Industrial effluent treatment and sludge treatment

INTRODUCTION

- Day by day rapid growth of population so that's why rapidly increasing industrialization of the country.
- So all the industries required huge amount of water for different industrial processes.

- Industries use water that obtained from the water treatment system for a variety of purposes, such as
- - For manufacturing goods.
- - For heating.
- - For cooling.
- - As carrier of raw material.
- - As carrier of waste matter.
- - As a solvent.
- • The resulting water is then classified as a wastewater.

WHAT IS INDUSTRIAL WASTE WATER ?

- Industrial wastes include liquid, solids and gases, we are presently concerned with liquid part, which is commonly known as industrial waste water.

- Waste **Water which is generated as a by-product from process unit operation having constituents which can cause harmful & hazardous effect to human, animal, plants, aquatic & microbial life / different life forms on the earth.**

Sources of industrial wastewater

- Agricultural waste
- Iron and steel industry
- Mines and quarries
- Food industry
- Complex organic chemicals industry
- Nuclear industry
- Textile industry
- Dairy industry

VARIOUS TYPES OF POLLUTANTS PRESENT

- Suspended Solid
- Colloidal Solids
- Inorganic & Organic Salts
- Organic compounds (Solvents, Pesticides, Insecticides, Herbicides, volatile compounds etc.)
- Oil & Grease
- Ammonia
- Phosphate
- Heavy Metals
- Cyanide
- Refractory substances resistant to biodegradation. e.g. ABS (Alkyl Benzene Sulfonate)
- Pathogens
- Colour

OBJECTIVE

- The principal objective of industrial wastewater treatment is generally to allow industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment.

- To manage water discharged from homes, businesses, and industries to reduce the threat of water pollution.

- **There are three alternatives for the disposal of industrial wastes-**

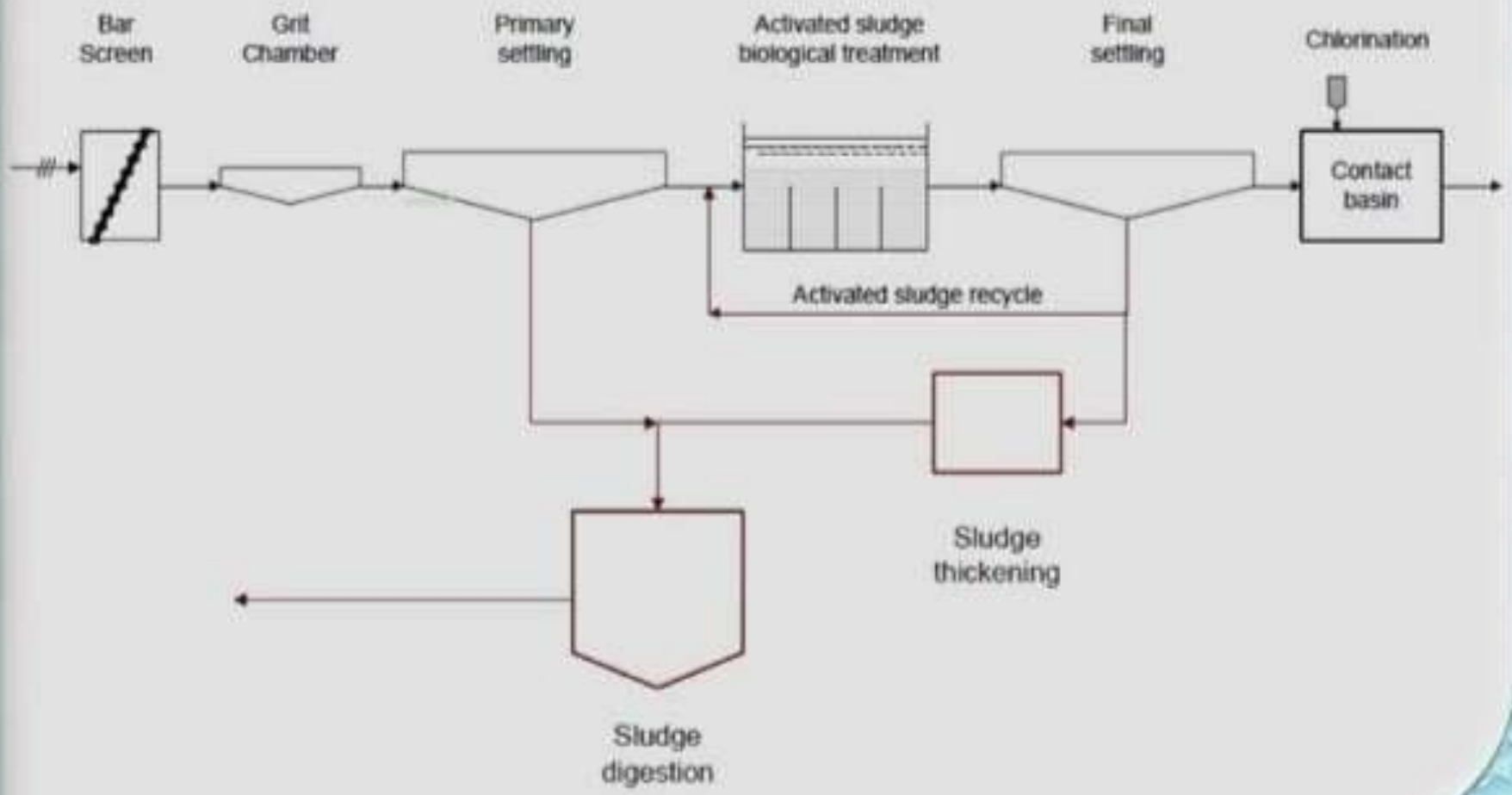
1. Direct disposal into the receiving waters, without any treatment.

2. Disposal into the municipal sewers for combined treatment.

1. Separate treatment of industrial wastes, before their disposal into receiving water/land.

Plan of a Typical Waste Water Treatment Plant

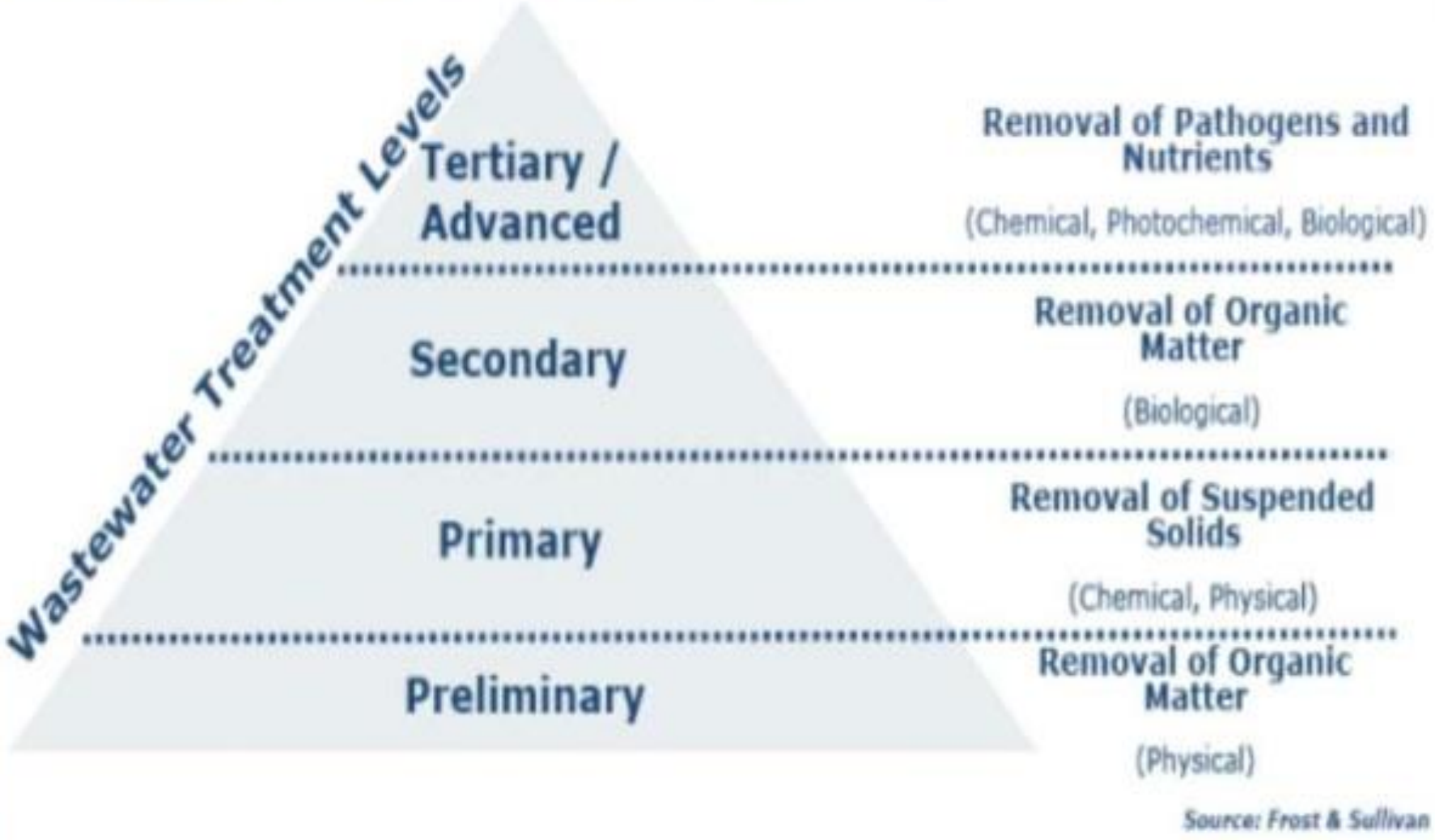
Typical wastewater treatment plant



WASTE WATER TREATMENT PROC

- Preliminary Treatment
- Primary Treatment
- Secondary Treatment
- Tertiary Treatment

Water and Wastewater Treatment Technologies: Levels of Wastewater Treatment



Source: Frost & Sullivan

Preliminary Treatment

Removal of waste water constituents such as rags, sticks, floatable grit, and grease that may cause maintenance or operational problem with the treatment operations, processes, and ancil1ary systems

Preliminary Treatment

Preliminary treatment consists of following units

- Screening — For removal of floating matter.
- Grit Chamber — For removal of sand and grits.
- Comminuters — For grinding large size suspended solids
- Floatation Units — For removal of oil and grease
- Skimming Tanks
- Flow Measuring units such as partial flume
- Pumps
- Pre-aeration Units

Primary Treatment

Removal of a portion of the suspended solids and organic matter from the wastewater.

Primary Treatment

Primary treatment consists of following processes/units

- Sedimentation — Primary Settling Tanks
- Coagulation — Secondary Settling Tank
- Flocculation

Enhanced removal of suspended solids and organic matter from the wastewater. Typically accomplished by chemical addition or filtration known as Coagulation and Flocculation.

Secondary Treatment

Removal of biodegradable organic matter [insoluble or suspension state} and suspended solids. Disinfection is also typically included in the definition of conventional secondary treatment

Secondary Treatment

Secondary Treatment Process for Wastewater Applications:

- Aeration Systems
- Biological Treatment Systems
- Sludge and Bio solids Processing Systems

Secondary treatment consists of following processes.

- Activated Sludge Process
- Oxidation Ponds and lagoons
- Trickling Filter

Secondary Treatment Process

Stabilization ponds & Lagoons:

- The ***stabilization ponds*** are open flow through basins specifically designed and constructed to treat sewage and biodegradable industrial wastes.
- They provide long detention periods extending from a few to several days.
- Pond systems, in which oxygen is provided through mechanical aeration rather than algal photosynthesis are called *aerated lagoons*.
- Lightly loaded ponds used as tertiary step in waste treatment for polishing of secondary effluents and removal of bacteria are called ***maturation ponds***.

Activate Sludge Process

In activated sludge process wastewater containing organic matter is aerated in an aeration basin in which micro-organisms metabolize the suspended and soluble organic matter.

Trickling filter

- Its also known as percolating filter or sprinkling filters.
- Trickling filter are used for biological treatment industrial waste which are amenable to aerobic biological processes.
- This will prevent the clogging of the by the filter settleable solids.
- A trickling filter or bio filter consists of a basin or tower filled with support media such as stones, plastic shapes, or wooden slats.

Tertiary Treatment

Removal of residual suspended solids (after secondary treatment), usually by granular medium filtration or micro screens. Disinfection is also typically a part of tertiary treatment. Nutrient removal is often included in this definition

TERTIARY TREATMENT

Process	Application
Chlorination / Ozonation / UV	For destruction of pathogen & chemical oxidation of organic matter
Filtration (Media, U/F, Micro, Nano)	For removal of suspended solids, oil & organics
Reverse Osmosis	Recovery of water for reuse
Evaporation	To reduce volume / zero discharge
Post Aeration	To increase the dissolved oxygen conc. is treated waste water before discharge to river/ sea.

SLUDGE TREATMENT

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Introduction…

Sludge refers to the residual, semi-solid material left from industrial wastewater, or sewage treatment processes.

Waste water sludge is the mixture of waste water and settled solids.

Depending upon the source it may be primary, secondary, excess activated sludge.

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Objectives…

- To reduce the volume of the material to be handled by removal of liquid portion.
- To decompose the organic matter and inorganic compounds for reduction in the total solids.

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GOALS OF SLUDGE TREATMENT…

Volume reduction	• Thickening • Dewatering
Elimination of pathogenic germs	• If used in agriculture as fertiliser or compost
Stabilisation of organic substances	• Gas production • Reduction of dry content • Improvement of dewatering • Reduction of odour
Recycling of substances	• Nutrients, fertiliser • Humus • Biogas

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Sludge handling and disposal includes:-

- Collection of sludge
- Transportation of sludge
- Processing of sludge to convert it to a form suitable for disposal
- Final disposal of the sludge

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Sludge types…

- Primary sludge
  - 3 to 8 % solids
  - About 70% organic material
- Sec. sludge
  - Wasted microbes and inert materials
  - 90% organic material
- Tertiary sludge
  - If sec. clarifier is used to remove phosphate, this sludge contain chemical precipitates.

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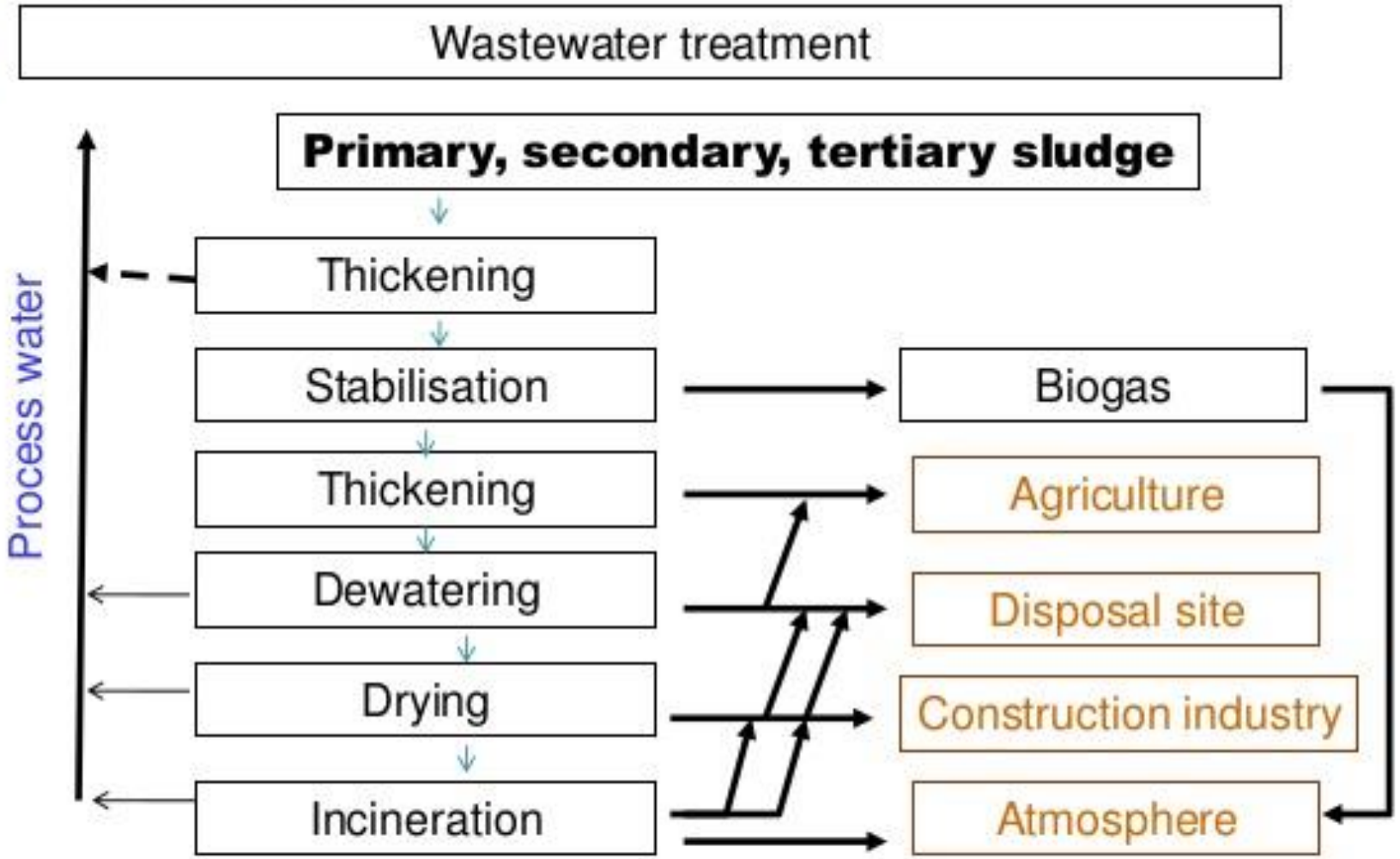
Overview



Need for sludge treatment

- *Coarse primary solids and secondary biosolids accumulated in a wastewater treatment process must be treated and disposed of in a safe and effective manner. This material may be inadvertently contaminated with toxic organic and inorganic compounds.*

Digestion of Sludge

- *The purpose of sludge digestion is to reduce the amount of organic matter and the number of disease-causing micro-organisms present in the solids. The most common treatment options include Anaerobic digestion, aerobic digestion, and composting.*

Anaerobic digestion

- *A bacterial process carried out in the absence of oxygen.*

a)Thermophilic, in which sludge is fermented in tanks at a temperature of 55°C

b) Mesophlic, at a temperature of around 36°C.

Adv. And Disadv. Of Anaerobic Digestion

- *Generates Biogas with a high proportion of methane that may be used to both heat the tank or for other on-site processes..*
- *Its key disadvantage is the long time required for the process (up to 30 days) and the high capital cost.*

Aerobic Digestion

- *Aerobic digestion is a bacterial process occurring in the presence of oxygen. Under aerobic conditions, bacteria rapidly consume organic matter and convert it into Carbon dioxide. Once there is a lack of organic matter, bacteria die and are used as food by other bacteria. This stage of the process is known as* **endogenous respiration**.

Adv. And Disadv. Of Aerobic Digestion

- *Since Aerobic digestion occurs much faster than anaerobic digestion, the capital costs of aerobic digestion are lower.*
- *The operating costs are characteristically much greater for aerobic digestion because of energy costs for Aeration needed to add oxygen to the process.*

Composting

- *Composting is also an aerobic process that involves mixing the wastewater solids with sources of Carbon such as sawdust, straw or wood chips. In the presence of oxygen, bacteria digest both the wastewater solids and the added carbon source and, in doing so, produce a large amount of heat.*

Thermal depolymerization

- *convert reduced complex organics to oil.*
- *grit-reduced sludge is heated to 250C and compressed to 40 MPa.*
- *The hydrogen in the water inserts itself between chemical bonds in natural polymers. The oxygen of the water combines with C, H and metals. The oxygen of the water combines with carbon, hydrogen and metals. The result is oil, light combustible gases, carbon dioxide, and residue of inert insoluble material*

Sludge Thickening

- *Thickening is carried out in a sedimentation tank or in a sedimentation pond. The latter is advantageous if land area is available, because a higher solids content of the thickened sludge is achieved.*

Sludge Dewatering and Drying

- *Dewatering aims to reduce the water content further so that the solids content of the sludge is about 20 %. The sludge can then be handled like a solid.*
- *Dewatering can be done mechanically using a filter press or a centrifuge. It can also be done using drying beds.*

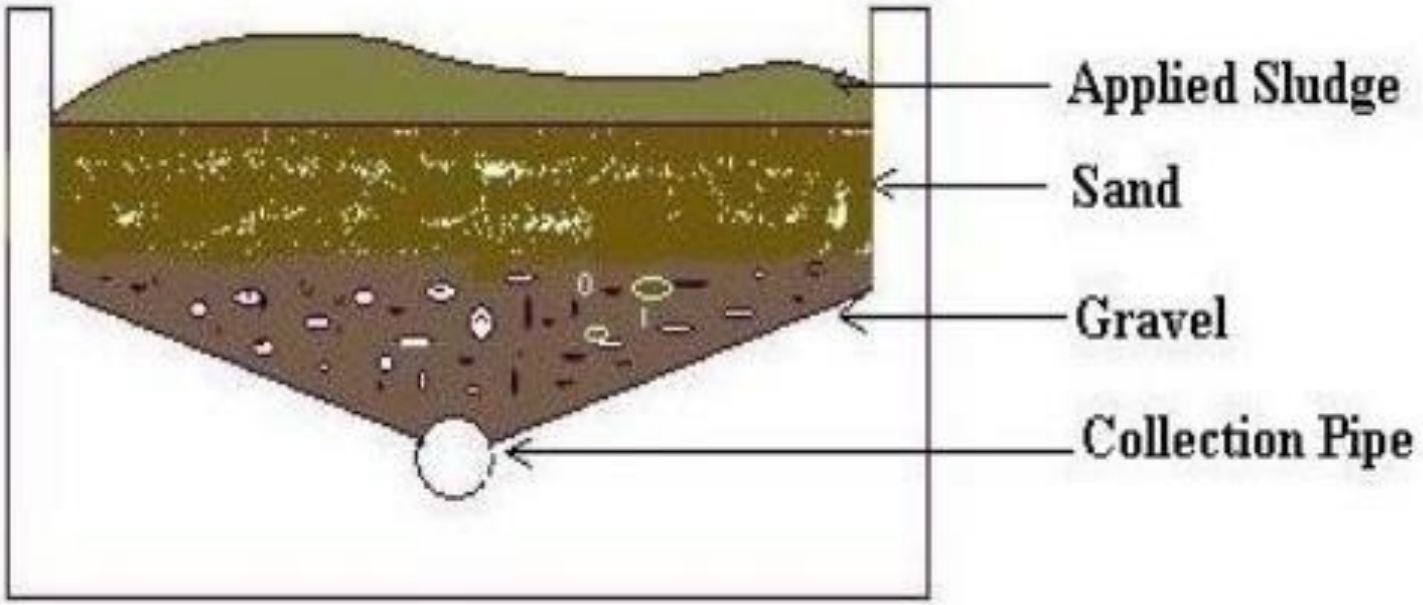


Fig: Sludge Drying Bed

Sludge Reuse

- *Reuse of composted sludge as a soil conditioner returns C, N, P and elements essential for plant growth back to the soil. Less chemical fertilisers are required. The potential of leaching of the nutrients to ground or surface water by rainfall run-off is much reduced.*
- *Pathogens and heavy metals can limit the reuse of sludge.*

Disposal of sludge

- *Final disposal of sludge, which cannot be reused, is by landfilling or incineration.*
- *lining of the landfill with clay or plastic liner may be required.*
- *Incineration of sludge is by a multiple hearth furnace or fluidised bed furnace. Combustion flue gases usually need treatment to meet air pollution control standards.*