FERTILIZER AND PESTICIDE INDUSTRIES

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FERTILIZERS CAN BE GROUPED INTO :

- Nitrogenous, e.g. urea, ammonium sulphates, ammonium nitrate, ammonium chloride
- Phosphatic, e.g. superphosphates
- Complex, e.g. ammonium phosphate and ammonium sulphates-phosphate
- Potassic

Chemicals required in the production of these fertilizers are mainly sulphuric acid, nitric acid, naphtha, carbon dioxide and phosphoric acid.

Manufacturing Process

1.Ammonia synthesis: - a mixture of pure nitrogen and pure hydrogen in proportion of 1:3 by volume is compressed under 200 atmospheric pressure and passed through chamber (catalyser) heated to 500-550 ^{0}C, containing finely divided iron (which acts as catalyst) and molybdenum (acts as promoter).

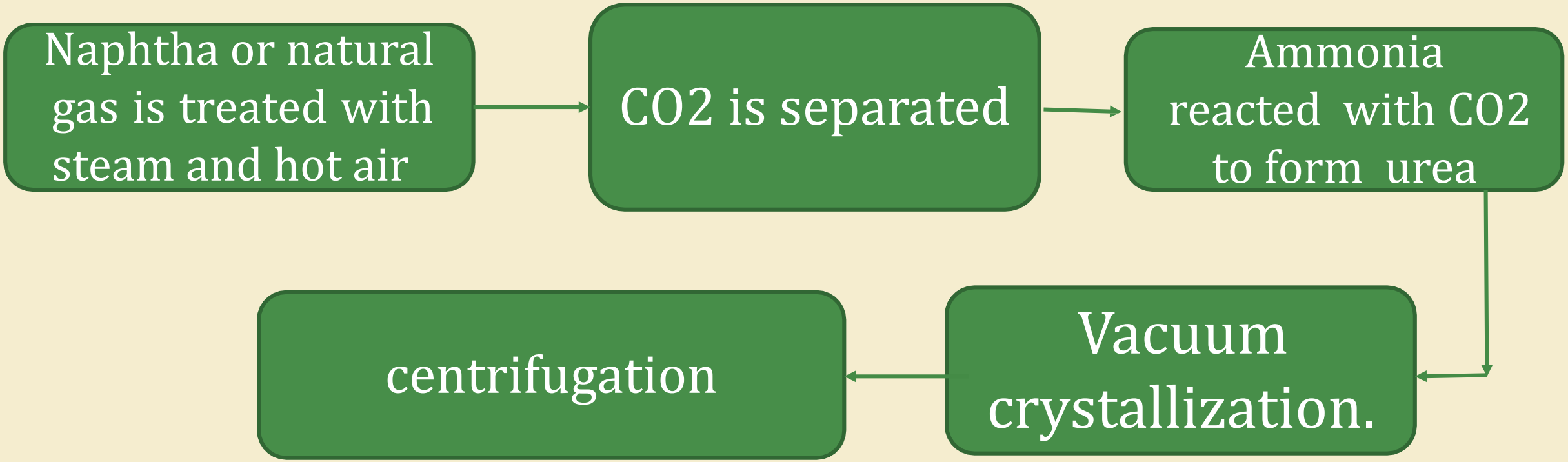
Nitrogen combines with hydrogen to form ammonia.

- These gases containing ammonia and unreacted nitrogen are cooled under pressure, when ammonia is liquefied and other gases are recycled to the reaction chamber to get more ammonia.
- The reaction is exothermic and ammonia thus generated is used in urea manufacture.

2. Urea Synthesis

- Naphtha or natural gas is treated with steam and hot air to produce carbon monoxide, carbon dioxide and hydrogen.
- CO_2 is separated and sent to urea synthesis plant.
- Separation is done by using potassium carbonate, monoethanolamine, diethanolamine and caustic soda.
- Ammonia from ammonia synthesis is reacted with CO_2 to form urea

- The liquid is filtered and subjected to Vacuum crystallization.
- Crystals are separated by centrifugation, dried and remelted.
- Molten urea is pumped into top of prilling tower and is sprayed against current of hot air.
- Spherical prills of area are formed at the bottom of the tower, where they are collected.


Naphtha or natural gas is treated with steam and hot air
CO2 is separated
Ammonia reacted with CO2 to form urea
Vacuum crystallization.
centrifugation

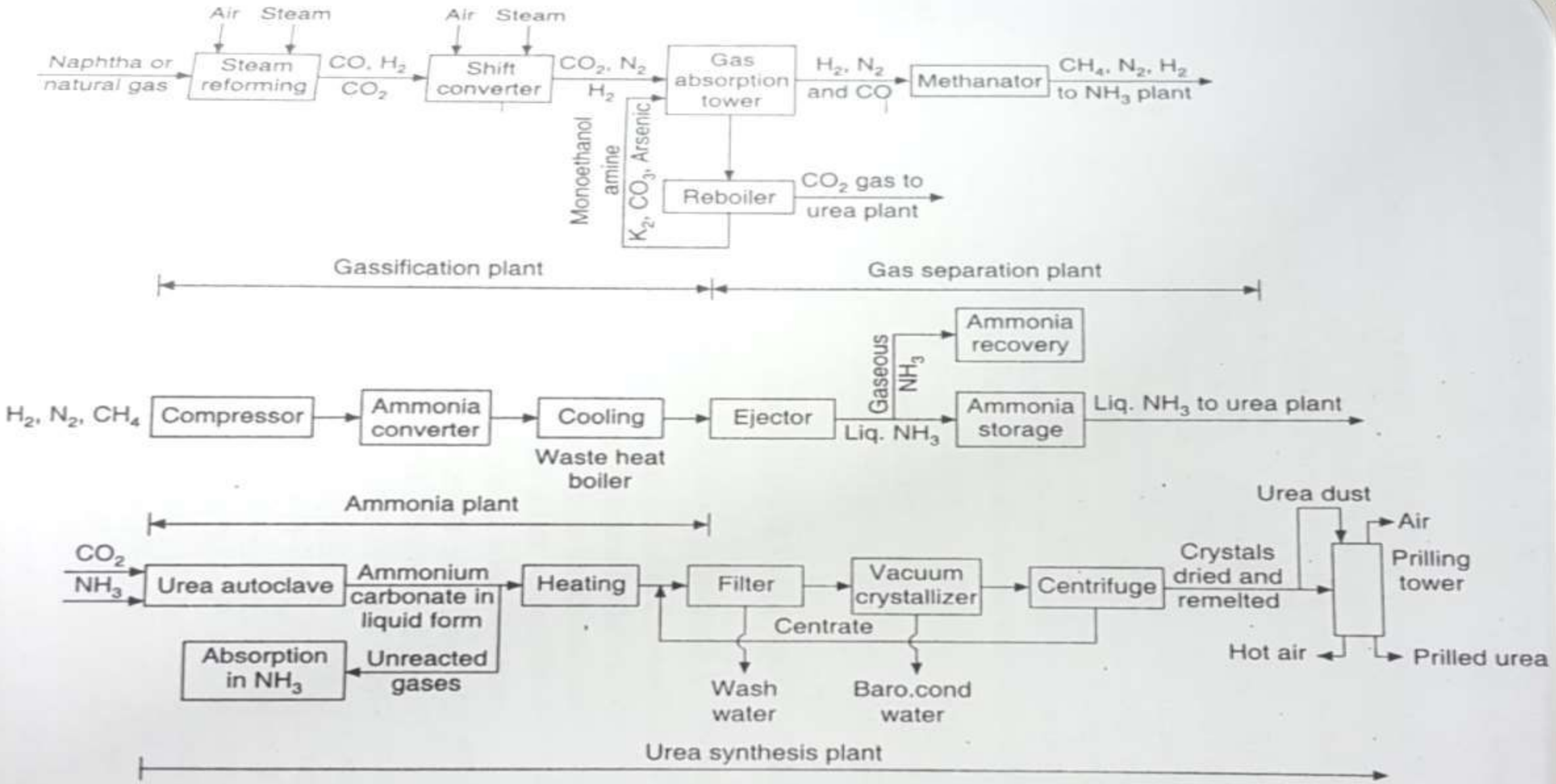


Figure 16.1 Urea synthesis.

Solid Waste from Fertilizer Industry

- Phosphogypsum: This is a solid by-product rich in calcium sulfate obtained from the production of phosphoric acid. Disposal can be challenging due to its radioactivity, and it often ends up in large stacks, posing environmental concerns.

- Sludges: The production of fertilizers can result in various sludges, often containing heavy metals and other pollutants. Proper disposal or treatment is crucial to prevent soil and water contamination.

Gaseous Waste from Fertilizer Industry

- **Ammonia (NH_3):**

Source: Produced during the manufacturing of ammonia-based fertilizers.
Environmental Impact: Ammonia emissions contribute to air pollution. It can react with other pollutants in the atmosphere, leading to the formation of particulate matter and aerosols.
Control Measures: Emission control technologies, such as scrubbers, can be employed to capture and reduce ammonia emissions.

- **Greenhouse Gases**, especially Nitrous Oxide (N_2O):

Source: Generated during the production and application of nitrogen-based fertilizers.
Environmental Impact: Nitrous oxide is a potent greenhouse gas with a much higher warming potential than carbon dioxide. It contributes to climate change and can also lead to ozone depletion.
Control Measures: Optimizing fertilizer application practices and using controlled-release fertilizers can help minimize nitrous oxide emissions. Additionally, adopting technologies that enhance nitrogen use efficiency in fertilizers can be beneficial.

Sources of Solid and Gaseous Waste

- **Raw Materials:** The type of raw materials used in fertilizer production can influence the nature of waste generated. For example, phosphate rock in phosphoric acid production.

- **Process Emissions:** The chemical reactions involved in fertilizer production contribute to gaseous emissions. Controlling and optimizing these processes is essential.

Disposal

- **Landfills:** Traditional disposal methods involve storing solid waste in designated landfills. However, this has environmental implications, especially for materials like phosphogypsum.

- **Treatment Plants:** Some solid wastes may undergo treatment to neutralize or reduce their environmental impact before disposal.

- **Controlled Release:** Gaseous emissions can be controlled through proper ventilation and emission control technologies. Efforts should be made to minimize the release of pollutants into the atmosphere.

Sources of Wastewater:

- Process water.
- Process intermediates.
- Final products.
- Oil-bearing wastes from compressor house and boiler house.
- Wash water from gas scrubbing towers.
- Regeneration and rinse waters from demineralization plant.
- Cooling tower and boiler blowdowns.
- Phenols and cyanides, if ammonia is extracted from ammoniacal liquor of coke ovens.

Treatment of waste generated by fertilizer and pesticide industry

The treatment of waste generated by the fertilizer and pesticide industry is essential to minimize environmental and human health risks. This waste includes various byproducts and residues that can be hazardous if not managed properly. Here are some common methods and considerations for treating waste from this industry:

1. **Waste Characterization**: Understanding the nature and composition of the waste is the first step in determining how to treat it effectively.

2. **Segregation and Separation**: Waste should be sorted into different categories based on its type and properties. This makes it easier to manage and treat each type appropriately.

3. **Recycling and Reuse**: Where possible, waste materials should be recycled or reused. For example, excess nutrients from fertilizer production can be repurposed for new fertilizer production.

4. **Wastewater Treatment**: Wastewater generated in the production process should be treated to remove contaminants. This can involve physical, chemical, or biological treatment methods.

Treatment of waste generated by fertilizer and pesticide industry

6.Chemical Treatment: Chemical reactions may be used to neutralize or detoxify hazardous waste. For example, acids or bases can be used to neutralize acidic or alkaline residues.

7. Biological Treatment: Bioremediation, using microorganisms to break down organic contaminants, is a common approach for treating pesticide waste.

8. Secure Landfilling: Waste that cannot be treated or recycled safely should be disposed of in secure, engineered landfills designed to prevent contamination of soil and groundwater.

9. Regulatory Compliance: The industry must comply with environmental regulations and obtain necessary permits for waste management and disposal.

10. Monitoring and Reporting: Regular monitoring of waste treatment processes is critical to ensure proper operation and compliance with regulations. Data must be reported to authorities.

11. Research and Innovation: Continuous research and development can lead to more environmentally friendly products and waste management techniques, reducing the overall environmental impact.

Disposal of wastewater:

a) **Disposal at sea:** Minimum treatment required disposal before disposal is removal of components which could damage, corrode or form incrustations in the pumps, piping and outfall. In addition, a through study of the ocean currents and their mixing characteristics is required to decide the length of the outfall.

b) **Disposal into river:** Treatment required for removal of toxic substances to avoid fish kills, prevent deterioration of downstream water supplies, avoid eutrophication.

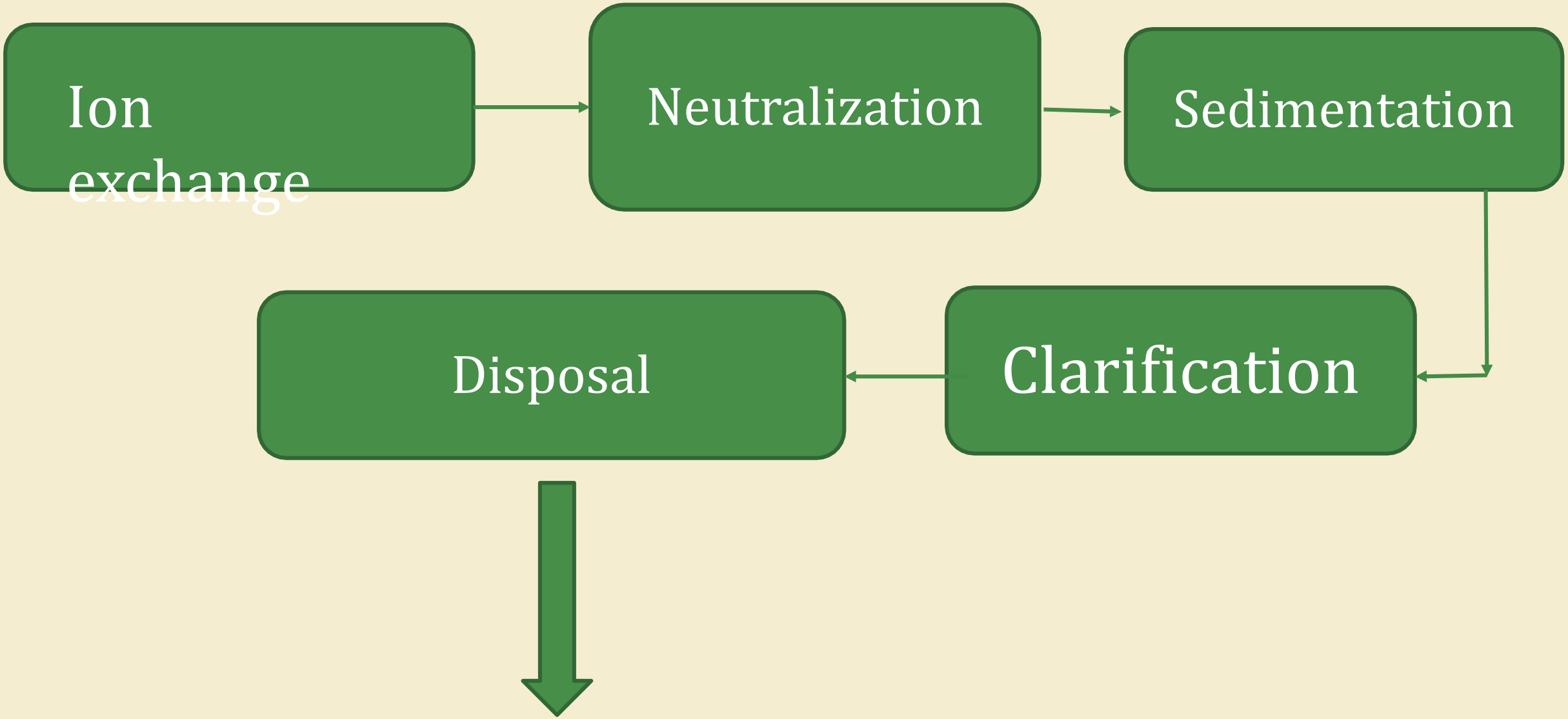
c) **Disposal into land:** Removal of pollutants harmful to soil organisms and reduction of total dissolved solids to less than 2100 mg/L.

Method of treatment :

a) Ion exchange, strong acid resin, weak base resin, air stripping.
b) Neutralization
c) Sedimentation
d) Clarification

Ammonia removal is done by :

a) Air stripping
b) Stream stripping
c) Lagooning after pH adjustment
d) Nitrification and denitrification.


Ion exchange
Neutralization
Sedimentation
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Disposal

Pesticides industry

Pesticides commonly used in agriculture can be grouped as:

a) Insecticides: organochlorines, organophosphates, carbamates and synthetic pyrethroids
b) Organic fungicides and bactericides: dithiocarbamates, dicarboximides, systemic fungicides and benzimidazoles
c) Organic herbicides: phenoxyaliphatic acids, nitroanilines, aryaliphatic acid and bipridylium.

These pesticides persist in water and soil for long time , the factors affecting their persistence depending on the:

a) Nature of pesticides,
b) Nature of water,
c) Properties of the soil.

Most pesticides undergo partial or complete decomposition when exposed to light: the photodecomposition is limited to only the upper layer of the soil.

Manufacturing processes of few pesticides:
Carbaryl, parathion and methyl parathion, malathion, benzene hexachloride (BHC).

Characteristics of wastewater:

a) Benzene ring
b) High organic matter
c) Strong-highly acidic
d) Highly toxic

Methods of treatment:

Simply by dumping into sufficient dilution stream such as ocean.

Method of treatment include chemical, physico-chemical, biological and physical steps, the general sequence being:

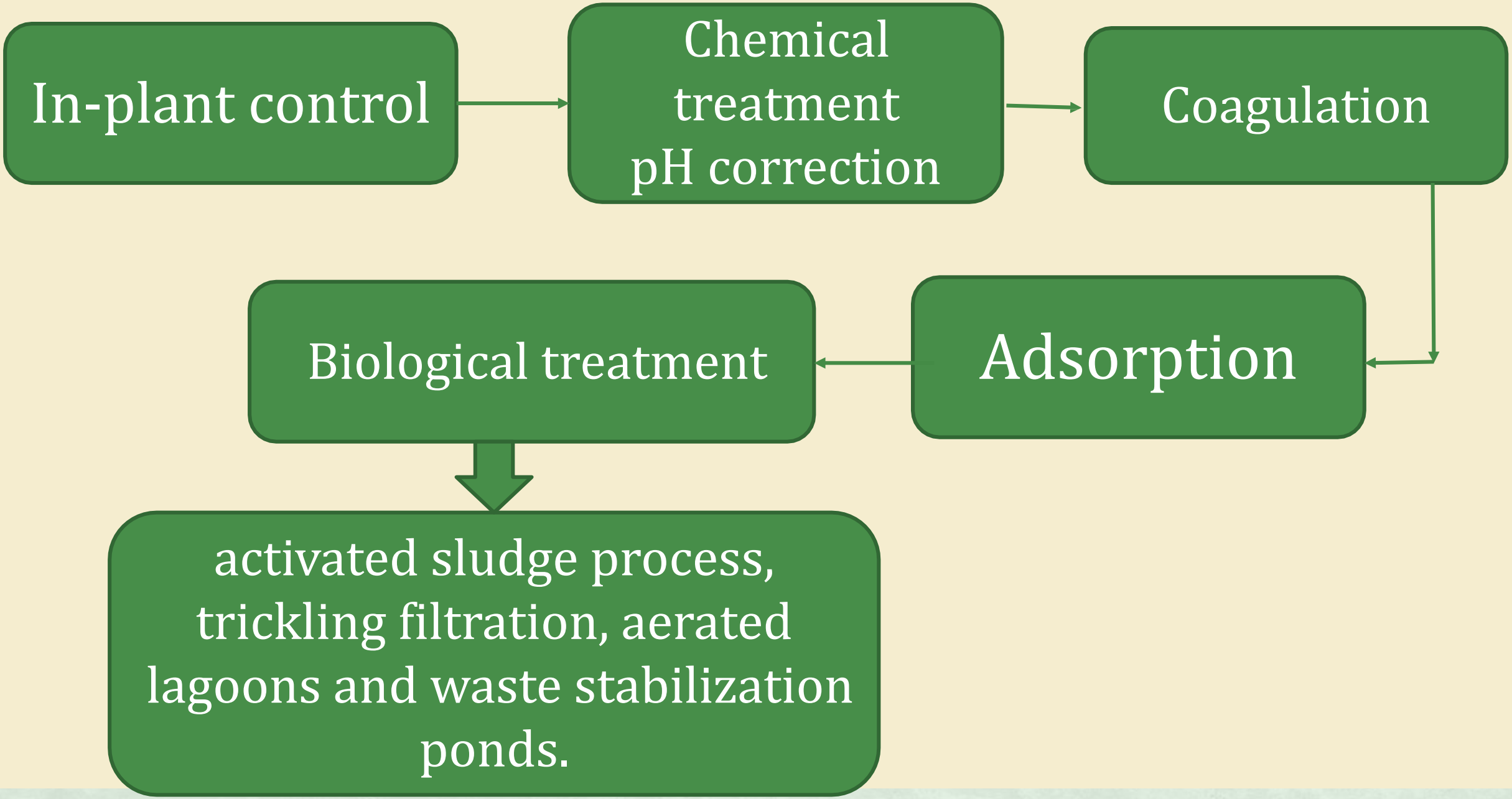
a) In-plant control,

b) Chemical treatment, pH correction by using lime, or sodium hydroxide or anhydrous ammonia, Oxidation with chlorine , ozone, potassium permanganate , hydrogen peroxide has been successful in removing the active components of the pesticides,

c) Coagulation,

d) Adsorption, and

e) Biological treatment include activated sludge process, trickling filtration, aerated lagoons and waste stabilization ponds.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Coagulation
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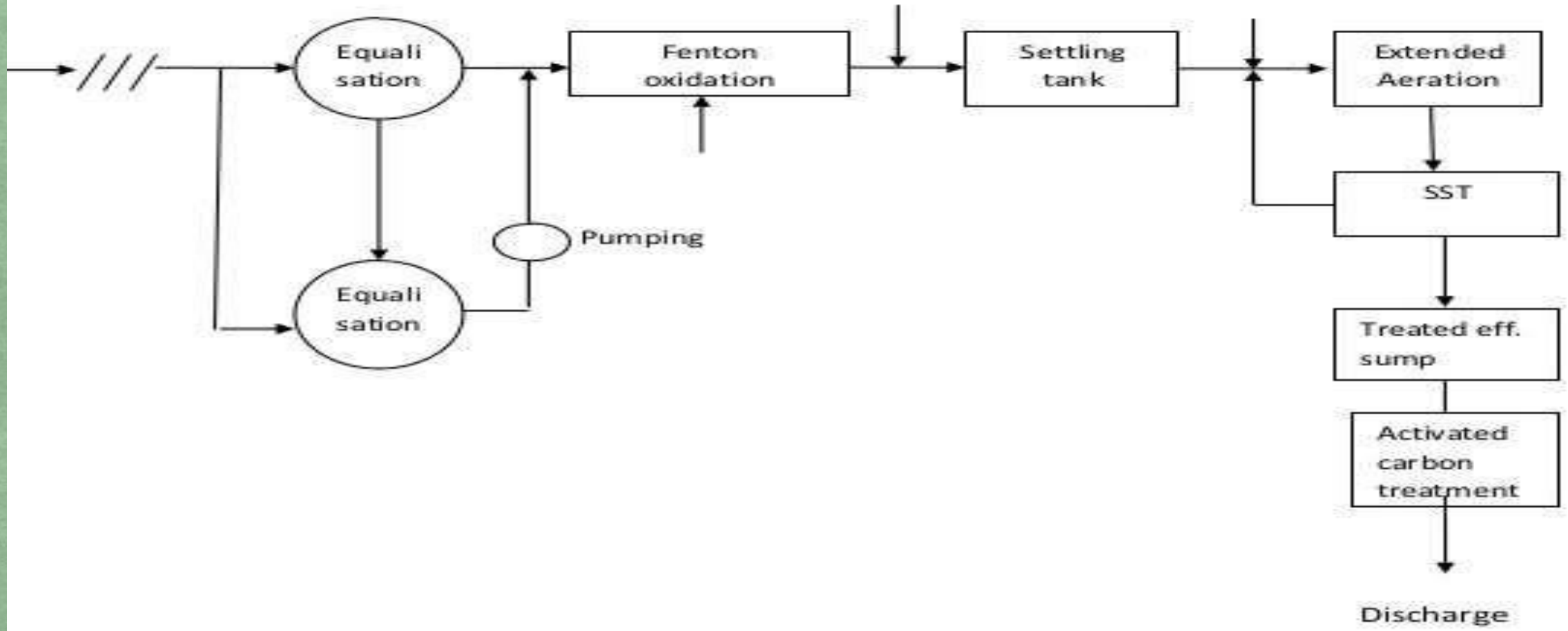
Methods of disposal of solid, semisolid and concentrated liquid wastes from the manufacture of pesticides are as:

a) Incineration
b) Burial
c) Ocean disposal

Effluent Treatment Flow Chart –



Thank you