Solid Waste Management

Solid waste

Solid waste, often called the third pollution, after air and water pollution. Solid waste is that material which arises from various human activities and which is normally discharged as useless or unwanted. It consists:

- Highly heterogeneous mass of discharged materials from the urban community.
- The more homogeneous accumulation of agricultural, industrial and mining waste.

Classification of solid wastes

Solid wastes may be classified based party on content and party on moisture and heating value. A typical classification is as follows:

(a) **Garbage (القمامه المتعفنه):** Refers to the putrescible solid waste constituents (النفايات الصلبه القابله للتعفن) produced during the preparation or storage of meat, fruit, vegetables etc. These wastes have a moisture content of about 70% and heating value of about 6×10^6 J/kg.

(b) Rubbish (القمامه غير المتعفنه): Refers to non-putrescible solids waste constituents, either combustible or non-combustible. Combustible wastes would include paper, wood scrap, rubber, leather etc. Non-combustible wastes are metals, glass, ceramics etc. These wastes contain a moisture content of about 25% and heating value of the waste is around 15×10^6 J/kg.

(c) Pathological wastes (النفايات المرضيه): Dead animals, human waste, etc. The moisture content is 85% and there are 5% non-combustible solids. The heating value is around 2.5×10^6 J/kg.

(d) Industrial wastes (النفايات الصناعيه): Chemicals, paints, sand, metal ore processing, fly ash, sewage treatment sludge etc.

(e) Agricultural wastes (النفايات الزراعيه): Farm animal manure (السماد), crop residues etc.

Environmental and health impacts.

The organic fraction of municipal solid waste is an important component, not only because it constitutes a sizable fraction of the

solid waste stream in a developing country, but also because of its potentially adverse impact upon public health and environmental quality. A major adverse impact is its attraction of rodents and vector insects for which it provides food and shelter. Impact on environmental quality takes the form of foul odours and unsightliness. These impacts are not confined merely to the disposal site. On the contrary, they pervade the area surrounding the site and wherever the wastes are generated, spread, or accumulated.

Uncontrolled or poorly managed intermediate decomposition products can contaminate air, water, and soil resources.

Solid waste disposal methods

An appropriate selection of disposal method of solid waste can save and avoid future problems. The method should also provide opportunities for recycling of materials if possible, and should not pollute the air, the ground water, the surface water or the land.

Several disposal methods are being used in the various parts of the world and the most prominent of these are:

1. Recovery and utilisation of resources
2. Composting التسميد
3. Incineration الحرق
4. Sanitary landfill دفن النفايات الصحي
5. Open dumping النفايات المعرضه للجو

1. Recovery and utilisation of resources :

For several reasons, resource recovery is a major element in solid waste management in developing nations. Reuse and recovery of the inorganic components (metals, glass, plastic, textiles, and others) of the waste stream is an important aspect of waste management.

Special attention is given to organic (biodegradable) residues since, in the majority of developing countries, these residues constitute at least 50% of the waste (by weight). The resource recovery aspect regarding the organic component is threefold:

1. The component can be used in agriculture as a soil amendment through composting.
2. Its energy content can be recovered either biologically or thermally. Biological energy recovery is by way of methane production through anaerobic digestion. Thermal recovery is by way of combustion to produce heat.

3. The organic content can be hydrolysed either chemically or enzymatically to produce a sugar. The sugar can be used as a substrate for ethanol fermentation or for single-cell protein production.

Of the three applications, use in agriculture is the most practical. Although dating back many years, methane production ("biogasification") has only recently begun to receive serious attention as a potential alternative source of energy. Many hurdles, primarily economic in nature, must be surmounted before either single-celled protein production or ethanol fermentation become a practical reality.

2. Composting التسميد

Composting of refuse is an aerobic method of decomposing solid waste. Many types of microorganisms already present in the waste stabilize the organic matter in the waste to produce a soil conditioner.

Initially, the process starts with the mesophilic bacteria which oxidize the organic matter in the refuse to carbon dioxide and liberate heat. The temperature rise to about 45 ^{o}C and at this point the thermophilic bacteria take over and continue to decomposition. During this phase, the temperature further rise to about 60 ^{o}C . The refuse is periodically بشكل دوريturned over نقلب to allow sufficient oxygen to penetrate to all parts of the material to support aerobic life. After about three week, the compost is stabilized. The end point of operation can be measured by noting a drop in temperature. The compost should have an earthy smell and a dark brown color.

3. Incineration:

Incineration involves burning of solid wastes at high temperature, leftover ashes, glass, metals and unburned combustible amount to perhaps 25% of the original waste. Incineration leads to air pollution unless the plant is designed, equipped مجهزه and operated to comply with air pollution standards. Typical air pollution from incineration is fly ash, SO_2, hydrogen chloride, and organic acid. Incineration is an economic method for solid waste disposal because useful material and energy can be recovered from the process. Heat can be recovered by putting a waste heat boiler or some other recovery device on an existing waste incinerator. The solid waste has about one-third the heating value of coal with very low sulfur content.

The advantages of incineration include wide range ability for handling varying loads and small space requirement for ultimate disposal. However, the method requires fairly high level of maintenance and the operating costs are higher than those for operating of a sanitary landfill.

4. Sanitary landfill :

Sanitary landfilling is an engineering operation, designed and operated according to acceptable standards. It may be defined as a method of disposing refuse الفمامة on land without creating nuisances مصادر ازعاج or hazards to public health or safety.

In sanitary landfill operation, refuse الفمامة is spread and compacted in thin layers within a small area. This layered structure is usually referred to as a cell. To allow for proper compaction, the cell depth should not exceed about 2 meters. The cell is then covered with a layer of soil which is spread uniformly and then compacted. To provide an adequate seal the cover should normally be at least 20 cm thick. When a number of cells reach the final desired elevation, a final cover of about one meter of earth is placed and it is again compacted. The final cover is necessary to prevent rodents (القوارض) from burrowing (الاختباء) into refuse.

5. Open dumping :

Open dumping is practiced in many cities because it is cheap and requires no planning. The open dumps cause public health problems by encouraging the breeding of flies, rats, mosquitoes and other pests. They also become source of objectionable odors and cause air pollution when the wastes are burned in order to reduce their volume and conserve space.

Integrated waste management .

Integrated waste management is a frame of reference for designing and implementing new waste management systems and for analysing and optimising existing systems. Integrated waste management is based on the concept that all aspects of a waste management system (technical and non-technical) should be analysed together.

Integrated waste management, is intended to help guide decisions about the generation of waste, recycling of material, and ultimate disposal of waste resides.

An outline of some of highlights of integrated waste management are listed below:

1- Source reduction.

- Reduce toxicity.
- Less packaging.
- Product reuse.
- More durable products.
- On-site mulching and composting.

2- Recycling.

- Collection.
- Processing.
- Use of recycled material in products.
- Composting.

3- Disposal.

- Combustion with energy recovery.
- Landfill.
- Incineration without energy recovery.

References

C.S.Rao , "Environmental Pollution Control Engineering", 2nd eddition , New Age International(P) Limited, Published, 2006, Reprint 2007.

R. K. Sinnott, Chemical Engineering Design, Vol. 6. 4th edition, Chemical Engineering Design, 2005, pp. 450-457.

Noel de Never, "Air Pollution Control Engineering", McGrow-Hill, Inc 1987.

M. Grawford, "Air Pollution Control Theory", McGraw-Hill, New York, 1976.

M. M. Gilbert, "Introduction To Environmental Engineering And Science ", 2nd edition, Hall, Inc, New Jersey, 1998.