption Clarification, Centrifugation, stripping filtration, Evaporation.

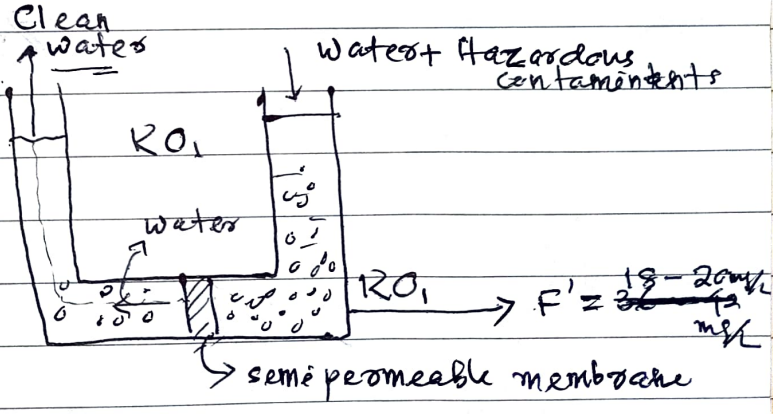
Stripping: (steam or hot air)

$$NH_3 + H_2O \rightleftharpoons NH_4OH$$



- Steam stripping, Steam distillation
- Filtration: Rotating drum, plate & frame type
- Reverse Osmosis:

It is used to separate salts/ions from water.



- Aluminium plant:

α emit = 1.5 mg/L

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Desalination

waste water

↓

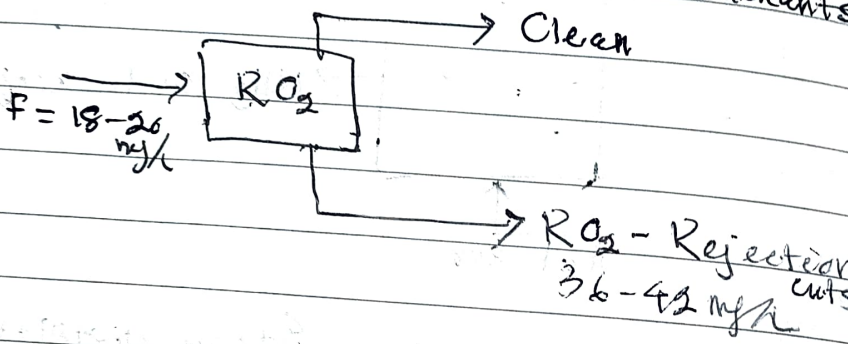
TSS / TDS

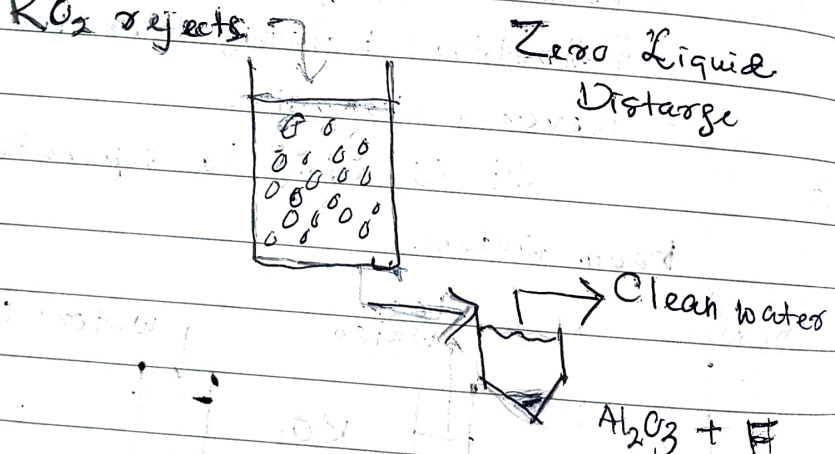
+

7 - 10 mg/L

↓

#azardous contaminants





$H_2S + O_2 \longrightarrow SO_2 + H_2O$

$SO_2 + H_2S \longrightarrow S + H_2O$

Hazardous waste: → Physical → not destroyers properties only reduction in volume/conc.

↓ chemical
Biochemical
Integrated
property destruction

(1) Destroy (2) Less hazardous/harmful product intermediately

Physicochemical

Precipetation: The hazardous waste can be removed by using method of precipetation.

$M^{++} + OH^- \longrightarrow M(OH)_2 \downarrow$

Heavy metal — lime — precipetate ↓ disposal

$MSO_4 + Na_2S \longrightarrow MS \downarrow + Na_2SO_4$

Heavy metal — (ppt.) — (soluble in water)

↓ Sent to smelter plant

Steel plant: (Cyanide production)

Ammonical liquor + coke

↓

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Cynide bearing hazardous waste treatment

Oxidation:

$$CN^- + Cl_2 + 2OH^- = CNO^- + H_2O + 2Cl^-$$

$$2CNO^- + 3Cl_2 + 4OH^- = 2CO_2 + N_2 + 2H_2O + 6Cl^-$$

Oxidizing agent: Cl_2, H_2O_2, $KMnO_4$, $Ca(OCl)_2$, $NaOCl$

Water concentration should be reduced to make the process efficient.

Toxic: $Cr^{+6} \longleftrightarrow Cr^{+3}$

Cr^{+6} - mine drainage.

Chromite mine, Jajpur, Keonjhar

- $Cr(VI) \longrightarrow Cr(III)$ (less toxic) by $NaHSO_3$, $FeSO_4$

- $Na_2CrO_4 + FeSO_4 + H_2SO_4$
  $Cr(VI) \longrightarrow Cr_2(SO_4)_3 + Fe_2(SO_4)_3$
  $Cr(III)$
  $+ Na_2SO_4 + H_2O$
  (pH ≈ 2.5 to 3)

- $Cr_2(SO_4)_3 + 3Ca(OH)_2 \longrightarrow 2Cr(OH)_3 \downarrow + 3CaSO_4$
  (alkaline soln) (ppt.)

The toxic Cr(VI) is reduced to Cr(III) which is less toxic and then precipitated by alkaline soln ($Ca(OH)_2$)

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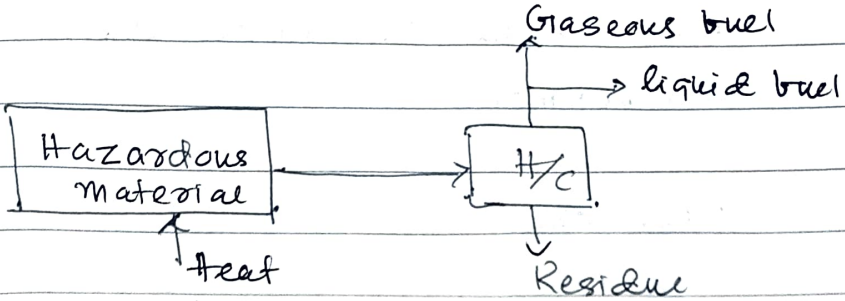
Thermal degradation of Hazardous waste:

1. Pyrolysis ← thermal, Catalytic
2. Incineration



$C + O_2 \not\rightarrow CO_2$

$C + H_2O(steam) \longrightarrow CO + H_2$

Incineration: (complete burning)
With excess % of air

$C, H, S + O_2 \longrightarrow CO_2 + SO_2 + H_2O$ ...

Materials to be incinerated:
Solvent waste, Oily waste (waste oil, oil emulsions)
Plastic, rubber, latex waste
medical/Hospital waste, pesticide waste
Pharmaceutical waste, refinery waste
Phenolic, grease and wax waste

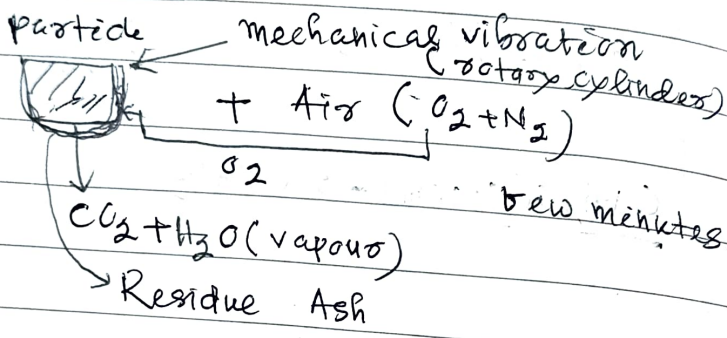
- Temperature is important for the process

Performance of the incinerator:
depends on
time (residence): (sec, min, Hr)
Temperature: (750°C)
Turbulence

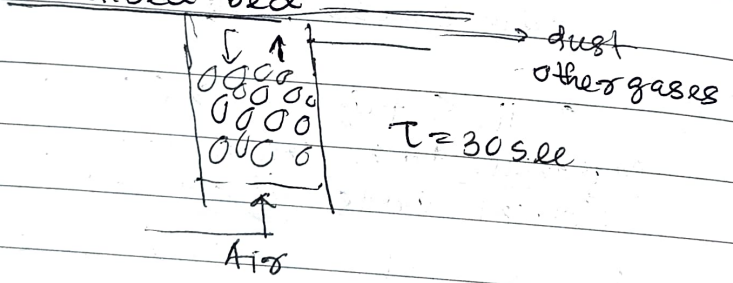
If the temperature is below 500°C, then the plastic and hospital waste get converted to secondary waste that cause hazardous effect on environment.

Turbulence:

Fixed bed:



Fluidised bed



Hazardous gases: CO, petroleum gases

Blast furnace gases can be injected to the incinerator.

Secondary pollutant control devices should be installed to prevent the toxic gases from going to the air.

Treatment by Incineration:

sponge-iron plant:

$Fe_2O_3 + coal \longrightarrow Fe + charge$

Slag + unburnt carbon

↓

Dolocharge (black) → 21–22% (coal)

Kiln size: (Capacity per day of production)

25	TPD	$6 \times 100 = 600$ TPD
50	TPD	
100	TPD	$350 \times 2 = 700$ TPD
200	TPD	$500 \times 6 = 3000$ TPD
350	TPD	
500	TPD	

Dolocharge can be used in the incinerator as it contains 21–22% carbon (coal).