TOPIC: -

DISPOSAL OF URBAN SOLID WASTE.

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INTRODUCTION: -

Solid waste could be considered as any material that is discarded because it has served its purpose or is no longer useful. Industrial solid waste is usually the by-product or end-product of materials from large-scale production factories and industries. They are often considered hazardous and are therefore toxic to the biological environment. Domestic solid wastes are wastes originating from domestic activities such as those that emanate from household or small-scale activities. This latter type includes human and animal wastes, garbage from unwanted food items, paper and other old clothes or materials. Fluid wastes are their liquid and gas components. The conglomeration of all these waste products in a city or town is usually termed municipal solid waste. In developing nations, the waste is characterized by vegetative matters (60%), tins and cans (<10%), metals (<10%), polythene, wood and termites among others. Hazardous waste is any waste material that, when improperly handled and disposed of, can cause substantial harm to human health, death of smaller animal and plant organisms and a general breakdown and loss to the immediate ecological system. Should the situation persist, the effect of hazardous waste may lead to irreversible imbalance in the ecosystem equilibrium. Thus the safety and health of the environment are at risk due to the poisonous and toxic nature of hazardous waste. This type of waste can take the form of solids, semi-solids, fluids or sludges (Britannica Corporate Site, 2001). Cities are at the nexus of a further threat to the environment, namely the production of an increasing quantity and complexity of wastes. The estimated quantity of Municipal Solid Waste (MSW) generated worldwide is 1.7 – 1.9 billion metric tons. Future projections estimate that the world's waste production could reach up to 27 billion tons by 2050, a third of which may be generated in Asia, with a significant percentage of that being produced in large economies such as China and India. The types of MSW produced change according to the standard of living in the city. There is an overall correlation between the generation of MSW, wealth and urbanization. Wastes generated in low- and middle- income cities have a large proportion of organic waste, whereas the wastes in high-income cities are more diversified with relatively larger shares of plastics and paper. The changing composition of waste in turn influences the choice of technology and waste management infrastructure, and underscores the importance of waste separation. Electrical and electronic wastes (e-waste) are rapidly growing forms of waste that are generating much concern. In 2005, 20 to 50 million tonnes of e-waste were generated worldwide, and by 2020, e-waste from used computers in emerging economies like South Africa, China and India will have increased by 200-500 per cent over 2007 levels. Other types of waste streams of concern in the context of an urban lifestyle are construction and demolition waste and end-of-life vehicles. For example, about 10-15 per cent of waste generated in developed countries is due to construction and demolition activity, while discarded vehicles generated in Germany, United Kingdom, France, Spain and Italy are responsible for approximately 75 per cent of waste generated in the European Union (EU-25).

In many cases, municipal wastes are not well managed in developing countries, as cities and municipalities cannot cope with the accelerated pace of waste production. Waste collection rates are often lower than 70 per cent in low-income countries. More than 50 per cent of the collected waste is often disposed of through uncontrolled landfilling and about 15 per cent is processed through unsafe and informal recycling.

Solid waste disposal is a smaller topic in the grander topic of solid waste management. It refers to what is done to the solid waste to get rid of it. The disposal of solid waste is a problem. This problem continues to grow with the growth of population and development of industries. Unmanaged disposal of waste affects human health, causes economic losses and damages the physical and biological environment (UNEP, 2002).

In India, collection, segregation, transportation, and disposal of solid waste are often unscientific and chaotic. Uncontrolled dumping of wastes on the outskirts of towns and cities has created overflowing landfills, which have environmental impacts in the form of pollution to soil, groundwater, and air, and also contribute to global warming. About 36.5 million tonne of municipal solid waste is generated in India every year. That is approximately 36.5 million tonne annually. The per capita waste generation in major Indian cities ranges from 0.2 kg to 0.6 kg. The difference in per capita waste generation between lower and higher income groups range between 180 to 800 g per day.The urban local bodies spend approximately Rs. 500 to Rs. 1500 per tonne on solid waste for collection, transportation, treatment and disposal. About 60-70% of this amount is spent on collection, 20-30% on transportation and less than 5% on final disposal. The calorific value of Indian solid waste is between 600 and 800 kcal/kg and the density of waste is between 330 and 560 kg/m3. Out of the total MSW collected, on an average 94% is dumped on land and 5% is composted.

CONCEPT OF MUNICIPAL WASTE DISPOSAL: -

Disposal is the “no alternative” option because it is the last functional element in the solid waste management system and the ultimate fate of all wastes that are of no further value. On the general concept, “disposal” means to put waste into a landfill for the purpose of final burial, destruction or placement for future recovery. As the terminal action for pollution control of solid waste, the final target of disposal is isolating solid waste and its environmental impact from biosphere and to keep humankind and environment from any unacceptable hazard from the infection of hazardous components in wastes. The object of final disposal is that the wastes cannot be processed and used further.

With a rigorous definition, "disposal" means the activities to minimize the quantity of produced solid wastes, to decrease and even eliminate hazardous components in solid wastes, the activities to contain solid wastes in a location or facilities which meet environmental protecting standard without the need to isolate from the biological environment. For meeting the specifications of disposal, some treatment process modifying the physical, chemical or biological characteristic of solid wastes would be introduced like compost, incineration and/or others.

The safe and reliable long-term disposal of solid waste residues is an important component of integrated solid waste management. Historically, landfills have been the most economical and environmentally acceptable method for the disposal of solid wastes in most of the countries. Even with implementation of waste reduction, recycling, transformation and energy recovery technologies, disposal of residual solid waste in landfill still remains a necessary component of waste management system.

COMMON PROBLEMS ASSOCIATED WITH UNSOUND MSW DISPOSAL: -

- The disposal of solid waste has always been a huge problem throughout India. The overwhelming majority of landfills in India are open dumps without leachate or gas recovery systems. Several are located in ecological or hydrologically sensitive areas. They are generally operated below the standards of sanitary practice. Municipal budgetary allocations for operation and maintenance are always inadequate.
- Careless and indiscriminate open dumping of wastes creates unsightly and unsanitary conditions within municipalities e.g. along the roads and highways.
- Delay in delivery of solid wastes to landfills (which are infect dump sites), resulting in nuisance dumps and unpleasant odours which attract flies and other vectors. Such dumps also lead to pollution of land/soils, ground and surface water through leachate and air through emission of noxious and offensive gases.
- Open solid waste dumps can also be a public health risk. Direct contact with refuse can be dangerous and unsafe to the public, as infectious diseases such as cholera and

dysentery can be spread through contact with these wastes. In most municipalities, scavenging on refuse dumps is a common practice, and such people face danger of direct exposure to hazardous waste. Open solid waste dumps can also provide suitable breeding places for vermin and flies and other disease vectors, and can also contain pathogenic micro-organisms.

- Some categories of solid wastes block permeability of soils and drainage systems, including water courses, open drains and sewers, thus posing difficulties in the functioning and maintenance of such facilities.
- Due to the capital-intensive nature of solid waste handling and disposal operations, these can become an economic burden and constrain service delivery in other areas such as medical care, education and road construction.

CRITERIA FOR EVALUATING OF WASTES DISPOSAL ORIENTATION: -

For getting a best choice from different technology and/or policy, decision-makers should consider a series of factors designed to facilitate comparison of the available alternatives. Before a well-informed decision can be made, to make these factors clear will shed light on particular key points that need to be resolved in advance.

(i) TECHNICAL AND SOCIAL FEASIBILITY: -

First of all, that if the technology is a competent to accomplish the basic scheduled goal in the circumstances where it would be used has to be verified. The decision maker must be sure that the basic characteristic of a certain technology is compatible with the target before any decision has been made.

(ii) BALANCE AMONG COST AND PERFECTIBILITY OF DISPOSAL ACTIVITY: -

A good decision-maker needs to find appropriate balance between the cost and environmental benefit to make the project most cost-effective. It means, an over-exacting disposal standard would only get a little environmental benefit with a huge extra cost.

(iii) CONSISTENCY WITH MACROSCOPICALLY MUNICIPAL PLAN: -

The eventual antinomy between the macroscopic municipal plan and project has to be prevented. What would be affected by the adoption of this technology or policy in administration and society is another criterion.

(iv) BACKGROUND CONDITIONS THAT AFFECT DISPOSAL ORIENTATION: -

Compared with water treatment, selection of disposal system of solid wastes is more sensible to society and nature. For example, incineration would degrade air quality by dust and chemicals primarily while landfilling and composting contaminate groundwater with organic matters, heavy metals and air with stench, infection and gas. The list of conditions that help determine sound practice includes:

(a) LEVEL OF ECONOMIC DEVELOPMENT AND TECHNOLOGICAL DEVELOPMENT: This depends on the kind of disposal technology selected, and a comparison of the nonrecurring expense for facilities construction, on the operational cost and on the technical requirement would be identified in general. For example, the cost of incineration treatment on both facilities construction and operation is much higher than landfill.

(b) NATURAL CONDITIONS: Most of natural conditions, such as topography, soil characteristics, and type and proximity of bodies of water; climate temperature, rainfall, propensity for thermal inversions, and winds, are important considerations in the process of decision making for the location of waste disposal to a great extent.

(c) CHARACTERISTIC OF WASTES: These conditions are primarily affected by human activities. Waste characteristics including density, moisture content, combustibility, ability of recycle, and inclusion of hazardous waste in MSW; the characteristics of municipal wastes are closely related to city characteristics such as size, population density, and infrastructure development.

(d) POLITICAL CONSIDERATIONS: Environmental policies, land policies and public environmental regulations frequently interfere with the normal technical scheme. The degree to which decisions are constrained by political considerations, and the nature of those constraints, degree of importance assigned to the various temporary elements.

DISPOSAL OF URBAN SOLID WASTE: -

The final stage of solid waste management is safe disposal where associated risks are minimized. There are four main methods for the disposal of solid waste:

1. Dumps and landfills
2. Thermal disposal
3. Biological disposal

4. Resource recovery

The most common of these is undoubtedly land application, although all four are commonly applied in emergency situations. Details of disposal on-site and off-site can be found in following sections.

(A) ON-SITE DISPOSAL OPTIONS: -

The technology choices outlined below are general guidelines for disposal and storage of waste on-site, these may be adapted for the particular site and situation in question.

i. **COMMUNAL PIT DISPOSAL: -**

   Perhaps the simplest solid waste management system is where consumers dispose of waste directly into a communal pit. The size of this pit will depend on the number of people it serves.

ii. **FAMILY PIT DISPOSAL: -**

   Family pits may provide a better long-term option where there is adequate space. This method is best suited where families have large plots and where organic food wastes are the main component of domestic refuse.

iii. **COMMUNAL BINS: -**

   Communal bins or containers are designed to collect waste where it will not be dispersed by wind or animals, and where it can easily be removed for transportation and disposal. A popular solution is to provide oil drums cut in half. The bases of these should be perforated to allow liquid to pass out and to prevent their use for other purposes. A lid and handles can be provided if necessary.

iv. **FAMILY BINS: -**

   Family bins are rarely used in emergency situations since they require an intensive collection and transportation system and the number of containers or bins required is likely to be huge.

v. **COMMUNAL DISPOSAL WITHOUT BINS: -**

   For some public institutions, such as markets or distribution centres, solid waste management systems without bins can be implemented, whereby users dispose of waste directly onto the ground.

vi. **TRANSPORTATION OPTIONS: -**

Where bins or collection containers require emptying, transportation to the final disposal point is required. As described, waste transportation methods may be human-powered, animal-powered or motorised.

a. **HUMAN-POWERED:** Wheelbarrows are ideal for the transportation of waste around small sites such as markets but are rarely appropriate where waste must be transported considerable distances off-site. Handcarts provide a better solution for longer distances since these can carry significantly more waste and can be pushed by more than one person.

b. **ANIMAL-POWERED:** Animal-powered transportation means such as a horse or donkey with cart are likely to be appropriate where they are commonly used locally.

c. **MOTORISED:** Where the distance to the final disposal site is great, or where the volume of waste to be transported is high, the use of a motorised vehicle may be the only appropriate option. For large volumes of waste, it may sometimes be appropriate to have a two-stage transportation system requiring a transfer station.

(B) OFF-SITE DISPOSAL OPTIONS: -

The technology choices outlined below are general options for the final disposal of waste offsite.

SANITARY LANDFILLS: -

Landfills are designed to greatly reduce or eliminate the risks that waste disposal may pose to the public health and environmental quality. They are usually placed in areas where land features act as natural buffers between the landfill and the environment. Some sanitary landfills are used to recover energy. The natural anaerobic decomposition of the waste in the landfill produces landfill gases which include Carbon Dioxide, methane and traces of other gases. Methane can be used as an energy source to produce heat or electricity. Thus some landfills are fitted with landfill gas collection (LFG) systems to capitalise on the methane being produced. The process of generating gas is very slow, for the energy recovery system to be successful there needs to be large volumes of wastes.These landfills present the least environmental and health risk and the records kept can be a good source of information for future use in waste management, however, the cost of establishing these sanitary landfills are high when compared to the other land disposal methods.

(a) **CONTROLLED DUMPS*:*** Controlled dumps are disposal sites which comply with most of the requirements for a sanitary landfill but usually have one deficiency. They may have a planned capacity but no cell planning, there may be partial leachate management, partial or no gas management, regular cover, compaction in some cases, basic record keeping and they are fenced or enclosed.

(b) **BIOREACTOR LANDFILLS*:*** Recent technological advances have lead to the introduction of the Bioreactor Landfill. The Bioreactor landfills use enhanced microbiological processes to accelerate the decomposition of waste. The main controlling factor is the constant addition of liquid to maintain optimum moisture for microbial digestion. This liquid is usually added by re- circulating the landfill leachate. In cases where leachate in not enough, water or other liquid waste such as sewage sludge can be used. The landfill may use either anaerobic or aerobic microbial digestion or it may be designed to combine the two. These enhanced microbial processes have the advantage of rapidly reducing the volume of the waste creating more space for additional waste, they also maximize the production and capture of methane for energy recovery systems and they reduce the costs associated with leachate management. For Bioreactor landfills to be successful the waste should be comprised predominantly of organic matter and should be produced in large volumes.

(ii) THERMAL TREATMENT: -

This refers to processes that involve the use of heat to treat waste. Listed below are descriptions of some commonly utilized thermal treatment processes.

(a) **INCINERATION*:*** incineration is the most common thermal treatment process. This is the combustion of waste in the presence of oxygen. After incineration, the wastes are converted to carbon dioxide, water vapor and ash. This method may be used as a means of recovering energy to be used in heating or the supply of electricity

(b) **PYROLYSIS AND GASIFICATION:** Pyrolysis and gasification are similar processes they both decompose organic waste by exposing it to high temperatures and low amounts of oxygen. Gasification uses a low oxygen environment while pyrolysis allows no oxygen. These techniques use heat and an oxygen starved environment to convert biomass into other forms. Gasification is advantageous since it allows for the incineration of waste with energy recovery and without the air pollution that is characteristic of other incineration methods.

(c) OPEN BURNING: Open burning has been practiced by a number of urban centres because it reduces the volume of refuse received at the dump and therefore extends the life of their dumpsite. Garbage may be burnt because of the ease and convenience of the method or because of the cheapness of the method.

(iii) BIOLOGICAL WASTE TREATMENT

(a) COMPOSTING: Composting is the controlled aerobic decomposition of organic matter by the action of microorganisms and small invertebrates. There are a number of composting techniques being used today. These include: in vessel composting, windrow composting, vermicomposting and static pile composting. The process is controlled by making the environmental conditions optimum for the waste decomposers to thrive. The rate of compost formation is controlled by the composition and constituents of the materials i.e. their Carbon/Nitrogen (C/N) ratio, the temperature, the moisture content and the amount of air.

(b) ANAEROBIC DIGESTION*:* Anaerobic digestion like composting uses biological processes to decompose organic waste. However, where composting can use a variety of microbes and must have air, anaerobic digestion uses bacteria and an oxygen free environment to decompose the waste. Aerobic respiration, typical of composting, results in the formation of carbon dioxide and water. While the anaerobic respiration results in the formation of carbon dioxide and methane. In addition to generating the humus which is used as a soil enhancer, anaerobic digestion is also used as a method of producing biogas which can be used to generate electricity.

(iv) RESOURCE RECOVERY/RECYCLE: -

This is where solid waste is not put to direct disposal but the recyclable or reusable materials are sought out, cleaned, or re-processed and used for the original or for other purposes. This approach is highly acceptable to the public as it reduces waste of resources. It can also act as a source of income from the sale of salvaged metals, plastics, and glass as well as recovered energy (Ndoria, 2005).

This approach extends the life of the available open dumps and landfill sites. High initial and operational costs are however involved. A market must also be sought for the recovered materials and the energy produced. Costly maintenance and repairs are also involved and skilled operators are required (Miller, 1986). Resource recovery can have two approaches:

(a) HIGH TECHNOLOGY APPROACH: This is where large centralized resource recovery plant shreds and automatically separates mixed urban waste to recover glass, iron, aluminum, and other valuable materials, which are sold to manufacturing industries for recycling. The remaining paper, plastics, and other combustible wastes can be incinerated to produce steam, hot water or electricity. The incinerator residue including particulates removed to prevent air pollution can be used to reclaim damaged land as landfill sites or can be processed into blocks, bricks and other building materials (Miller, 1986).

(b) LOW TECHNOLOGY APPROACH: This involves source separation i.e. households and businesses place their waste material such as glass, paper, metals, and food scraps into separate containers. Compartmentalized city collection trucks, private haulers, or voluntary recycling organizations pick up the segregated waste, clean them if necessary and sell them to scrap dealers, composting plants or manufacturers.

CONCLUSION: -

The use and promotion of appropriate waste disposal techniques have become necessary to achieve a much healthier and cleaner environment in the world especially in the developing counties. For effectiveness, the governments and concerned agencies of these countries will do well to take the lead by encouraging the production and/or introduction of appropriates technology, equipment/machines including waste disposal vehicles for sound waste management procedures. The equipment should include machines capable of producing recyclable materials and machines that could recycle used materials to reusable ones.

Waste paper bags, dustbins, trashcans and disposal drums should be provided in strategic locations in the public and private places. Households should be knowing what materials are readily biodegraded and which substance are not; each of which should be disposed in different drums. Collection by waste disposal vehicles should then follow promptly. These will then be transported and disposal of in the appropriate places for proper storage, treatment and/or recycling. Adequate information and training should be given and disseminated to all concerned information pertaining to the negative impacts of wastes on and in the environment, waste disposal techniques, new technologies and their applications, could be communication through congresses, seminar, workshops, lectures, TV and Radio enlightenment programmes. This form of training and education is of outmost importance for all in the urban and rural communities. The training should include instructions on how to keep the surrounding clean by making proper use of the trashcans provided and not by throwing dirt and waste polythene on the bare ground/ floor indiscriminately. Good environment management (Aina, 1991), as well as sound waste disposal techniques aims at reducing and avoiding pollution, erosion and resource wastage.