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WASTE MANAGEMENT & STATICAL ANALYSIS, GLOBAL ISSUES OF ENVIRONMENTAL

SIERRA INNOVATIONS

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Unit - 7

Solid & Hazardous Waste Management

Type of Solid Waste

① Domestic / Residential waste :-

This category of waste compsises the solid wastes that originated from single and multi family household units. these wastes are generated as a consequence of household activities such as cooking, cleaning, repair, empty container, packaging, clothing, old books, writing / newspaper & old furnishing, households also discard bulky waste such as furniture & large appliance which cannot be repaired & used.

(11) municipal waste :-

municipal waste include wastes resulting from municipal activities & services such as street waste, dead animals, market waste & abandoned vehicles.

However the term is commonly applied in ~~order~~ a wider sense to incorporate domestic wastes, institutional wastes & commercial wastes.

(iii) Commercial waste :-

Included in this category are solid wastes that originate in offices, wholesale & retail stores, restaurants hotels market, warehouses & other commercial establishments. Some of these wastes are further classified as garbage & other as rubbish.

(iv) Institutional waste :-

Institutional waste are those arising from institutions such as schools, universities, hospitals & research institutes it includes wastes which are classified as garbage & rubbish as well as wastes which are considered to be hazardous to public health and to the environment

(v) Garbage:

Garbage is the term applied to animal & vegetable wastes resulting from the handling storage, sale, preparation, cooking & serving of food, such wastes contain putrescible organic matter, which

produces strong odours & therefore attracts rats, flies & other vermin, it requires immediate attention in its storage, handling & disposal.

(vi) Rubbish

Rubbish is a general term applied to solid wastes originating in households. commercial establishments & institutions, excluding garbage & ashes.

(vii) ASHES Ashes :-

Ashes are the residues from the burning of wood, Coal, Charcoal, coke & other combustible materials, for cooking & heating in houses, institutions & small industrial establishments, when produced in large quantities at power generating plants & factories these wastes are classified as industrial wastes. Ashes consist of a fine powdery residue, & cinders and clinkers often mixed with small pieces of Metal & glass.

(viii) Bulky wastes :-

In this category are bulky household wastes which cannot be accommodated in the normal storage ~~cont~~ containers of households.

for this reason they require special collection in developed countries bulky wastes are large household appliances such as cookers refrigerators & washing machines as well as furniture, crates, vehicle parts, tyres, wood, trees & branches. Metallic bulky wastes are sold as scrap metal but some portion is disposed of at sanitary landfills.

(ix) Street Sweeping

The term applies to wastes that are collected from streets, walkways, alleys, parks & vacant lots. In the more affluent countries manual street sweeping has virtually disappeared but it still commonly ~~in the more affluent countries manual~~ It takes place in developing countries, where littering of public places is a far more widespread & acute problem. Mechanised street sweeping is the dominant practice in the developed countries.
Street wastes include paper, cardboard, plastic, dirt, dust, leaves & other vegetable matter.

(x) Dead Animals

This is a term applied to dead Animals that die naturally or accidentally killed. This category does not include carcass & Animal parts from slaughterhouses which are regarded as industrial wastes. Dead Animals are divided into two groups, large & small. Among the large animals are horses, cows, goats, sheep, hogs, & the like. Small animals ~~incl~~ require special equipment for lifting & handling during their removal. if not collected promptly, dead Animals are a threat to public health bcz they attract flies & other vermin as they putrify. Their presence in public places is particularly offensive & emits foul smell from the Aesthetic point of view.

(XI) Construction & Demolition wastes :-

Construction & demolition Wastes are the waste material generated by the construction, Refurbishment repair & demolition of houses, commercial buildings & other structures, it mainly consists of earth, stones, Concrete, bricks, lumber, roofing material, plumbing materials, heating systems & electrical wires & parts of the general municipal waste stream, but when generated in large Amount at building & demolition sites it is

generally removed by contractors for filling low lying areas & by urban local bodies for disposal at landfills

(xii) Industrial wastes

In the category are the discarded solid material of manufacturing processes & industrial operations. They cover a vast range of substances which are unique to each industry. For this reason they are considered separately from municipal wastes. it should be noted, however, that solid wastes from small industrial plants & ash from power plants are frequently disposed of at municipal landfills.
for details please refer to chapter 6 on "Industrial wastes"

(xiii) Hazardous wastes :-

Hazardous wastes may be defined as wastes of industrial, institutional or consumer origin which by of their physical, chemical or biological characteristics are potentially dangerous to human and the environment.

In some cases although the active Agents may be liquid or gaseous. they are classified as solid wastes bcz they are confined in solid containers. Typical examples are solvents, paints and pesticides whose spent containers are frequently mixed with municipal wastes & become part of the urban waste stream. Certain hazardous wastes cause explosions in incinerators and fires at landfill sites. other such as pathological wastes from hospitals and radioactive wastes, require special handling at all time. Good management practice should ensure that hazardous wastes are stored, collected, transported and disposed off separately preferably after suitable treatment to render them innocuous.

(xiv) Sewage wastes :-

Solid by products of sewage treatment are classified as sewage wastes. They are mostly organic & derive from the treatment of organic sludge from both the raw & treated sewage. The inorganic fraction of raw sewage such as grit is separated at the preliminary stage of treatment. but bcz it entrains putrescible organic matter which may contain pathogens, must be buried/ disposed off without delay.

The bulk of treated dewatered sludge is useful as a Soil Conditioner but invariably its use for this purpose is uneconomical, the solid sludge therefore enters the stream of municipal wastes unless special arrangements are made of its disposal.

Classification of Solid Wastes

→ There are several different ways of classifying solid waste.
As you have seen, one way is to classify it by where it is generated. Another way is based on whether the waste is biodegradable or not.

→ Biodegradable solid wastes are those that can be broken down (decomposed) into their constituent elements by bacteria & other micro-organisms. food waste, manures and waste from producing crops are the main biodegradable wastes. If the decomposition process takes place in the absence of air (Anaerobically) Methane gas can form. Methane is a powerful greenhouse gas & can explode if enough

of it accumulates & an ignition source (such as an electrical spark) is present. The decomposition may also produce offensive and irritating smells.

→ However, controlled anaerobic decomposition can produce biogas - a useful fuel for heating, cooking as well as fertilisers & soil conditioners. Waste that decomposes in the presence of an adequate air supply (Aerobically) under controlled conditions can produce compost, which can be used to improve the quality of soils.

→ Non-biodegradable
(also sometimes called inorganic) solid wastes are those that do not decompose by microbial action. These wastes include plastic containers, scrap metal, food & drink cans & plastic bags.

→ Materials in solid wastes can also be classified as combustible or non-combustible, depending on whether they will burn or not.

→ Depending on the inherent dangers associated with its physical & chemical properties, Solid Waste can be classified as either hazardous or non-hazardous. Hazardous Wastes pose substantial or potential threats to public health or environment. for eg toxic, ignitable, infectious & corrosive (Acidic or Alkaline) substances are all likely to be classed as hazardous. Non-hazardous wastes are those that do not possess hazardous characteristics, although they can still be harmful to people or the environment.

Physical Characteristics

Density

→ Density of waste ie its mass per unit volume (kg/m^3) is a critical factor in the design of a solid waste management system. eg the design of sanitary landfills, storage, types of collection & transport vehicles etc.
To explain an efficient operation of a landfill demands compaction of waste to optimum density.

Any normal compaction equipment can achieve reduction in volume of wastes by 75%. which increases an initial density of 100 kg/m3 to 400 kg/m3

* Moisture Content :-

→ Moisture content is defined as the ratio of the weight of water (wet weight - dry weight) to the total wet weight of the waste.
Moisture increases the weight of solid wastes & thereby the cost of collection and transport. In addition moisture content is a critical determinant in the economic feasibility of waste treatment by incineration. bcz wet waste consumes energy for evaporation of water & in raising the temp. of water vapour. In the main wastes should be insulated from rainfall or other extraneous water.

* Size of waste constituents :-

Size distribution of waste constituents in the waste stream is imp. bcz of its significance in the design of mechanical separators & shredder & waste treatment process. This varies widely & while designing a system, proper analysis of the waste characteristics should be carried out.

* Calorific Value

is the amount of heat generated from combustion of a unit weight of a substance expressed as Kcal/kg. The calorific value is determined experimentally using Bomb Calorimeter in which the heat generated at a constant temp. of 25°C from the combustion of dry sample is measured.

* The physical properties that are essential to analyse of wastes disposed at landfills are:-

⇒ * Field Capacity of municipal solid waste is the total amount of moisture which can be retained in a waste sample subject to gravitational pull. If it is a critical measure bcz water in excess of field capacity will form leachate & leachate can be a major problem in landfills.
Field capacity varies with the degree of applied pressure & the state of decomposition of the waste.

* Permeability of compacted wastes :-

The hydraulic conductivity of compacted wastes is an imp. physical property bcz it governs the movement of liquid and gases in a landfill. permeability depends on the other properties of the solid material include pore size distribution. surface area and porosity. porosity represents the amount of voids per unit total volume of material. The porosity of municipal solid waste varies typically from 0.40 to 0.67 depending on the compaction & composition of the waste.

* Compressibility

it is the degree of physical changes of the suspended solids or filter cake when subjected to pressure.

Chemical Characteristics

Knowledge of the classification of chemical compounds and their characteristics is essential for the proper understanding of the behaviour of waste, as it moves through the waste ~~mag~~ management system.

The products of decomposition and heating values are two examples of chemical characteristics. If solid wastes are to be used as fuel or are used for any other purpose, we must know their chemical characteristics, including the following:-

Chemical

include PH, Nitrogen, phosphorus & potassium (N-P-K) total carbon C/N ratio, calorific value.

Bio chemical

include, carbohydrate, protein, Natural fibre & biodegradable factor.

Toxic

include heavy metals, pesticides, insecticides, toxicity test for leachates (TCLP) etc.

Lipids

This class of compounds includes fats, oil & grease. Lipids have high calorific value about 38000 Kcal/kg which makes waste with a high lipid content suitable for energy recovery processes. Since lipids in the solid become liquid at temp. slightly above Ambient, they add to the liquid content during waste decomposition, They are biodegradable but bcz they have a low solubility in waste.
The rate of biodegradation is relatively slow.

Carbohydrates :-

found primarily in food & yard waste. They include sugar & polymers of sugars such as starch and cellulose & have the general formula $(CH_2O)_x$. Carbohydrates are readily biodegraded to produce such as CO_2, water, & Methane, Decomposing Carbohydrates are particularly attractive for flies & rats & for this reason should not be left exposed for periods longer than is necessary.