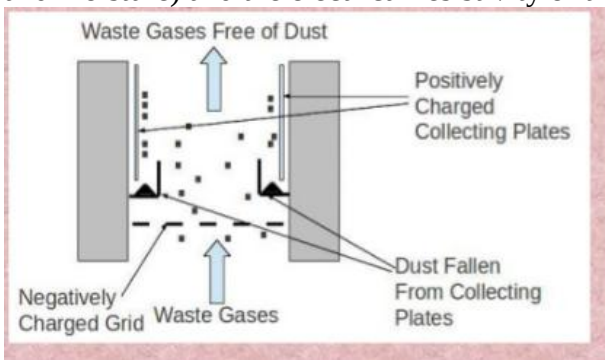
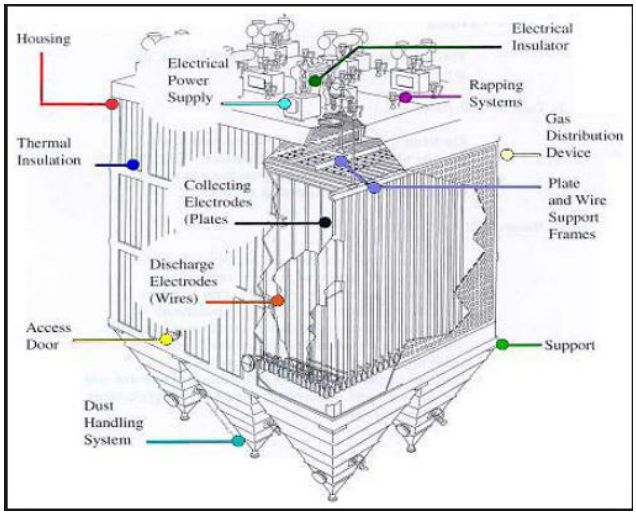
Improvement Test

SOLID WASTE MANAGEMENT - 15CV651 - SOLUTION

Ans1. Incineration can be defined as a controlled combustion process for burning of solid, liquid and gaseous combustible waste to gases and residue containing non combustible materials. Burning of refuse at high temperatures in furnaces are called Incinerators. Incineration is a chemical process used to reduce the volume of solid wastes. The process can also be called as chemical volume reduction. Chemical process such as pyrolysis, hydrolysis and chemical conversion are also effective in reducing the volume of wastes. Incineration process is preferred over other process because it can be used both for volume reduction and for power production. Normally only the combustible matter such as garbage, rubbish and dead animals are burnt and the incombustible matter like broken glass, china ware, metals etc are either left unburnt or are separated for recycling and reuse before burning the solid wastes. The incinerators along with the non- recycled incombustible materials may, however, measure as much as 10-25% of the original waste, which in any case has to be disposed either by sanitary land filling or in some other productive manner. For example the clinkers can be used as aggregates for making low grade concrete or as road material and the ashes can be used for making bricks. The heat produced during burning of the refuse is used in the form of steam power for running turbines to generate electricity.

Electrostatic precipitator: The electrostatic precipitator (ESP) operate on the principle of electrostatic attraction. A high negative voltage , 20,000 to 100,000 volts, applied to the discharge electrodes, produces a strong electric field between the discharge and collector electrodes. Particles in the gas stream acquire a negative charge as they pass through the electrical field. Because of their charge, the particles are then attracted to collector electrode. The efficiency of an ESP is a function of the flue gas characteristics (especially temperature and moisture) and the electrical resistivity of the particles.





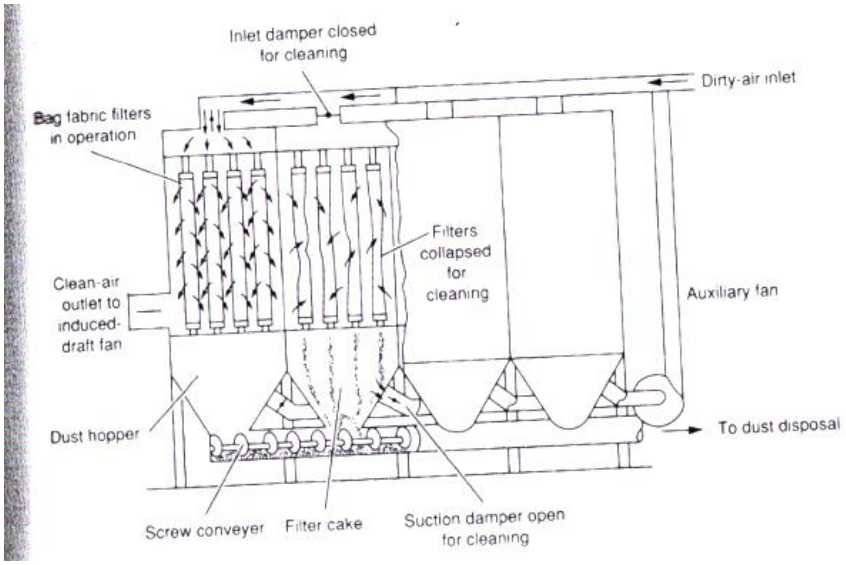
ELECTROSTATIC PRECIPITATOR : Consists of six major components,

i) A source of high voltage
ii) Discharge electrodes and collecting electrodes
iii) Inlet and outlet for the gas
iv) An electric cleaning system
v) 'Hopper' for collection and disposal of particulates
vi) An outer casing [called shell] to form an enclosure around the electrodes.

APPLICATIONS

1) Cement factories : Cleaning of flue gas from cement kilns, recovery of cement dust from kilns.
2) Pulp and paper : Soda-Fume recovery in kraft pulp mills.
3) Steel plants : Cleaning blast furnace gas, cleaning open hearth and electric furnace gases.
4) Chemical Industries – Collection of SO_x, Phosphoric Acid mist, cleaning various types of gases i.e., hydrogen, CO_2, SO_2, Removing dust from elemental phosphorus in the vapor state.
5) Petroleum industry:- Recovery of catalyst.
6) Carbon black industry :- Agglomeration and collection of carbon black.
7) Thermal Power plants:- Collecting Fly ash from coal fired boilers.

Fabric filter: The fabric filter has become the technology of choice on most recently constructed MSW combustion systems in the United States. The fabric filter, or bag house as it is sometimes referred to, is an intrinsically simple device. A number of filter bags are connected in parallel in a housing. Particles in the flue gas are trapped on a dust bed that gradually builds upon the surface of the fabric. The dust bed allows the fabric to filter particles as small as 0.1μm, much smaller than the 50 to 75μm. As particles build up on the surface of the fabric, the pressure drop across the fabric filter gradually increases. The particles are removed from the filter bags by several techniques, including mechanical shaking, reverse air flow and pulse-jet. A Typical fabric filter installation is illustrated in figure. The major design parameters for fabric filter are filter area, material and method of cleaning. Felted glass and Teflon have been used as fabric filters with some success in MSW combustion applications.



Ans.2. Volume reduction or compaction refers to densifying wastes in order to reduce their volume. Some of the benefits of compaction include:
a. Reduction in the quantity of materials to be handled at the disposal site;

b. Improved efficiency of collection and disposal of wastes;

c. Increased life of landfills;

d. Economically viable waste management system.
Equipment used for compaction Based on their mobility, we can categorise the compaction equipment used in volume reduction under either of the following:
(i) Stationary equipment: This represents the equipment in which wastes are brought to, and loaded into, either manually or mechanically. In fact, the compaction mechanism used to compress waste in a collection vehicle, is a stationary compactor.
(ii)Movable equipment: This represents the wheeled and tracked equipment used to place and compact solid wastes, as in a sanitary landfill.
Chemical volume reduction is a method, wherein volume reduction occurs through chemical changes brought within the waste either through an addition of chemicals or changes in temperature. Incineration is the most common method used to reduce the volume of waste chemically, and is used both for volume reduction and power production. Other chemical methods used to reduce volume of waste chemically include pyrolysis, hydrolysis and chemical conversions.
Size reduction or shredding
This is required to convert large sized wastes (as they are collected) into smaller pieces. Size reduction helps in obtaining the final product in a reasonably uniform and considerably reduced size in comparison to the original form.
In the overall process of waste treatment and disposal, size reduction is implemented ahead of:
(i)Land filling to provide a more homogeneous product.
(ii)Recovering materials from the waste stream for recycling.
(iii)Baling the wastes – a process sometimes used ahead of long distance transport of solid wastes – to achieve a greater density.
(iv)Making the waste a better fuel for incineration

(v)Reducing moisture, i.e., drying and dewatering of wastes

Magnetic separation
Various types of equipment are in use for the magnetic separation of ferrous materials. The most common types are the following:
(i) Suspended magnet: In this type of separator, a permanent magnet is used to attract the ferrous metal from the waste stream. When the attracted metal reaches the area, where there is no magnetism, it falls away freely. This ferrous metal is then collected in a container.
(ii) Magnetic pulley: This consists of a drum type device containing permanent magnets or electromagnets over which a conveyor or a similar transfer mechanism carries the waste stream. The conveyor belt conforms to the rounded shape of the magnetic drum and the magnetic force pulls the ferrous material away from the falling stream of solid waste.
Air separation
Air separation is primarily used to separate lighter materials (usually organic) from heavier (usually inorganic) ones. The lighter material may include plastics, paper products and other organic materials. Generally, there is also a need to separate the light fraction of organic material from the conveying air streams, which is usually done in a cyclone separator.
Conventional chute type: In this type, when the processed solid wastes are dropped into the vertical chute, the lighter material is carried by the airflow to the top while the heavier materials fall to the bottom of the chute. The control of the percentage split between the light and heavy fraction is accomplished by varying the waste loading rate, airflow rate and the cross section of chute. A rotary air lock feed mechanism is required to introduce the shredded wastes into the classifier.

Ans.3. Hazardous wastes refer to wastes that may, or tend to, cause adverse health effects on the ecosystem and human beings. These wastes pose present or potential risks to human health or living organisms, due to the fact that they are non-degradable or persistent in nature; can be biologically magnified; are highly toxic and even lethal at very low concentrations
Characteristics of hazardous wastes
a.Ignitability : A waste is an ignitable hazardous waste, if it has a flash point of less than 60° C; readily catches fire and burns so vigorously as to create a hazard; or is an ignitable compressed gas or an oxidiser.
b.Corrosivity: A liquid waste which has a pH of less than or equal to 2 or greater than or equal to 12.5 is considered to be a corrosive hazardous waste.
c. Reactivity: A material is considered a reactive hazardous waste, if it is unstable, reacts violently with water, generates toxic gases when exposed to water or corrosive materials, or if it is capable of detonation or explosion when exposed to heat or a flame.
d. Toxicity: To determine if a waste is a toxic hazardous waste, a representative sample of the material must be subjected to a test conducted in a certified laboratory.

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Ans.5. Biomedical waste: The waste (solid waste as well as liquid waste) produced by hospitals, nursing homes, clinics, research laboratories, diagonostic centres, vetenary hospitals,etc are potential sources of health hazards, and need to be specially treated and disposed off. The greatest risk of clinical waste is from the infectious and sharp components like needles, syringes,etc.
Collection and Treatment of Biomedical Wastes
The various types of medical wastes are divided into different categories, and collected in different coloured bins or containers, so as to help in segregation of hazardous and non-hazardous wastes, needing different types of treatments. The process is known as waste segregation. The system using different coloured bins and bags to collect different types of solid medical wastes is known as colour coding.
Contents of Bags
1. Yellow bin wastes: These wastes need to be incinerated or buried deep, and may include: human anatonomical wastes, animal wastes, pathological wastes, micro-biological wastes, sharp wastes, discarded medicines, cytotoxic drugs, and solid wastes.
2. Red bin wastes: These wastes will have to be autoclaved, disinfected with chemicals, or microwaved. They may include : plastic wastes and disposable items like tubes, catheters, blood or urine bags, gloves etc.
3. Black bin wastes: These wastes can be sent for disposal to secure landfills/burials, and may include, chemical solid wastes and incinerated ash,etc.
4. Blue bags: Used sharps, solid disposal waste
Treatment methods include Autoclaving, Microwave Treatment and Incineration
Autoclaving is a low heat thermal process and it uses steam for disinfection of waste. Autoclaves are of two types depending on the method they use for removal of air pockets. They are gravity flow autoclave and vacuum autoclave.
Microwaving is a process which disinfects the waste by moist heat and steam generated by microwave energy. The microwave is based on the principle of generation of high frequency waves. These waves cause the particles within the waste material to vibrate, generating heat. This heat generated from within kills all pathogens.
High-heat systems employ combustion and high temperature plasma to decontaminate and destroy the waste. Incinerator & Hydroclaving are high heat systems.
Chemical Methods: 1 % hypochlorite solution can be used for chemical disinfection
Plasma Pyrolysis
Plasma pyrolysis is technology for safe disposal of medical waste. It is an environment-friendly technology, which converts organic waste into commercially useful by products. The intense heat generated by the plasma enables us to dispose all types of waste including municipal solid waste, biomedical waste and hazardous waste in a safe and reliable manner. Medical waste is pyrolysed into CO, H_2, and hydrocarbons when it comes in contact with the plasma-arc. These gases are burned and produce a high temperature (around 1200^oC).

Ans6. Construction waste consists of unwanted material produced directly or incidentally by the construction or industries. This includes building materials such as insulation, nails, electrical wiring, shingle, and roofing as well as waste originating from site preparation such as dredging materials, tree stumps, and rubble. Construction waste may contain lead, asbestos, or other hazardous substances. Building waste is made up of materials such as bricks, concrete and wood damaged or unused for various reasons during construction. Observational research has shown that this can be as high as 10 to 15% of the materials that go into a building, a much higher percentage than the 2.5-5% usually assumed by quantity surveyors and the construction industry. Since considerable variability exists between construction sites, there is much opportunity for reducing this waste

There is the potential to recycle many elements of construction waste. Often roll-off containers are used to transport the waste. Rubble can be crushed and reused in construction projects. Waste wood can also be recovered and recycled.

Drywall—3%: Drywall is 100% recyclable. Gypsum is a nuisance material in picking and sorting operations, producing dust which discomforts labour, and reduces the value of recyclable materials through contamination. Gypsum may be incorporated into new drywall, or used as a soil amendment.

Asphalt roofing—5%: Asphalt roofing shingles may be ground, sized and graded for remelting in asphalt paving applications, road base, new roofing, and fuel oil.