

Soil Pollution

- Soil is the upper layer of the earth that is produced by weathering of rocks over thousands of years.
- Soil is a mixture of inorganic minerals and organic compounds.
- Presence of harmful substances in soil cause severe damage to the quality of soil adversely affecting agricultural productivity. This is called land or soil pollution.

Causes of Soil Pollution

- Household / industrial wastes containing organic and inorganic substances, solid wastes, plastics, inorganic chemicals, heavy metals and toxic chemicals are dumped into soil.
- Domestic waste, sewage and sludge are the major sources of soil pollution in urban areas.
- Large amount of discarded materials viz. concrete, asphalt, paper and rags, leather, plastics, cans, glass and packing materials etc. are usually dumped into soil of landfills.

- **Acid rain** taking place due to air pollution, results in soil pollution, by making the soil acidic and infertile.
- **Chemicals used** to kill insects, rats, snails, fungi, herbs, etc., viz. pesticides, rodenticides, fungicides, herbicides get accumulated in the soil and cause soil pollution.
- **Radioactive wastes** and nuclear wastes from nuclear reactors and nuclear explosions also causes soil pollution.

Effect of Soil Pollution

- The toxicity level of soil is increased due to industrial effluents. Heavy metals destroy useful micro-organisms in the soil and also cause diseases.
- Excessive use of chemical fertilizers causes soil deterioration, reducing the fertility of soil.
- Soil polluted by dumping of sewage can cause the spread of diseases like typhoid, jaundice, dysentery, and gastroenteritis.

Control of Soil Pollution

- Recycling of solid waste should be encouraged.
- Excessive use of chemical fertilizers and pesticides should be avoided and use of bio-fertilizers and bio-pesticides should be encouraged.
- To prevent the reduction of nutrients in soil, the practice of crop rotations should be popularized.
- Sewage waste should be converted into organic manure through composting. Bio-gas can be produced from cattle dung.

- Afforestation and bioremediation of soil can reduce the soil degradation due to soil erosion.
- Biological control of pests should be encouraged by introducing selective pathogenic microbes/ insects.
- Atomic power plants should be properly constructed to prevent leakage of radioactive substances into the soil.

Soil Pollution



Soil Pollution



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Soil Pollution



Soil Pollution



Soil Erosion

It is the displacement of the upper layer of soil; it is a form of soil degradation. This natural process is caused by the dynamic activity of erosive agents, that is, water, ice (glaciers), snow, air (wind), plants, and animals (including humans).

Soil pollution Management

- Few things are listed below that could help in reducing soil pollution.

1. Reduced Use of Chemical Fertilizers

- Chemical fertilizers do more harm than good. While proper amounts could enhance the fertility of the soil, excess of it actually poisons the soil. The excess of chemical fertilizers could pollute the soil in several ways. It could mess with the pH levels of the soil.
- It could also destroy the good microorganisms in the soil. Not only that, but the runoffs from such soils also cause water pollution as well. Thus using chemical fertilizers is like a double-edged sword.

2. Reforestation and Afforestation Should be Promoted

- One of the major causes of soil pollution is soil erosion that is caused due to deforestation. It is natural that with the ever-growing population, the humankind needs more and more space to expand their civilization. Often it is achieved at the cost of the health of the soil. To prevent this from happening, reforestation of a deforested area should be promoted.
- Also, afforestation should be promoted in the barren lands. The roots of the plants bind the soil particles together and even capture good microorganisms in the soil. It also ensures the maintenance of the underground water table.

3. **Recycle and Reuse Products**

- These steps not only reduce waste generation but also ensure that soil pollution is reduced. At present, plastic forms a significant portion of the generated wastes. More often than not, these wastes are buried in landfills.
- In these landfills, these plastics and other materials decompose slowly and release toxic materials into the soil. These toxic substances are very harmful to the health of the soil and are a major source of soil pollution.
- By reusing and recycling things, we would ensure that lesser wastes are dumped in these landfills, and this, in turn, would reduce soil pollution.

4. **Get the Locals Involved**

- In order to ensure that a problem like soil pollution is solved, it is essential that every individual must get involved. It is with their involvement that things can work out better. Awareness programs could be designed so that people understand soil pollution better. If people are aware, they will help even subconsciously.

5. **Promote Use of Natural Manure**

- Natural manure is one of the best sources of nutrients for the soil. It is harmless and completely organic. It adds essential nutrients to the soil and restores the health of the soil. It has no harmful by-products that could harm the soil or the environment in any way.

Solid Waste Management

- Higher standards of living, rapid population growth and urbanization in developing countries has resulted in the generation of enormous quantities of solid waste.
- If waste generation continues in this way, it would result in irreparable damage to the environment.
- The waste is normally disposed without proper treatment in open dumps, resulting in widespread environmental pollution and degradation.
- Solid wastes cause a major risk to public health and the environment. Therefore, solid waste management become very important in order to minimize the adverse effects of solid wastes.

Types of Solid Waste

- Solid wastes (waste which are neither liquid nor gaseous) can be classified into
 - Urban or municipal wastes
 - Industrial wastes
 - Agricultural wastes
 - Medical wastes
 - Mining wastes
 - Hazardous wastes

The problem of solid waste generation is increasing rapidly with urbanization and industrial development. Developed countries viz. USA, Canada, Japan, England, Germany and France are the main solid waste producers.

Sources of Urban Waste

- **Domestic wastes:** It includes a variety of materials thrown out from homes
 - Food waste, Cloth, Waste paper, Glass bottles, Polythene bags, Waste metals, plastic containers, scrap, paints etc.
- **Commercial wastes:** It includes wastes coming out from shops, markets, hotels, offices, institutions, etc.
 - Waste paper, packaging material, cans, bottle, polythene bags, etc.
- **Construction wastes:** It includes wastes of construction materials.
 - Wood, Concrete, Debris, etc.

- **Horticulture waste** and waste from slaughter houses include vegetable parts, residues and remains of slaughtered animals, respectively.
- **Biomedical wastes**: It includes mostly waste organic materials
 - Anatomical wastes, Infectious wastes, glass bottles, plastic, metal syringe, etc.
- A large amount of solid waste is released from the mining activities.
- The increase in solid waste is due to **overpopulation**, affluence and technological advancement.

Classification of Urban Wastes:

Urban wastes are classified into two categories:

- Bio-degradable wastes
 - Those wastes that can be degraded by micro organisms are called biodegradable wastes
 - Food, vegetables, tea leaves, dry leaves, etc.
- Non-biodegradable wastes
 - Urban solid waste materials that cannot be degraded by micro organisms are called non-biodegradable wastes.
 - Polythene bags, scrap materials, glass bottles, etc.

Sources of Industrial Waste:

- The main source of industrial wastes are chemical industries, metal and mineral processing industries.
- Nuclear plants: Generate radioactive wastes
- Thermal power plants: Produce solid waste in the form of fly ash
- Chemical Industries: Produce large quantities of hazardous and toxic materials.
- Other industries: Other industries produce packing materials, rubbish, organic wastes, acid, alkali, scrap metals, rubber, plastic, paper, glass, wood, oils, paints, dyes, etc.

- **Typical Toxic Wastes**

- Solid tarry matter
- Pesticide residues
- Sludges containing copper, zinc, cadmium, nickel, arsenic, etc.
- Sulphides, fluorides
- Alkaloid wastes
- Aromatic hydrocarbons
- Chlorophenols
- β -naphthylamine

- **Harmful Effects of Solid Wastes**

- Inappropriate disposal of municipal solid waste on the roads and surroundings, results in the production of foul smell and spread of diseases, due to the decomposition of biological matter.
- Toxic metals like mercury and lead are released into the environment due to inappropriate disposal of industrial solid wastes. Hazardous solid wastes released by industries also cause soil pollution and affect the productivity of soils.
- Contamination of groundwater takes place because of toxic substances release from solid wastes.
- Burning of industrial or domestic wastes (cans, pesticides, plastics, radioactive materials and batteries) produce carcinogenic chemicals like dioxins and polychlorinated biphenyls.

- Water contaminated due to improper disposal of solid waste causes diseases like diarrhoea, dysentery, typhoid, cholera, plague, etc.
- Solid waste modifies the physiochemical and biological properties of plants and soil.
- Groundwater gets contaminated.
- It enhances air and water pollution.
- Provides breeding sites of insects and infectious organisms are produced.
- Solid waste management involves waste collection, transportation, segregation of wastes and disposal techniques.

- **Steps involved in Solid Waste Management**
- Important steps involved in solid waste management
 - Reduce, Reuse and Recycle of Raw Materials
 - Discarding wastes
- If usage of raw materials is reduced, the generation of waste also gets reduced
- Plastic bottles, metal containers, clothes and many other household items can be reused many times before discarding them
 - Rubber rings, and other useful items can be made from discarded cycle tubes.

Recycling

- Recycling is the reprocessing of discarded materials like glass, old paper cans, newspapers, tin, plastic, rubber, into new useful products.
 - Old aluminium cans and glass bottles can be recycled to produce new ones
 - Waste paper can be recycled to make fresh paper
 - Metals like steel and aluminum can be easily recycled. Lead is widely recycled.
 - Reduce, Reuse & Recycle (3R's) help in saving money, energy, raw materials and thereby help in reducing pollution.







Discarding wastes

- The following methods are adopted for discarding wastes:
 - Landfill
 - Incineration and
 - Composting

Landfills

- In sanitary landfills waste is dumped in many layers of 80 cm thick refuse which is covered with soil of 20 cm thickness. The decomposition of solid wastes generates toxic gases. Solid waste volume shrinks by 25-30% after 2-3 years. This is the most common and cheapest method of waste disposal and is mostly employed in big cities.

Advantages

- It is simple and economical
- Segregation of wastes is not required
- Landfilled areas can be reclaimed and used for other purposes
- Converts low-lying waste-land into useful areas.

Disadvantages

- Large area is required
- Land availability is away from the town, transportation costs are high
- Leads to bad odour if landfill is not properly managed.
- Land filled areas will be sources of mosquitoes and flies requiring application of insecticides and pesticides at regular intervals.
- Causes fire hazard due to formation of methane in wet weather.





Hazardous waste

Hazardous waste is solid waste that has hazardous waste characteristics or is a listed hazardous waste.

Hazardous substance may exhibit one or more of the following hazardous characteristics:

- ignitability, or something flammable.
- corrosivity, or something that can rust or decompose.
- reactivity, or something explosive.
- toxicity, or something poisonous.

Examples

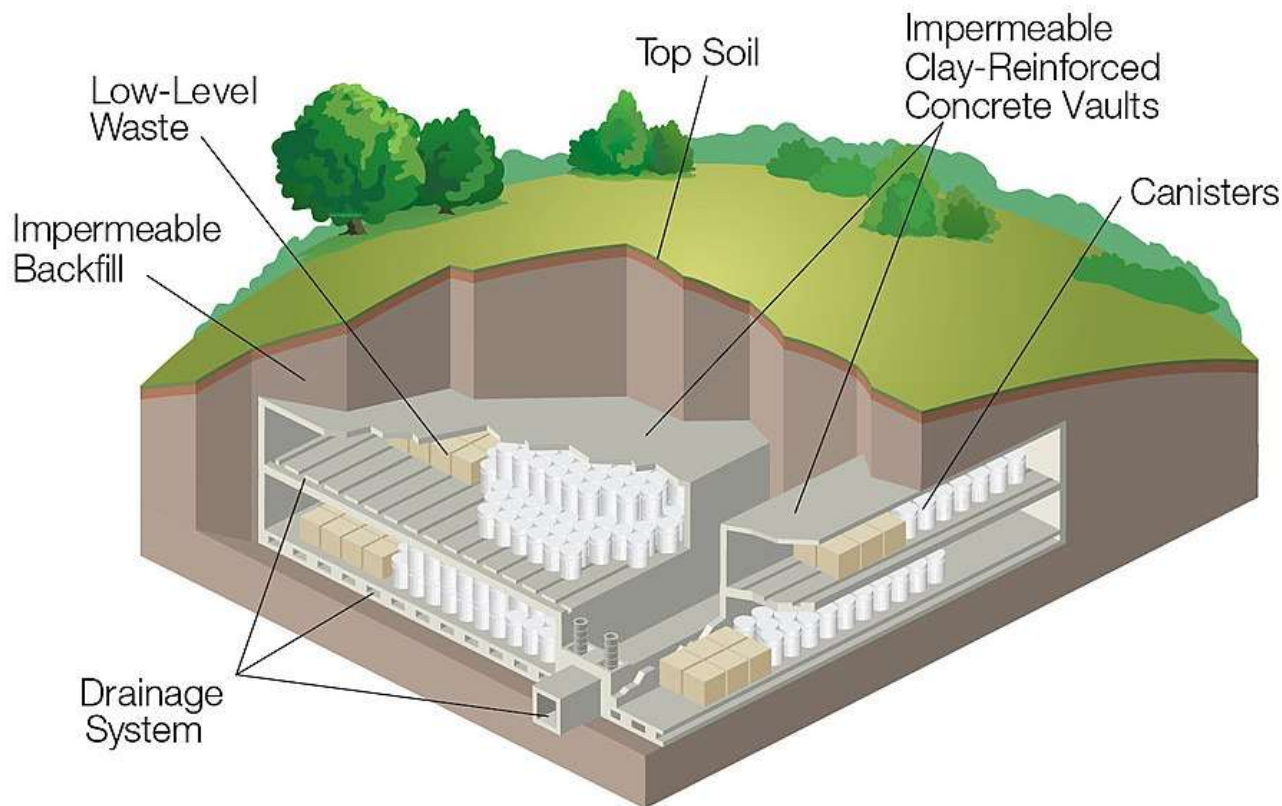
- Batteries containing toxic metals (zinc, lead or mercury)
- Radioactive materials
- Wastes from hospitals & pathology Labs
- Toxic Chemicals

Medical waste



Disposal of Radioactive Waste

Low-Level Radioactive Waste Disposal



This LLW disposal site accepts waste from States participating in a regional disposal agreement.



Disposal of Radioactive waste



Incineration

- It is a hygienic way of disposing solid waste. It is suitable if waste contains more hazardous material and organic content. This process is the most effective process for completely destroying plastic waste and pathogenic medical waste. It is expensive process, compared to other methods of waste disposal.
- Municipal solid wastes are burnt at high temperature in big furnaces called incinerators. Combustible substances such as plastic materials, rubbish, garbage, dead organisms are separated for burning in incinerators. The non-combustible materials can be left out for recycling and reuse. About 10 % solid material and ash remains after combustion which can be disposed off by other means.

- The heat produced in the incinerator during burning of refuse is used for generation of electricity through turbines.
- Municipal solid waste is generally wet and has a high calorific value. Therefore, it has to be dried first before burning. Waste is dried in a preheater from where it is taken to a large incinerating furnace called "destructor" which can incinerate about 100 to 150 tonnes per hour. Temperature normally maintained in a combustion chamber is about 700 C which may be increased to 1000 C when electricity is to be generated.

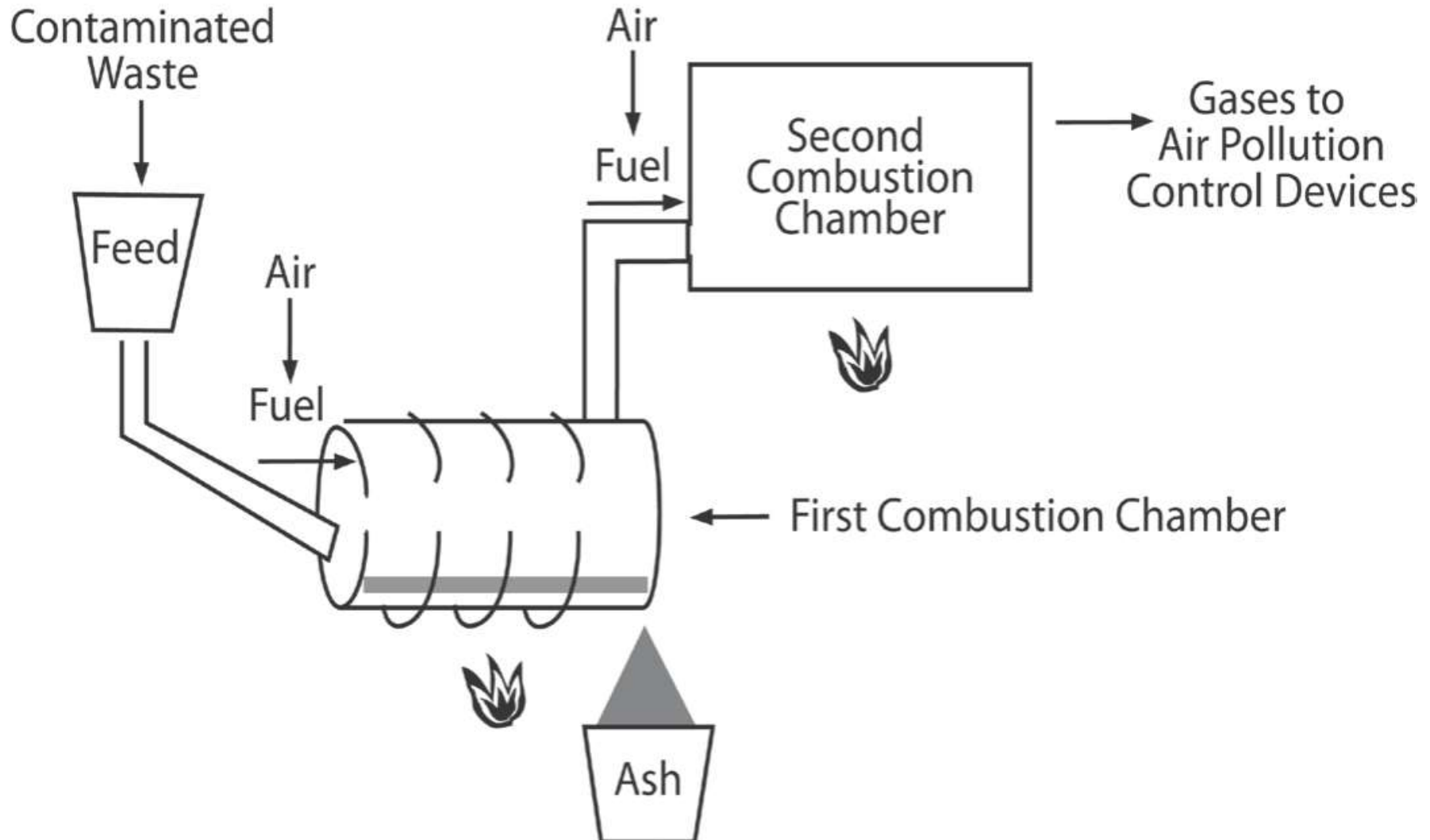
Advantages

- It reduces the waste volume by 90 per cent
- Requires very little space
- Safest from hygienic point of view
- The only method available for safe and complete decomposition/destruction of plastic waste
- An incinerator plant of 3000 tonnes per day capacity can generate 3MW of power.

Disadvantages

- Its capital and operating cost is very high
- Operation needs skilled personnel
- Formation of smoke, dust and ashes needs further disposal and that may cause air pollution.
- During incineration high levels of dioxins, furans, lead and cadmium may be emitted with the fly ash of incinerator.

Incineration



Incineration Plant

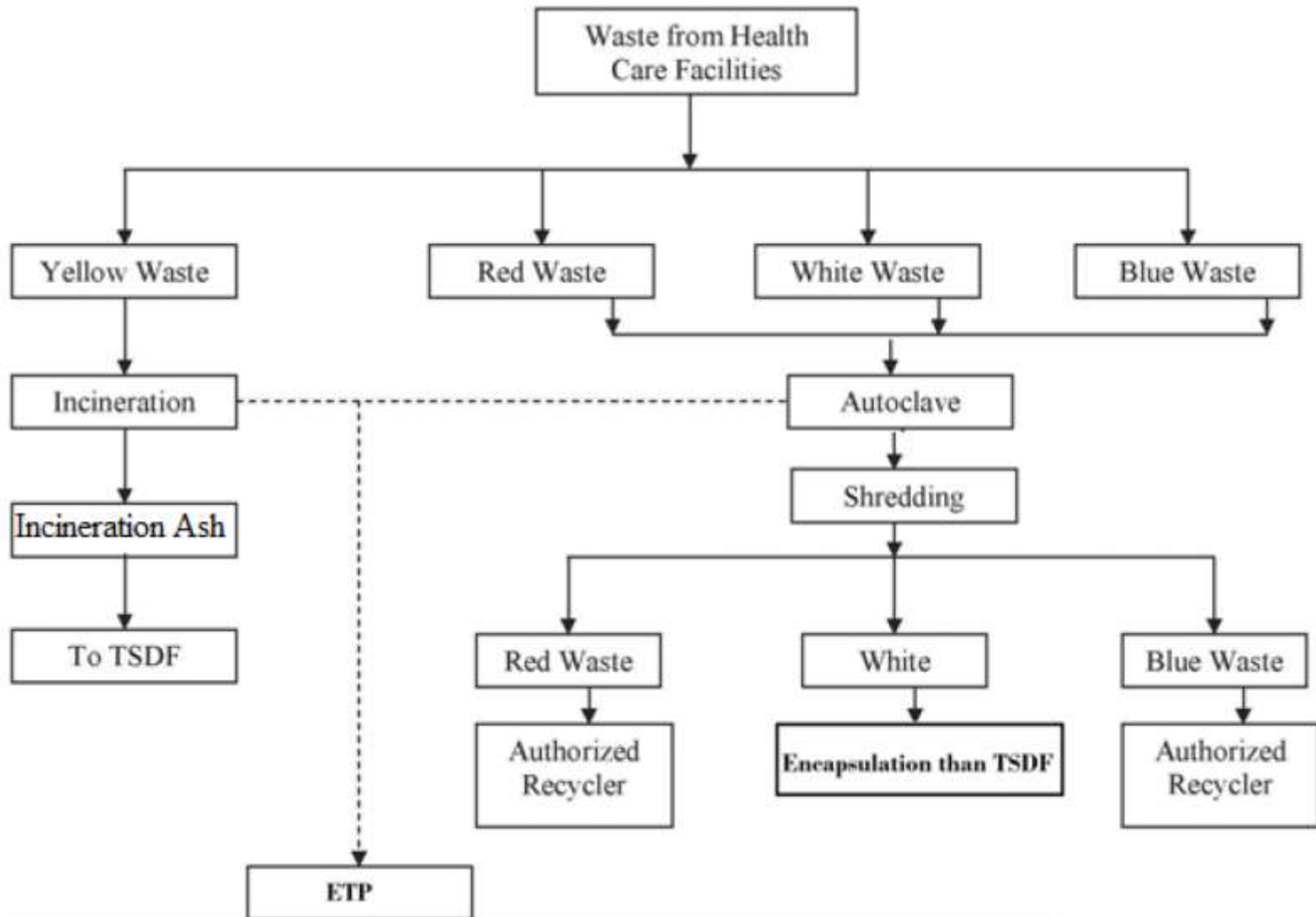


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Incineration Plant



Incineration of Medical waste



Composting

- It is a popular method used for the disposal of biodegradable wastes. During composting microorganisms like bacteria and fungi decompose the plant and animal waste into organic manure.
- Waste needs to be separated into biodegradable and non- biodegradable wastes before composing. Biodegradable wastes is dumped in underground trenches and covered with earth/old manure and left for decomposition. Organic matter is decomposed by bacteria and the refuse is finally converted into powdery brown coloured mass called compost which can be used in agriculture.

- Methane gas is also released during the process of composting, which can be utilized by composting the waste in a bio-gas plant.
- In several parts of India compost plants are in operations, e.g. in Ahmedabad, Calcutta, Mumbai, Chennai, Delhi, Pune, and Hyderabad.

Advantages

- Waste is converted into useful manure which enhances the productivity of soil.
- Industrial solid wastes which are biodegradable, can be composted.
- Manure can be sold easily, thereby reducing cost of waste disposal

Disadvantages

- Non-biodegradable waste must be separated collected.
- Non-biodegradable waste must be disposed off separately.
- The technology still not widely used due to problems in implementation.

Composting



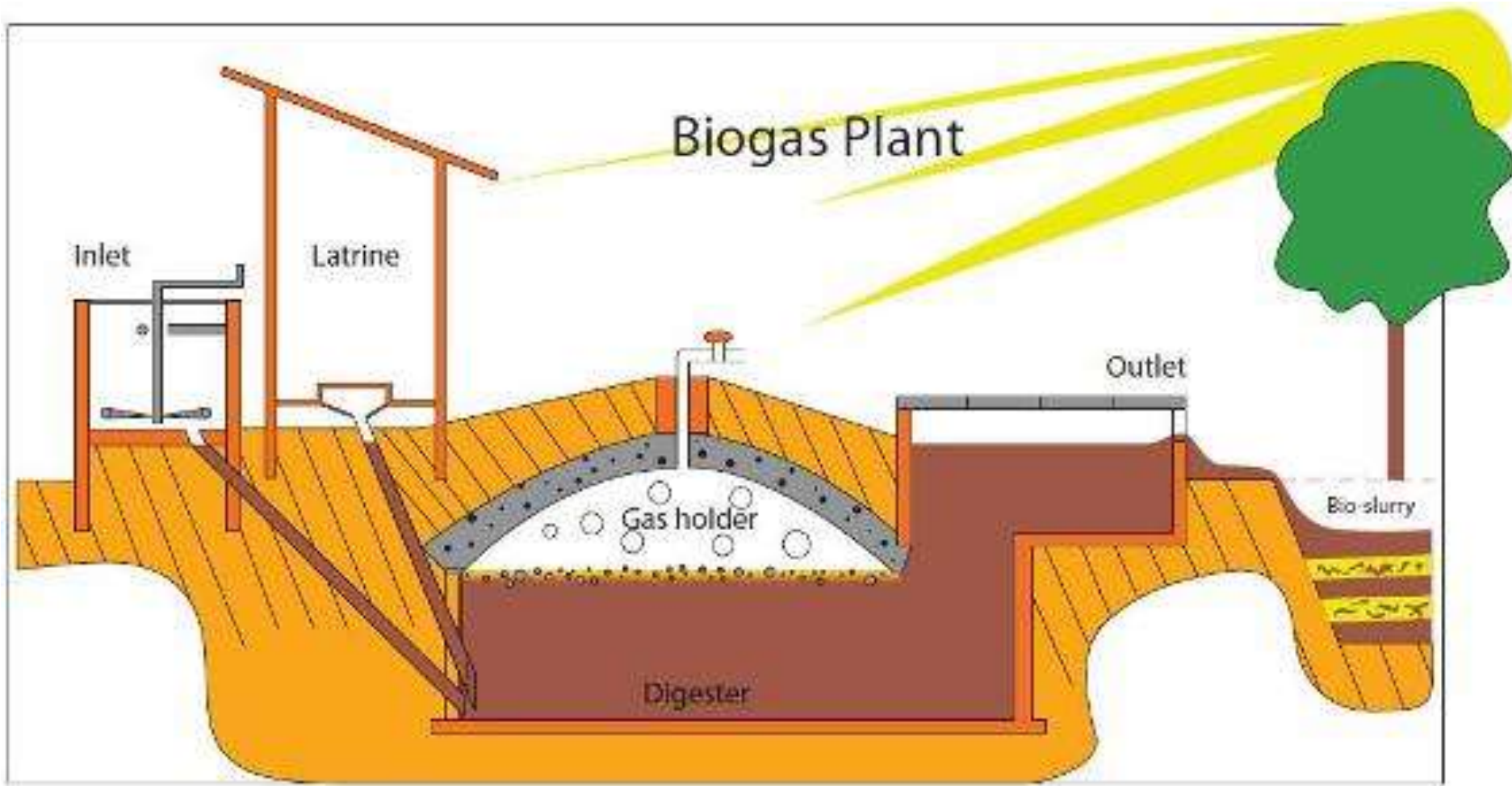
Composting



Composting



Bio Gas Plant



Bio Gas Plant



Sewage Treatment or waste water Treatment

Sewage:

- Wastewater from drains or sewers is released into water bodies. Sewer includes human wastes, soaps, and detergents.
- It causes serious environmental problems:
 - Enrichment of a body of water by high levels of plant and algal nutrients (nitrogen and phosphorus).
 - Increase in Biological Oxygen Demand (BOD) i.e. the amount of oxygen needed by microorganisms to decompose biological wastes.
 - As BOD increases Dissolve Oxygen (DO) decreases.

Treatment of Sewage

Primary treatment

Removing suspended and floating particles by mechanical processes .

Secondary treatment

Treating wastewater biologically to decompose suspended organic material; reduces BOD.

Sewage Sludge

Solids remaining after primary and secondary sewage treatment has been completed.

Tertiary treatment

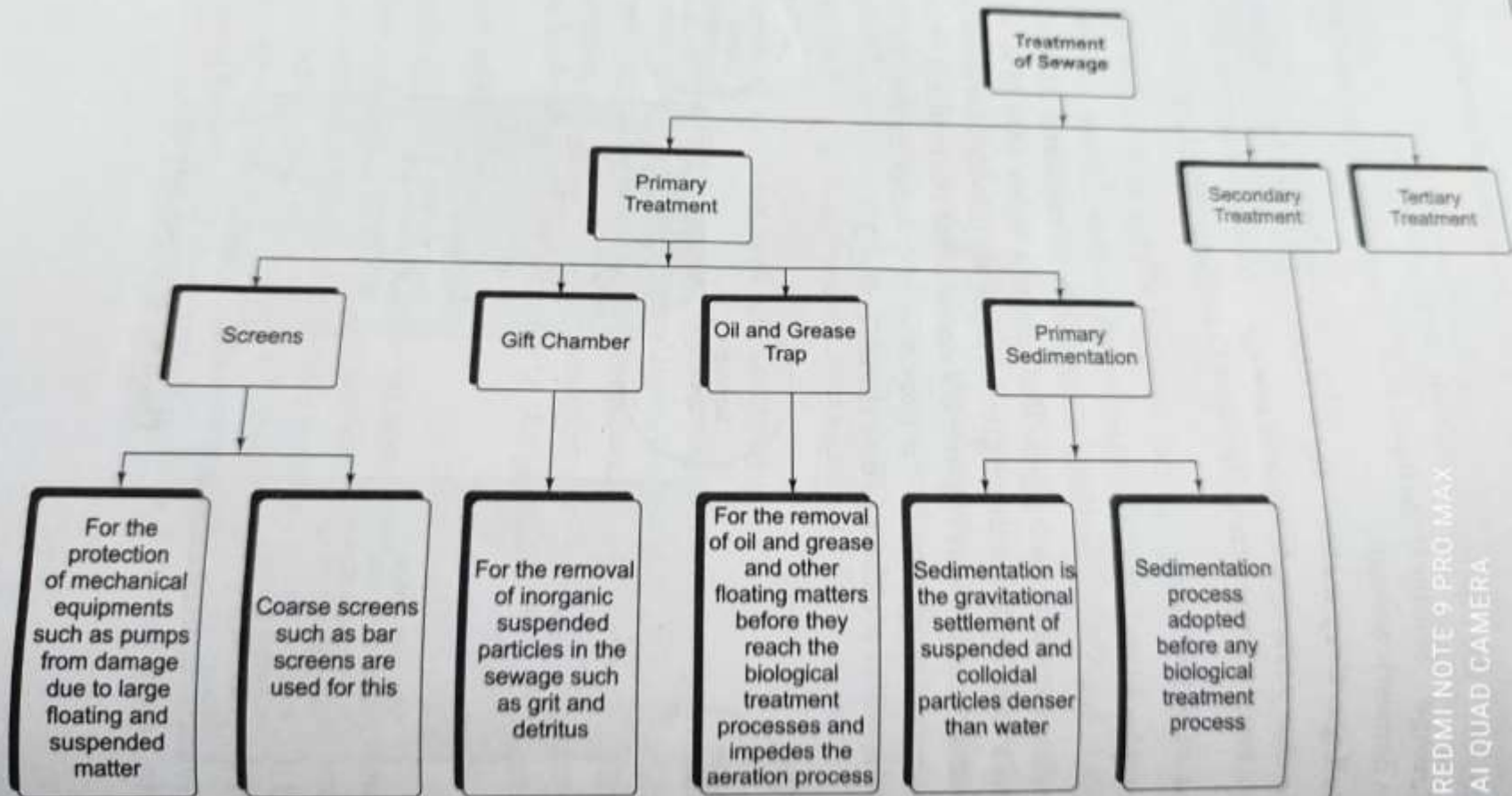
Advanced wastewater treatment methods that are sometimes employed after primary and secondary treatments

Reduce phosphorus and nitrogen

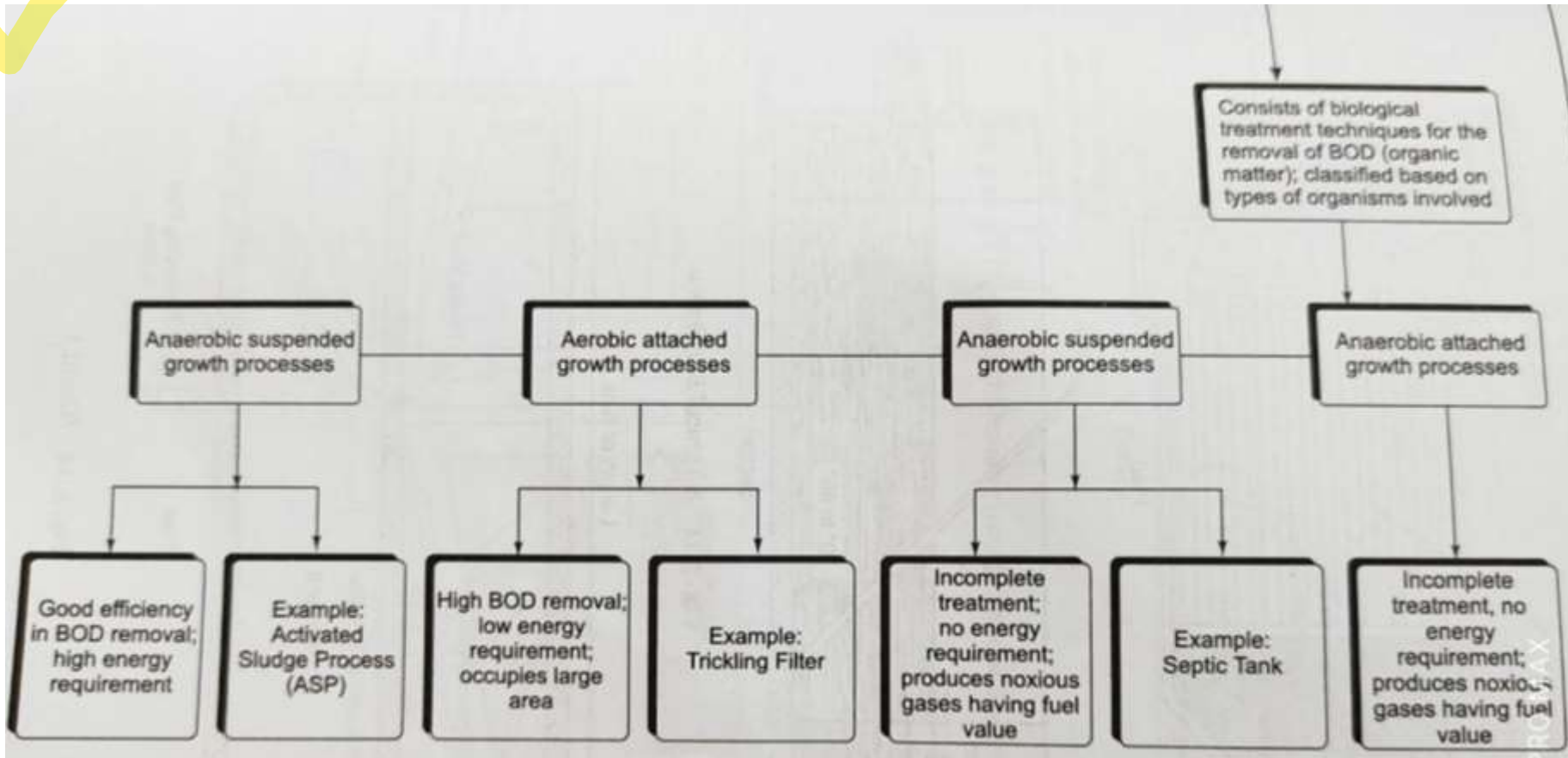
Sewage Treatment Plant



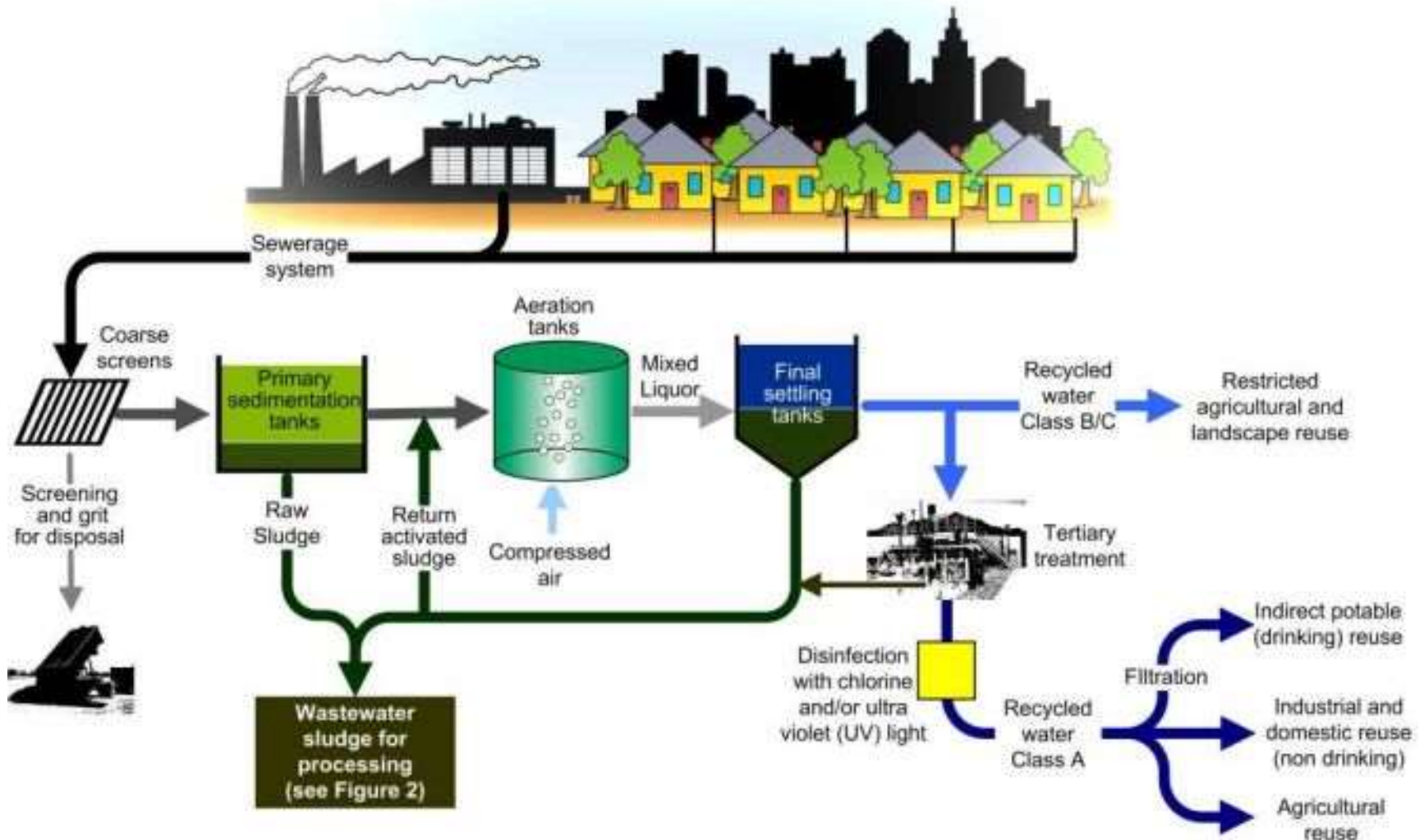
Treatment of Sewage

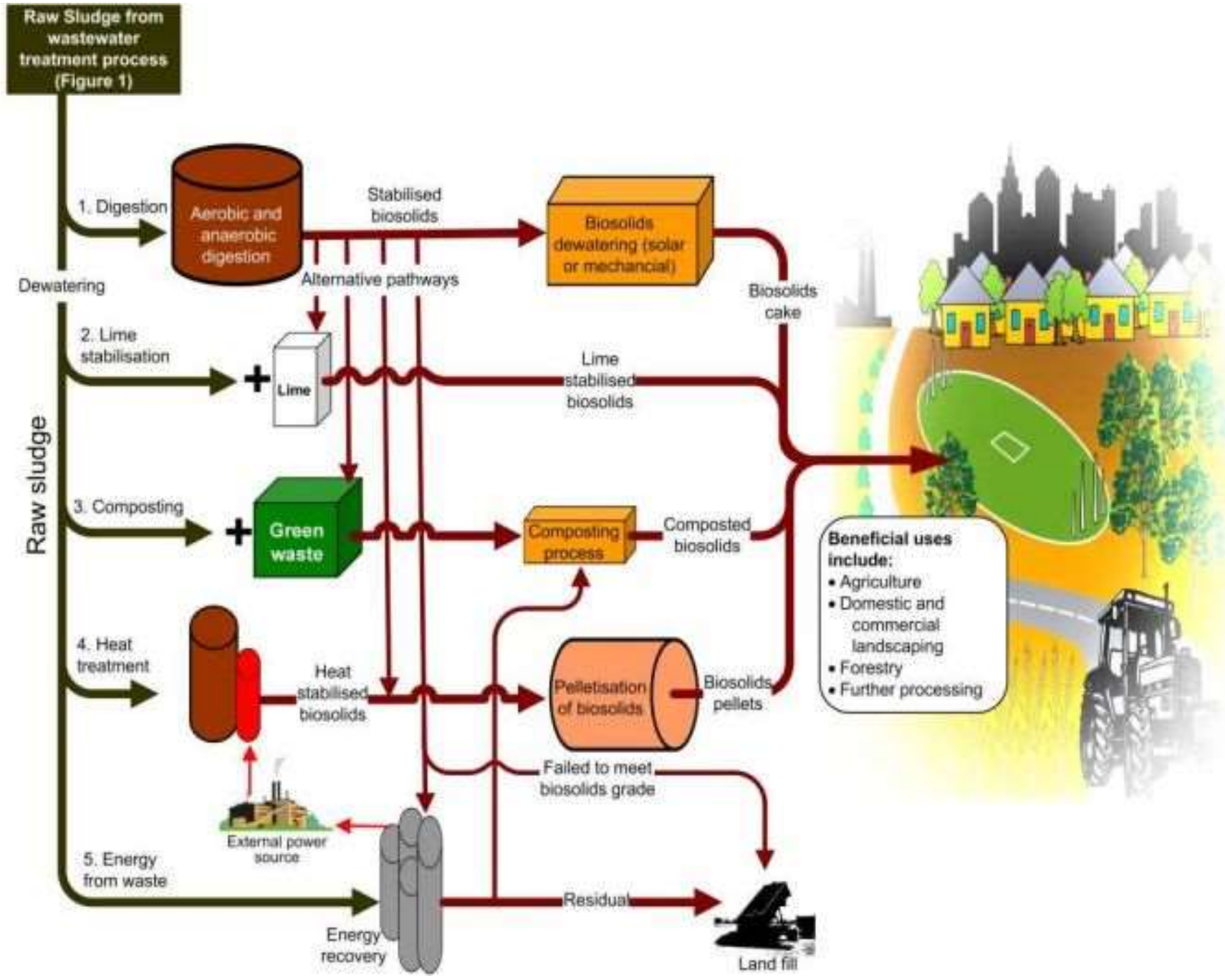


Secondary Treatment



Sewage Treatment Overview





Nuclear (radioactive) waste management

- Radioactive waste is the material resulting from the manufacture or use of substances containing at least one element of unstable atomic structure.
- The sources of radioactive waste includes nuclear power plants, medical facilities and research institutions.
- High-level Radioactive waste management:
 - 1) Store indefinitely
 - 2) Reprocess
 - 3) Dispose of by burial or isolation

- Low level Radioactive waste management:
 - 1) Waste minimization
 - 2) Volume reduction by compression
 - 3) Volume reduction by incineration
 - 4) containment