



# Solid Waste Management

- Solid waste Management
- Causes, effects and control measures of urban and industrial wastes



# 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.



# Absence of Solid Waste Management





# Absence of Solid Waste Management





## 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.



## Sources of Urban Waste

- 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
- $\beta$  -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.



## Harmful Effects of Solid Wastes

- 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.



# 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.



# Recycling





# Recycling





# Recycling Bins





# Solid waste management

## 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.



# Landfills

## 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.



# Land Fill





# Land Fill





## 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





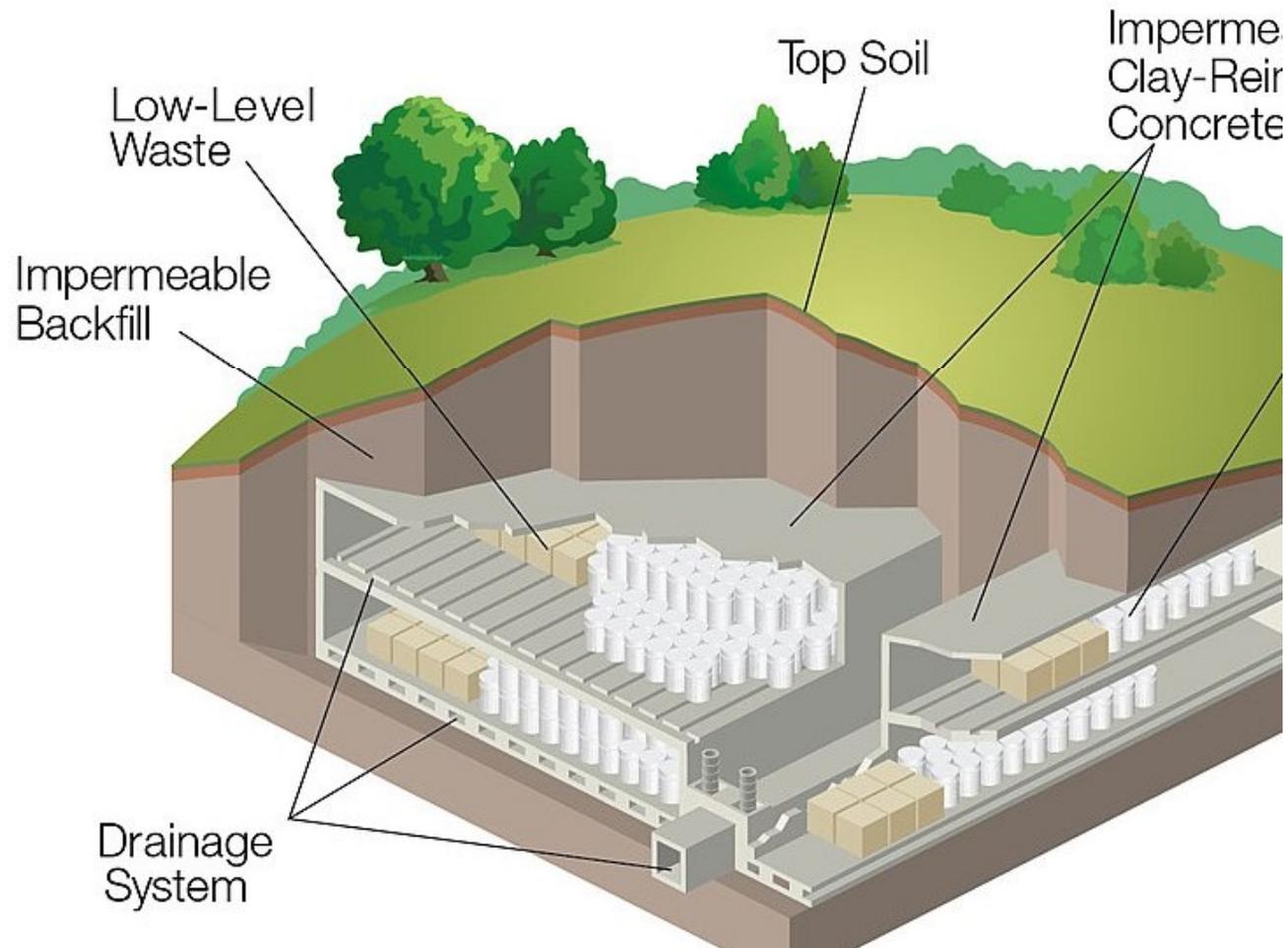
# Medical waste





# Disposal of Radioactive Waste

## Low-Level Radioactive Waste Disposal





# 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.



# Incineration

- 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.



# Incineration

## 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.



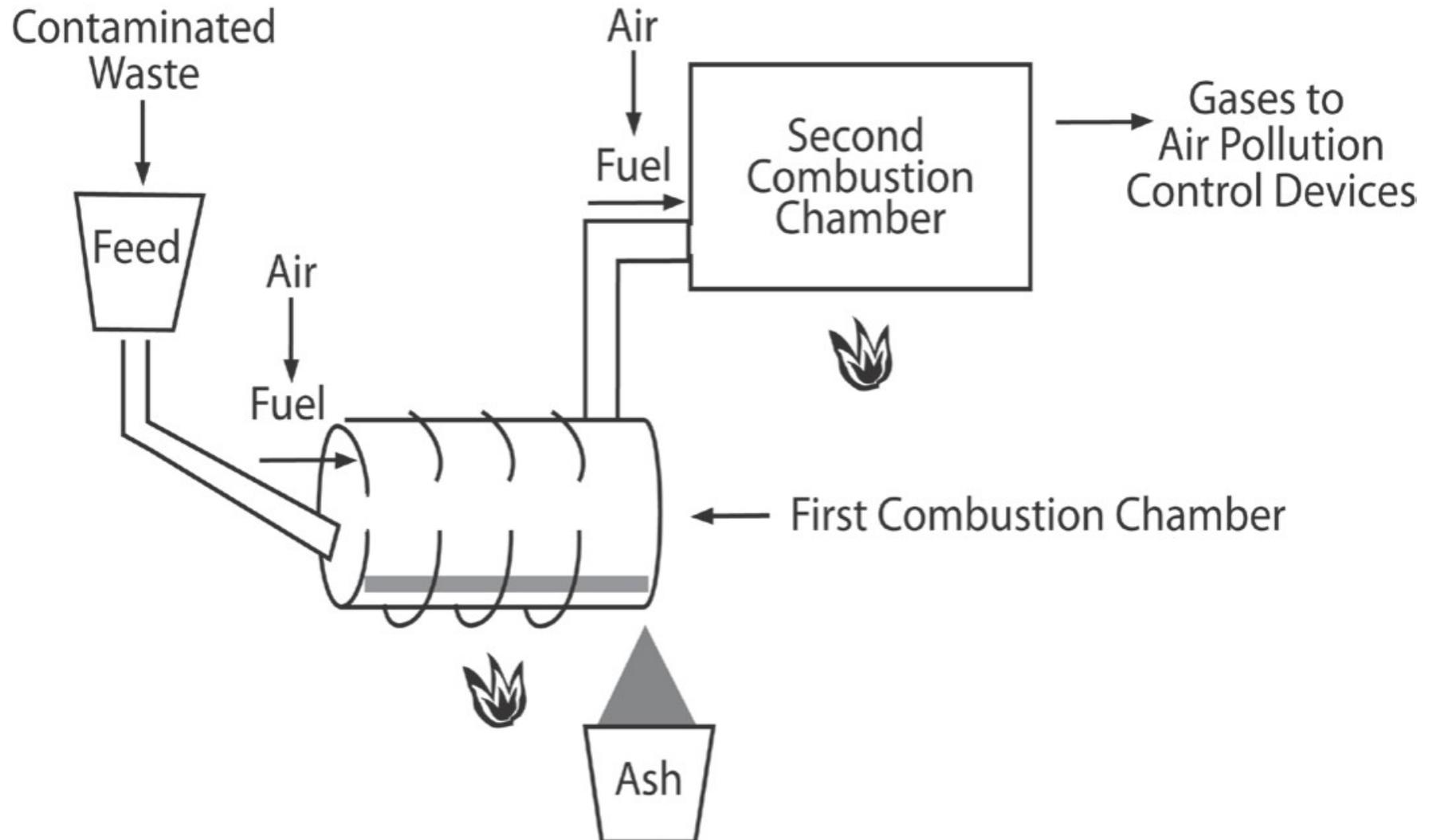
# Incineration

## 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



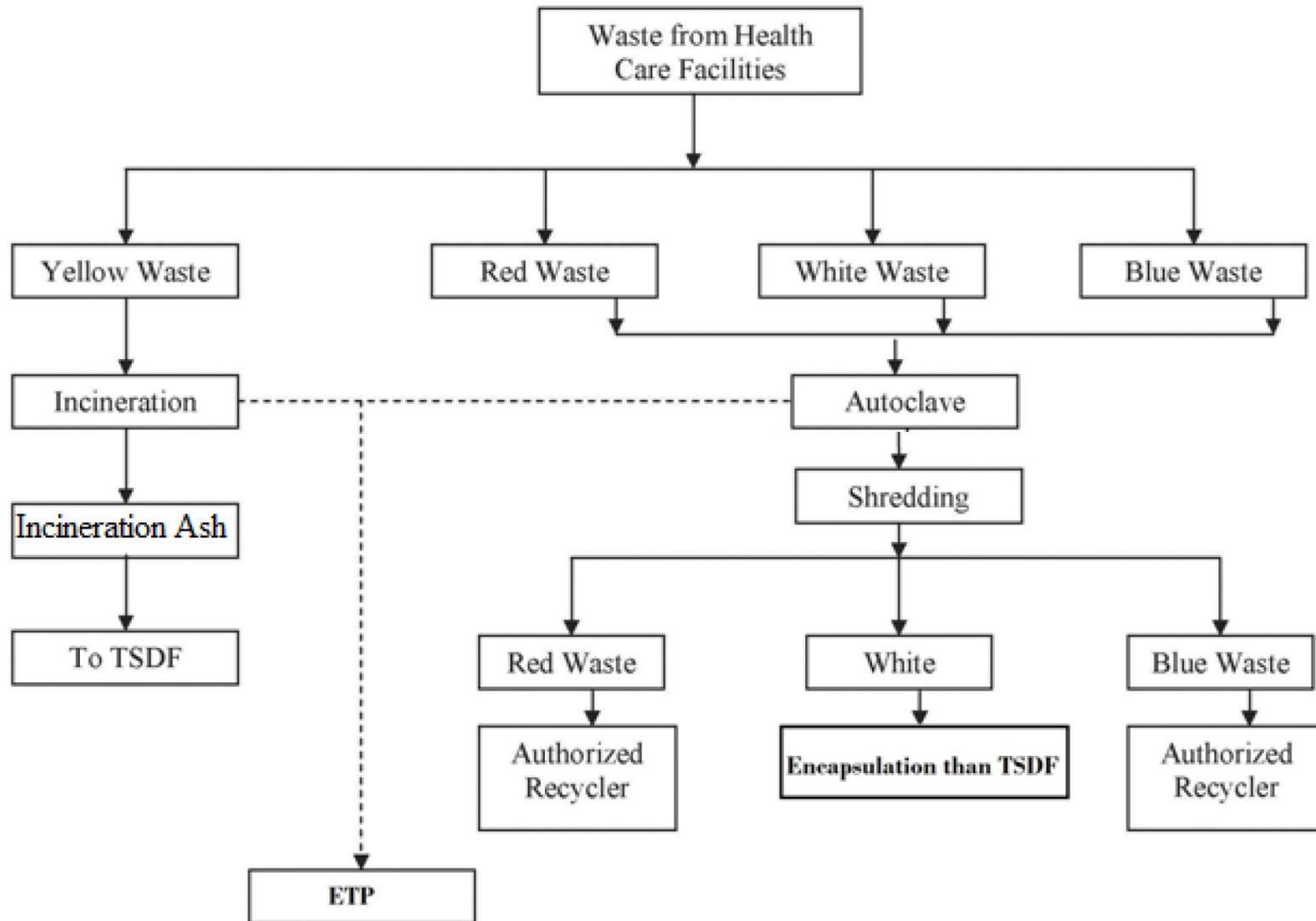


# Incineration Plant





# 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.



## Composting

- 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.



# Composting

## 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



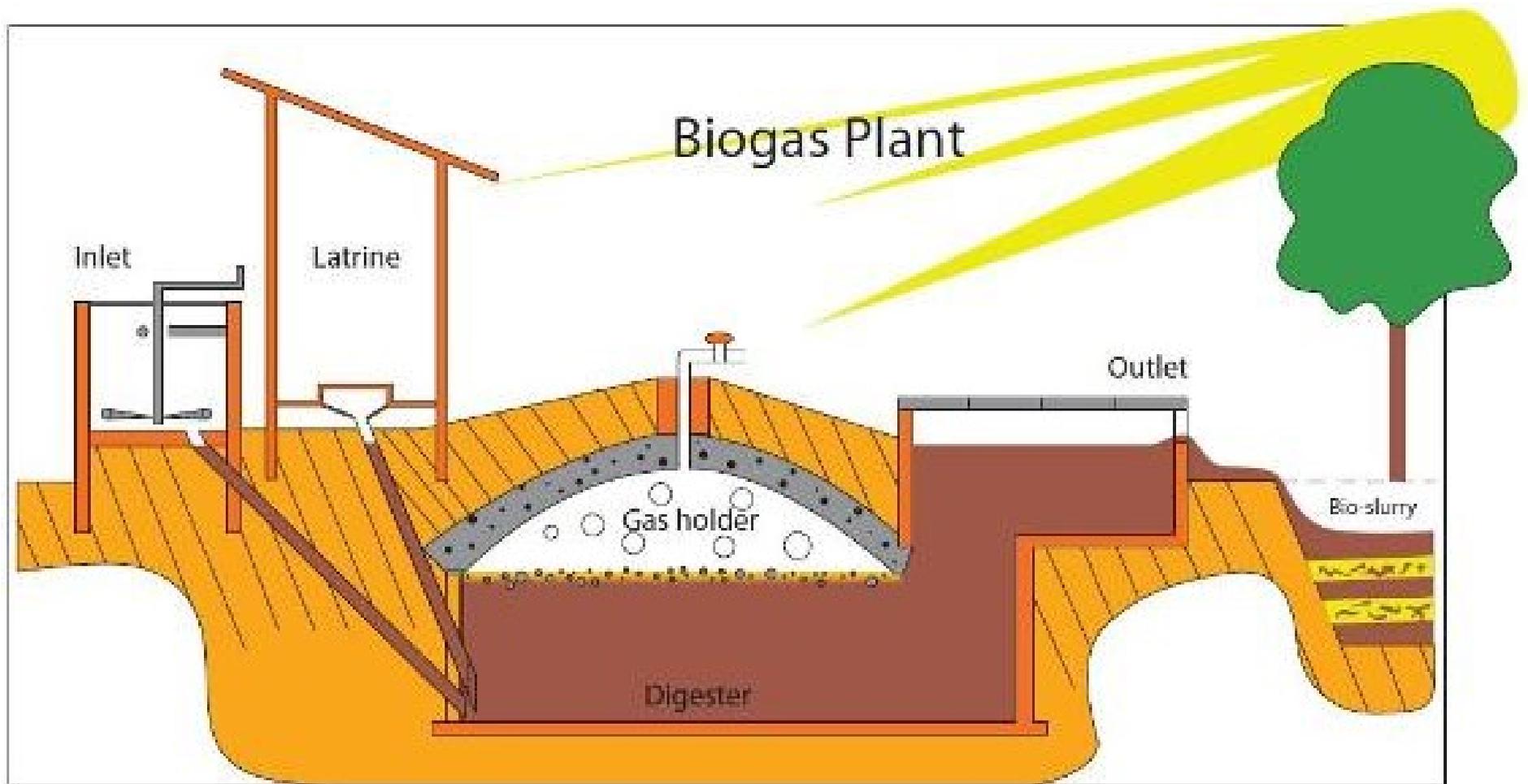


# Composting





# Bio Gas Plant





# Bio Gas Plant

