COURSE CODE:	EMT 504
COURSE TITLE:	Waste Management And Control
NUMBER OF UNITS:	3 Units
COURSE DURATION:	3 hours per week

COURSE DETAILS:

Course Coordinator: Dr Adewole M. Gbadebo *B.Sc., M.Sc., PhD*

Email: Jumaid2000@yahoo.co.UK

Office Location: COLERM

Other Lecturers:

COURSE CONTENT:

Waste Management and Control

Definitions, Sources of Waste, Integrated waste management, Methods of disposal, Monitoring Pollution in Sanitary Landfills, Hazards effect of Pollution from Landfills, Resource recovery, Sustainability, Costs, Waste management concepts,

COURSE REQUIREMENTS:

This is a compulsory course for all 400 level students in the Department. It is compulsory that students should participate in all the course activities and have minimum of 75% attendance in order to be qualify to write the final examination.

.

READING LIST:

LECTURE NOTES

Waste (also known as **rubbish**, **trash**, **refuse**, **garbage**, **junk**, **litter**) is unwanted or useless materials. In biology, waste is any of the many unwanted substances or toxins that are expelled from living organisms; such as urea, sweat or faeces. Litter is waste which has been disposed of improperly.

Waste is directly linked to human development, both technologically and socially. The compositions of different wastes have varied over time and location, with industrial development and innovation being directly linked to waste materials. An Example of this include plastics and nuclear technology. Some components of waste have economical value and can be recycled once correctly recovered.

Waste is sometimes a subjective concept, because items that some people discard may have value to others. It is widely recognized that waste materials are a valuable resource, whilst there is debate as to how this value is best realized. Such concepts are colloquially expressed in western culture by such idioms as "One man's trash is another man's treasure."

There are many waste types defined by modern systems of waste management, notably including:

- Municipal Waste includes household waste, commercial waste, demolition waste
- Hazardous Waste includes Industrial waste
- Bio-medical Waste includes clinical waste
- Special Hazardous waste includes radioactive waste, Explosives waste, E-waste

Definitions

Being considered of no further use in relation to the original purpose of a mechanism.

United Nations Environment Programme (UNEP)

According to the Basel Convention:
"Substances or objects which are disposed of/or are intended to be disposed of or are required to be disposed of by the provisions of international law" (Basel Convention).

Produced by the United Nations Statistics Division (U.N.S.D.):
"Wastes are materials that are not prime products (that is products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded."

Sources of Waste

Everything on the planet earth, living or non-living has its source, waste is not an exception. On olumes or mass.

i) Domestic
ii) Industrial
iii) Commercial
iv) Agricultural

v) Construction
vi) Mining

Taxonomically, waste can be categorized in terms of state of matter i.e: solid, liquid and gaseous. Also, it can be toxic, hazardous or volatile. A typical solid domestic waste will consist of paper, glass, plastic, metals, textiles, woods, vegetables etc. liquid waste include gey water, kitchen sludges, oils, grease while gaseous include CH_4, CO_2, CO, aerosols.

Identification of waste source helps in giving proper nomenclature to waste. It also helps in identification of the required collection, storage, transportation and disposal. Similarly, analysis of waste involves quantification in volumes or mass.

Waste management is the collection, transport, processing, recycling or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for each.

Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management for non-hazardous waste residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator.

Integrated waste management

Integrated waste management using LCA (life cycle analysis) attempts to offer the most benign options for waste management. For mixed MSW (Municipal Solid Waste) a number of broad studies have indicated that waste administration, then source separation and collection followed by reuse and recycling of the non-organic fraction and energy and compost/fertilizer production of the organic waste fraction via anaerobic digestion to be the favoured path.

WASTE STORAGE

\Storage of waste takes place at the spot where the waste is generated. Domestic refuse is normally stored continually in a container or sack until collected. The daily production is usually stored inside until it is carried outside for collection. There can be 1 unit/household or per several households, or local communal collection points where garbage is emptied in a bin or caontainer. In some developing countries, old oil barrels, concrete tubes and other improvised enclosures may be used for storage often without any systematized garbage collection taken place. Industry and business often have their own systems with relatively large storage units. Some factories run large refuse heaps on the factory's premises without any form of regular collection. Containers used as storage units are common for a great many industries and outside large market places.

WASTE COLLECTION

Collection of waste generally take place by loading from the storage containers unto a vehicle e.g. hand-cart (simple), donkey-cart (complex), tractor with trailer (sophisticated), lorry or

special garbage truck. The garbage is usually collected and emptied by the crew of the vehicle (garbage collectors) but in some cases, collectors make a sound signal in which members come and empty their garbage int the vehicle.

Collection requires passable routes and the choice of technology must be adapted to the existing quality of roads, streets and settlement.

A simple cart can often be more useful than a modern garbage truck and labour intensive method, more efficient than modern mechanized ones. The choice of technology should also be considered on the basis of available facilities for maintenanace. In some places, tractors ordinarily used for agricultural purposes have proved useful for collection and transportation of waste.

Moreover, in agricultural areas where tractors are sued, there is often a food infrastructure with garages available spare parts. Where there is systematic collection, small scale industries and businesses are usually included. Major manufacturing industries producing large amount of waste usually run their own system for collection and transport.

Collections of liquid waste (sludge) from waste water treatment plants require separate collection routes.

Also, gaseous wastes are often collected through emission pipes (stacks) to be emitted into the atmosphere.

WASTE TRANSFER AND TRANSPORT

This is the process of shifting discarded resources from the point of generation or storage to the point of recovery or pre-disposal point by a pre-determined medium. The medium can be man, mechanical or nature. If the place of disposal is far away or if very small vehicles are used for collection, it can be appropriate to load the garbage unto a larger transport vehicle. Transport is thereby rationalized in that it takes fewer vehicles and crews. Waste transfer can take place by the collection car emptying the garbage into a container for collection by a larger container car that transports it to a place of final disposal.

There are certain factors to be considered when designing waste transport system aspect of waste management.

These include:

i) Location of disposal points
ii) Disposal facilities
iii) Available technology
iv) Prevailing climate
v) Route plans and road network and
vi) Waste quality and quantity

In the transportation of waste resources the following can be used:

i) Tippers
ii) Side loaders

iii) Skip vehicles and
iv) Roll over vehicle

These are useful in the transportation of compressible wastes.

A front-loading garbage truck in North America.

Transportation of liquid waste may take place through networking in which the effluent passes into soil pipes (a channel) or through the channel to the final storage point and this is regulated through the use of gauge valve.

Methods of disposal

Open Dumps

It appears that in most low-income countries and many medium income countries, very little progress has been in upgrading waste disposal methods. Open dumps are consequently often used. Solid waste is usually accumulated in the open, where the refuse is piled up without being covered or otherwise protected. Dumps are located wherever land is available, without regard to safety, health hazards and aesthetic degradation. Open dumps where the waste is unloaded in piles, make very uneconomical use of the available space, allow free access to waste pickers, animals and flies and often produce unpleasant and hazardous smoke from slow burning fires.

In industrialized nations, open dumps area is a thing of the past. In the U.S., thousands of open dumps have been closed and new ones banned. Common sites were mines and quarries where gravel and stones had been removed, natural low areas like swamps or flood plains, and hillside areas above or below towns. In some instances, the refuse is ignited and allowed to burn, in some the refuse is leveled and compacted.

As a general cycle, open dumps create a nuisance by being unsightly, providing breeding grounds for pests creating health hazards, polluting the air and sometimes polluting ground water and surface water.

Landfill

Landfill operation in Hawaii.

A landfill compaction vehicle in action.

Disposing of waste in a landfill involves burying the waste, and this remains a common practice in most countries. Landfills were often established in abandoned or unused quarries, mining voids or borrow pits. A properly designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly designed or poorly managed landfills can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate. Another common byproduct of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobically. This gas can create odour problems, kill surface vegetation, and is a greenhouse gas.

Spittelau incineration plant in Vienna.

Design characteristics of a modern landfill include methods to contain leachate such as clay or plastic lining material. Deposited waste is normally compacted to increase its density and stability, and covered to prevent attracting vermin (such as mice or rats). Many landfills also have landfill gas extraction systems installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity.

Incineration

Incineration

Incineration is a disposal method in which solid organic wastes are subjected to combustion so as to convert them into residue and gaseous products. This method is useful for disposal of residue of both solid waste management and solid residue from waste water management. This process reduces the volumes of solid waste to 20 to 30 percent of the original volume. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam and ash. Besides reducing a large volume of waste to a much smaller volume of ash, incineration has another advantage in that the process can be used to supplement other fuels and generate electrical power.

Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants.

Incineration is common in countries such as Japan where land is more scarce, as these facilities generally do not require as much area as landfills. Waste-to-energy (WtE) or energy-from-waste (EfW) are broad terms for facilities that burn waste in a furnace or boiler to generate heat, steam or electricity. Combustion in an incinerator is not always perfect and clean; there have been concerns about pollutants in gaseous emissions from incinerator stacks. Particular concern has focused on some very persistent organics such as dioxins (a carcinogenic toxin), furans, PAHs which may be created which may have serious environmental consequences. Smoke stacks from incinerators may emit oxides of nitrogen and sulphur that lead to acid rain after series of photochemical reactions in the atmosphere. Heavy metals such as Pb, Cd and Hg; and CO_2 which hypothetically is related to global warming.

In modern incinerator facilities, smoke stacks are filled with special devices to trap pollutants but the process of pollutant abatement is very expensive. Furthermore, the plant themselves are expensive to establish.

On-site disposal

A common on-site disposal method in urban areas in developed countries is mechanical grinding of kitchen food waste. Garbage disposal devices are installed in the waste water pipe system at the kitchen sink and the garbage is ground and flushed into the sewer system. Final material is transferred to sewage treatment plants, where solids remaining as sewage sludge still must be disposed off.

Sanitary landfill

Sanitary landfill is a site where solid wastes are placed are placed on or in the ground at a carefully selected location by means of engineering techniques that minimize pollution of air, water and soil, and other risks to man and animals. Aesthetic considerations are also taken into considerations are also taken into account.

A sanitary landfill is designed to concentrate and contain refuse without creating a nuisance or hazard to public health or safety. The idea is to confine the waste to the smallest practical area,

reduce it to the smallest practical volume and cover it with a layer of soil at the end of each day of operation or more frequently if necessary.

Covering the waste is what makes the landfill sanitary. The compacted layer restricts (but does not eliminate) continued access to the waste by insects, rodents and animals such as seagulls. It also isolates the refuse, minimizing the amount of surface water entering into and gas escaping from the waste.

Most sanitary landfills designs attach considerable importance to prevailing polluted water (leachate) from escaping from the site. It has been shown that large quantities of leachates can be produced by by landfills even in semi-arid climates.

Most designs include expensive and carefully constructed impermeable layers which present leachates moving downward into the ground and drainage systems to bring the leachates to a treatment plant or a sewage tank. However, if the plant is not emptied before it overflows, or if the plant is not working the leachate control system actually makes the pollution worse than from an open dump, because all the leachates is concentrated in one place, giving natural purification system very little chance of reducing the pollution impacts. This example shows that good design and construction alone can achieve nothing if they not followed by good operation. Hence, there is training of a site manager, the provision of sufficient financial and physical resources to allow a reasonable standard of operation.

The most significant hazard from a sanitary landfill is obviously the pollution of groundwater or surface water. If waste buried in a landfill comes into contact with water percolating down from the surface or with groundwater moving laterally through the refuse, leachates are produced. The nature and strength of such leachates produced at a disposal site depends on the composition of the waste, and the length of time that the infiltrated water is in contact with the refuse.

Choosing the site for a sanitary landfill is important. A number of factors must be taken into consideration including:

i) Topography
ii) Location of the ground water
iii) Amount of precipitation
iv) Type of soil and rocks
v) Location of the disposal zone in the surface-water and groundwater flow system.

A favourable combination of climates, hydrologic and geologic conditions help to ensure reasonable safety in containing the waste and its leachates. The best sites are in arid regions, disposal conditions are relatively safe because little leachate is produced in a dry environment. In humid climates, sanitary landfills are best cited where there is relatively impermeable clay and silt soils well above the water table. This is so that any leachate produced remains in the vicinity of the site and degrades by natural filtering action and chemical reactions between the clay and the leachate.

Monitoring Pollution in Sanitary Landfills

Once a site is chosen for a sanitary landfill and before filling starts, monitoring the movement of groundwater should begin. The monitoring is accomplished by periodically taking samples of water and gas from specially designed monitoring wells. Monitoring the movement of leachates

and gases should be as long as there is any possibility of pollution. This procedure is particularly important after the site is completely filled with a final, permanent cover material is in place. Continued monitoring is necessary because a certain amount of settlement always occur after a landfill is completed, and if small depressions form, surface water may collect, infiltrate and produce leachate. Monitoring and proper maintenance of an abandoned landfill reduce the pollution potential.

Hazards effect of Pollution from Landfills

Landfills, if not properly managed can become source of hazardous substances into the environment. Such pollution may enter the environment by as many as six routes namely:

i) Methane, ammonia, hydrogen sulphide and nitrogen gases may be produced from compounds in the soil and the waste, and may enter into the atmosphere
ii) Soluble materials such as chloride and iron may be retained in the soil, soluble materials such as chloride, nitrates and sulphates may readily pass through the waste and soil to the underground water
iii) Heavy metals such as Lead, chromium and iron may be retained in the soil
iv) Overland run-off may pick up leachates and transport it into streams and rivers
v) Some plants (including crops) growing in the disposal area may selectively take up heavy metals and the toxic materials to be passed up the food chain as people and animal eat them
vi) If the plant residue from crops left in the field contains toxic substances, these materials will return to the soil.

Ideally, a thorough monitoring program considers all six possible paths by which pollutants enter the environment. Hence, adequate precautions could have been taken.

RESOURCE RECOVERY

To some people, a perfect system for waste disposal system would be a technology that is capable of accepting an unlimited amount of waste and safety containing it forever outside the sphere of human life. This is an impossible dream and it is not environmentally sound. The environmentally preferred concept with respect to waste management is to consider wastes as resources out of place.

With increasing cost of raw materials, energy, transportation and land to reuse and recycle more resources will become financially feasible. Moving towards this objective is moving towards an utopian environmental view that there is no such thing as waste, only resources. Hence, everything considered useful for something even though a waste somewhere. Resource recovery means obtaining some economic benefits from materials that has been regarded as waste by someone.

It includes:

(i) Reduce: the objective here is to reduce the amount of urban and other types of wastes that must be disposed of in landfills, incinerators, or other waste management facilities. Reducing waste can be facilitated by better packaging establishment of recycling programs and large-scale composting programs.

(ii) Reuse: this suggests using the same materials for the same purpose again, rather than disposing of it. An example of this is the refilling of soft drink bottles.

(iii) Conversion: this involves the processing of materials to make something different (such as producing padding for clothing and steeping bags from plastic bottles or producing compost from food waste)

(iv) Recycling: this involves processing materials so that it can be used again as the same material, such as the processing of waste paper to make pulp and then new ones. Recycling refers to the collection and reuse of waste materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, or sorted directly from mixed waste streams. The most common consumer products recycled include aluminum such as beverage cans, copper such as wire, steel food and aerosol cans, old steel furnishings or equipment , polyethylene and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines and light paper, and corrugated fiberboard boxes. PVC, LDPE, PP, and PS are also recyclable. These items are usually composed of a single type of material, making them relatively easy to recycle into new products. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required. The type of recycling material accepted varies by city and country. Each city and country have different recycling programs in place that can handle the various types of recyclable materials

(v) Energy recovery (Waste-to-energy): The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel. Recycling through thermal treatment ranges from using waste as a fuel source for cooking or heating, to anaerobic digestion and the use of the gas fuel (see above), to fuel for boilers to generate steam and electricity in a turbine. Pyrolysis and gasification are two related forms of thermal treatment where waste materials are heated to high temperatures with limited oxygen availability. The process usually occurs in a sealed vessel under high pressure. Pyrolysis of solid waste converts the material into solid, liquid and gas products. The liquid and gas can be burnt to produce energy or refined into other chemical products (chemical refinery). The solid residue (char) can be further refined into products such as activated carbon. Gasification and advanced Plasma arc gasification are used to convert organic materials directly into a synthetic gas (syngas) composed of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam. An alternative to pyrolisis is high temperature and pressure supercritical water decomposition (hydrothermal monophasic oxidation).

Anaerobic digestion component of Lübeck mechanical biological treatment plant in Germany, 2007

Steel crushed and baled for recycling

Sustainability

The management of waste is a key component in a business' ability to maintaining ISO14001 accreditation. Companies are encouraged to improve their environmental efficiencies each year. One way to do this is by improving a company's waste management with a new recycling service. (such as recycling: glass, food waste, paper and cardboard, plastic bottles etc.)

Biological reprocessing

An active compost heap.

Composting is a biochemical process in which organic materials such as lawn clippings and kitchen scraps decompose to rich soil-like material. Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. The resulting organic

material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity and heat (CHP/cogeneration) maximising efficiencies. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter.

There is a large variety of composting and digestion methods and technologies varying in complexity from simple home compost heaps, to small town scale batch digesters, industrial-scale enclosed-vessel digestion of mixed domestic waste (see Mechanical biological treatment). Methods of biological decomposition are differentiated as being aerobic or anaerobic methods, though hybrids of the two methods also exist.

Anaerobic digestion of the organic fraction of MSW Municipal Solid Waste has been found to be in a number of LCA analysis studies to be more environmentally effective, than landfill, incineration or pyrolisis. The resulting biogas (methane) though must be used for cogeneration (electricity and heat preferably on or close to the site of production) and can be used with a little upgrading in gas combustion engines or turbines. With further upgrading to synthetic natural gas it can be injected into the natural gas network or further refined to hydrogen for use in stationary cogeneration fuel cells. Its use in fuel cells eliminates the pollution from products of combustion.

An example of waste management through composting is the Green Bin Program in Toronto, Canada, where Source Separated Organics (such as kitchen scraps and plant cuttings) are collected in a dedicated container and then composted.

Avoidance and reduction method

Waste minimization

An important method of waste management is the prevention of waste material being created, also known as waste reduction. Methods of avoidance include reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using disposable products (such as disposable cutlery), removing any food/liquid remains from cans, packaging, and designing products that use less material to achieve the same purpose (for example, lightweighting of beverage cans).

Costs

Environmental costs

Waste attracts rodents and insects which harbour gastrointestinal parasites, yellow fever, worms, the plague and other conditions for humans. Exposure to hazardous wastes, particularly when they are burned, can cause various other diseases including cancers. Waste can contaminate surface water, groundwater, soil, and air which causes more problems for humans, other species, and ecosystems. Waste treatment and disposal produces significant green house gas (GHG) emissions, notably methane, which are contributing significantly to global climate change.

Social costs

Waste management is a significant environmental justice issue. Many of the environmental burdens cited above are more often borne by marginalized groups, such as racial minorities, women, and residents of developing nations. NIMBY (not-in-my-back-yard) is a popular term used to describes the opposition of residents to a proposal for a new development close to them. However, the need for expansion and siting of waste treatment and disposal facilities is increasing worldwide. There is now a growing market in the transboundary movement of waste, and although most waste that flows between countries goes between developed nations, a significant amount of waste is moved from developed to developing nations.

Economic costs

The economic costs of managing waste are high, and are often paid for by municipal governments. Money can often be saved with more efficiently designed collection routes, modifying vehicles, and with public education. Environmental policies such as pay as you throw can reduce the cost of management and reduce waste quantities. Waste recovery (that is, recycling, reuse) can curve economic costs because it avoids extracting raw materials and often cuts transportation costs. The location of waste treatment and disposal facilities often has an impact on property values due to noise, dust, pollution, unsightliness, and negative stigma. The informal waste sector consists mostly of waste pickers who scavenge for metals, glass, plastic, textiles, and other materials and then trade them for a profit. This sector can significantly alter or reduce waste in a particular system, but other negative economic effects come with the disease, poverty, exploitation, and abuse of its workers.

Waste management concepts

There are a number of concepts about waste management which vary in their usage between countries or regions. Some of the most general, widely used concepts include:

- Waste hierarchy - The waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.
- Extended producer responsibility - Extended Producer Responsibility (EPR) is a strategy designed to promote the integration of all costs associated with products throughout their life cycle (including end-of-life disposal costs) into the market price of the product. Extended producer responsibility is meant to impose accountability over the entire lifecycle of products and packaging introduced to the market. This means that firms which manufacture, import and/or sell products are required to be responsible for the products after their useful life as well as during manufacture.
- Polluter pays principle - the Polluter Pays Principle is a principle where the polluting party pays for the impact caused to the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the waste.

Institutional participation in solid waste management

Management of solid waste (or waste in general) should not be allowed to be handled by individuals alone since the cost of such management may be too exorbitant, however various institutions that can participate in waste management include:

i) The three tiers of government viz a) local, b) state and c) federal
ii) Organized clubs in high schools and higher institutions of learning
iii) Buoyant individual or philantropist
iv) Non-governmental organization
v) Community based organizations
vi) International institutions such as industries, oil companies, foreign bodies.

At the local government level, management of waste is commonly supervised by local government officials popularly referred to as the Environmental Health Officers who embark routine inspection of houses and streets within various communities in that particular local government in order to ensure general cleanliness. The assignment of solid waste management was formerly exclusive to the local government has been in existence and entrenched in the 1989 constitution of Nigeria. This might be due to the fact that the local government is closer to the people that is: grassroot, however it has since been be assessed because it lacks the fiscal, managerial and supervisory capacity to perform effectively the task of solid management (collection, disposal). This is one of the reasons solid waste management has been recognized and also treated as issue of state and federal government.

At the state level, the solid waste management was formerly under the umbrella of the state Environmental protection Agency which comes under different acronyms such as OGEPA, LASEPA, OSEPA etc. these EPA bodies in all states of Nigeria are now under the ministry of Environment. The body organizes monthly environmental sanitation in which a day is set aside throughout the entire states of the country for the general cleaning of the environment which involves collection, transportation and disposal of waste among which is solid waste to designated sites. This type of sanitation exercise takes place once in some states and twice in other states, while it is no more in existence in some other states. Apart from EPA, there are some other agencies at state level that are directly are directly connected or concerned with the management of solid waste such include LAWMA, KAI (both in Lagos), MSI (Abeokuta). OSWMA (Akure, Ondo).

At federal government level, for along time this tier of government through the now ministry of Environment as been concerned directly or indirectly with issue of waste management. This is achieved through the disbursement of funds to the state government and other relevant agencies or organizations concerned with environmental management program. Notable among these is the one time popular WAI (War Against Indiscipline) which passed through series of phases. It was primarily the problem of monitoring unsightly and potentially dangerous spread of solid waste in our cities which led to the formal launching of a national environmental sanitation he program (also referred to as the 5^{th} phase of the WAI IN August 1985). However, due to the draconial measures of WAI, the program was wiped out. It is disheartening that people only respond to this program when it is backed up with FORCE. When this is removed or slackened, people will drop back to their pollution causing habits.

FINANCIAL INSTITUTE AND FOREIGN BODIES

Similarly, the local, state or federal government levels may be financed by local or foreign institutions and agencies. Many years ago, World Bank released $460m to Lagos State for the construction of drainage channelization project while in 1981, European Economic Community third one was converted to Civic Centres

SCHOOL CLUBS PERTICIPATION

The management of solid waste should not be left in the hands of government or communities alone. Formation of solid waste management clubs under any chosen names will go a long way to keep garbages from most of the cities. It will even help the club members and the society at large which are likely to be dominantly people of youthful ages to group in the consciousness of 'cleanliness is next to godliness'. Buoyant individuals can also assist the communities or local government in finding the cost of waste management thereby getting rid of shanty environment dotted with heaps of solid waste. Non-governmental (NGOS) agencies and community based organization as some of the examples of different institutions that can participate in the management of waste and this involves coming together of people of like minds, raising fund at community level for the management of waste or coming together of people of different background, educational status but with common goal. Seeking fund locally and internationally for the management of waste. Oil companies are not left out in the management of waste. Being a strong financial company, prompt release of substantial amount of money to communities and different tiers of government will assist in the management of waste. They can also organize or finance seminars at different levels in other to create more awareness about solid waste management in our society.

ECONOMIC IMPORTANCE OF WASTE

1. Serve as Soil Nutrients.
2. Used as fertilizer-crop product.
3. Source of abode.
4. Source of income-scaveryers.

ENVIRONMENTAL AND HEALTH EFFECTS OF WASTE MANAGEMENT

When we are talking about environmental effects it implies negative or positive impact, and these impact may either be direct or indirect. When it is direct, it means that the impact is linked with waste itself, and when it is indirect, it means it linked with other activities that is associated with waste management. Waste problems in developing countries are different and often greater than in developed countries. In developing countries waste disposal is base on controlled dumping on unsuitable e.g river banks, streets, canals, small and large rubbish heap. In several developing countries, the amount of waste normally increase in proportion especially in relation to industrial development. The waste problem is great and increases in cities. Extensive migration to cities and relatively great differences between the poor and there rich urban areas are major factors in considering wask generation and handling.

ENVIRONMENTAL ASPECTS

1. Waste results in Slum: - Most of the wastes generated are in form of metal scraps, glass, cardboards, plastics, textiles. These are deposited in heaps on our settlements. Waste heaps are not often common in affluent environment because of regular collection. Therefore, the land that would have been useful in better ways has been designated during sites in most of the environment of developing countries.
2. Foul odours: Most of the waste environment often consists of organic matter e.g vegetable scraps and excrements from animal and humans. Such are areas are characterized by bad smell and large ant of files and rodents.
3. Impacts on soil: Leachates from the waste during sites percolate into the soil, this percolation continues in porous soil media or stop and accumulate in the non-porous impermeable soil media. This ways, the metal load of the soil is increased.

4. Impact on air: Waste gas normally contains heavy metals like Hg, Cd, Pb and Zn. Also, this includes gas flaming in the oil and gas industries. Waste gases also include fumes from chemical industries. The incineration process of waste normally lead to the increase of gases like Acid gas Hg, So, H_2S nitrous oxide and also harmful components like PH and dioxins
5. Impacts on water: Water flowing from the waste can leach into the underground i.e aquifer, thereby polluting it. It can also get i.e through the drains out nearby rivers, especially the wastes deposited at the banks of the rivers and this leads to metal accumulation of the river and eutrophication.
6. Impacts on flora and fauna: Eutrophication resulting from leachates from the waste dumpsites will lead to deoxygenation and extermination of natural flora and fishes. The solubility of poisonous mineerals like Al and Cd from waste may increase and clamage roots of plants thereby reducing their nutrients intake and uptake.
7. Impact on health aspect humans and animals: This is most felt in term of health problems.

a) Acid gases may in high concentration lead to health problems, cause damage to vegetation and corrode buildings and materials.
b) Acidification of water bodies through precipitation may poison and kill small faura and flora.
c) Waste may serve as an outbreak of diseases e.g. cholera typhoid etc.
d) Landfill gas may lead to suffocation among workers and there is also the possibility of health hazards due to toxic, carcinogenic and irritation organic that gases which are generated.
e) Manual sorting of waste may lead to injury from sharp and painted object hence infection.
f) Exposure of waste scavengers/manual sorters to waste dust may lead to respiratory dxs.
g) Back injury may occur to people involved in the collection and transfer of too heavy waste or overfilled.
h) Noise from waste processing plants may represent a health risk to refuse workers and people living nearby especially in the case of every large plant.

Effect of hazardous waste to man

In the case of koko incident in Nigeria, some of the workers called to dear the dump site experienced chemical burns in their hands even through hand gloves were given, some have nausea (vomiting) and even paralysis. some women in that enviornment had premature birth due to the toxicity at the dump site. The fumes from the site also sent from people to coma. Man, more often than not is always at the receiving end of toxic waste dump for instance, toxic waste comprising toxins that are considered persistent bio-accumulated toxins (PBTs) e.g. Pb, Cd, Cr, etc. are particularly dangerous because they do not degrade over long pawd of time and can easily spread and move between air, water, and soil resulting in the bioaccumulation of the toxin far from the original point source of pollution. PBTs accumulated in fatty tissues of human and animals, thereby making the toxins to gradually concentrate, putting those at the top of the food chain at the greatest risk, some of these PBTs get leached into H2o bodies and are taken by man and animals that use such water for drinking purposes. Also plant roots takes some of these toxins up from polluted soil which may not necessarily lead to death but are rather stored in their leaves. These leaves are fed on by animals who overtime accumulate them in there tissues and some of these animals are taken by man whereby causing acute and most time chronic diseases-PBTs are associated with a range of adverse human effect including damage to nervous system, reproductive developmental problems, cancer and genetic impact. Polybrominated diphenyl ether (PBDE)

a common toxin in waste cell phones is associated with liver damage, neurological and immune system problems, thyroid dysfunction among others. Hg poisoning has also resulted from eating fish from polluted water.

water.