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Empirical Study on Disposal of Waste with Special Reference to Chennai City

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ABSTRACT:

Waste generation, collection and sustainable management are widely discussed topics all over the world. The waste management concept of "Reduce, Reuse, and Recycle" makes a significant contribution to "sustainable waste management," particularly in developing nations like India, where the generation and collection of solid wastes is a significant obstacle. In urban areas of developing nations, used paper makes up a significant portion of the material composition of solid waste. Many educational institutions and offices have been using white paper for academic and office purposes and have adopted a "throw away culture" toward used paper. Solid waste production in developing nations is influenced by population growth and urbanization. The way of solid waste generation and management in a particular area give an important insight into how the people in that particular area live. This non-doctrinal paper deals with the various issues faced by the people due to waste, people's awareness about the laws related to the disposal of waste and other basic knowledge about the disposal process and some remedial measure that has to be implemented from making further damage to the environment and future generation.

INTRODUCTION:

The majority of developing nations face significant difficulties in the production and management of solid waste. The attitude of the people and their environmental awareness are also other factors which are contributing to the specific issue. According to a report from a survey conducted by the United Nations Development Program, 151 mayors of various cities from around the world believe that inadequate solid waste disposal is the second most serious issue that city dwellers face. According to the 2001 census of India, the population of India is expected to rise from 1029 million in 2000 to 1400 million in 2026. This represents an increase of 36% in 26 years at a rate of 1.2% per year. 285 million people live in cities, while 742 million live in rural areas.

The level of urbanization of the country has also increased from 17.6 percent to 31.16 percent during the last 60 years and is expected to rise further to 40 percent by the year 2026. In 1996, India's urban population generated 1,14,576 tons of municipal solid waste per day. By 2026, that number was predicted to rise to 4,40,460 tons per day. This astonishing rise in the amount of municipal solid waste generated is due to changing lifestyles, food habits and living standards of the urban population.

CLASSIFICATION OF WASTE:

The different classification of solid waste is necessary to control and monitor existing waste management systems and to make regulatory, financial and institutional decisions. The various sources and types of waste are as follows:

1. Residual Waste.
2. Industrial Waste
3. Commercial Waste
4. Institutional Waste
5. Constructional and Demolition Waste
6. Municipal Waste
7. Process Waste
8. Waste from Agriculture

WASTE GENERATION RATES: FACTORS INFLUENCING WASTE GENERATION RATES:

- Social and economic progress,
- Degree of industrialization,
- Climate.

The rates of waste production per capita also rise as GNP moves toward the middle-income range. The amount of solid waste generated rises proportionally with economic wealth and urban population share. Composition of Waste: Factors Affecting Composition of Waste:

- Physical Setting,

- Quality of Life
- Power Source • The climate

CHARACTERISTICS AND OBJECTIVES:

Characteristics of Wastes:

1. Corrosive: Waste that has the potential to corrode metal containers like tanks and contains acids or bases.
2. Ignitability: This is the waste that, under certain circumstances, such as Waste oils and Solvents.
3. Reactive: These are unstable in nature; they cause explosions, toxic fumes when heated.
4. Toxicity: Harmful to consume.

Management of solid waste aims at:

a) The social flow of goods.
b) Reduction in raw material usage.
c) Reduction in solid waste Quantities
d) Reuse of materials
e) Material recuperation
f) Energy Recuperation
g) g) Management of daily solid waste is anything that is thrown away, has no use, or is not wanted.

Waste material is any substance or item that needs to be disposed of because it is broken, worn out, contaminated, or otherwise spoiled, as well as any substance or article that constitutes scrap material, effluent, or other unwanted surplus substance arising from the application of a process. The major sources/factors influencing the generation of waste is:

Urban solid waste sources:

a. Rubbish and food waste in the home.
b. In commercial settings, food waste and trash.
c. Special waste and trash are found in open areas like streets, parks, and playgrounds.

Sources of industrial solid waste:

a. Chemical Manufacturing – Acids and bases
b. Waste ink and heavy metal in the painting industry
c. Benzene is used in petroleum refining.
d. Paper Industry – Paint Waste
e. Metal Industry – Cylinder waste, Heavy metals.

MANAGEMENT OF MUNICIPAL SOLID WASTE:

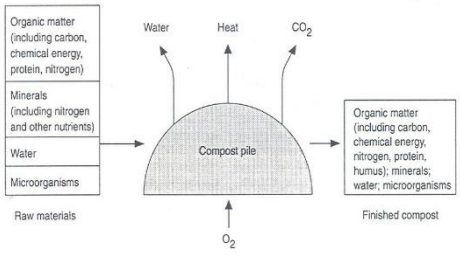
The frequently used municipal solid waste disposal methods are:

COMPOSTING:

In fact, human beings have used this naturally occurring process for centuries to stabilize and recycle agricultural and human wastes. Composting, on the other hand, is now a complex process that can be approached in a number of different ways, depending on the kind of organic materials being used and the properties that are desired for the products.

The chain of succession of different types of microbes continues, until there is little decomposable organic material life. The organic material that is remaining is termed compost. It is primarily composed of undecomposed organic and inorganic particles, microbial skeletons, and byproducts of microbial decomposition. Decomposition may proceed slowly at first because of smaller microbial populations, but as populations grow in the first few hours or days, they rapidly consume the organic materials present in the feedstock.

In composting non-toxic agricultural materials, yard trimmings, and municipal solid waste, which typically contain an adequate diversity of microorganisms, environmental factors typically do not limit the number or type of microorganisms.



i. Mesophilic or moderate-temperature phase: Compost bacteria combine carbon with oxygen to produce carbon dioxide and energy. Some of the energy is used by the microorganisms for growth and reproduction, and the rest is made into heat.
ii. Thermophilic or high-temperature phase: The thermophilic microorganisms are very active and produce heat in the second stage of the process. Although such high temperatures are neither common nor desirable in compost, this stage can continue up to approximately 70°C. This rapid heating phase can last just a few days, weeks, or months.
iii. The microorganisms that were replaced by the thermopiles migrate back into the compost during the cooling phase to digest the organic materials that are more resistant.
iv. Maturation or curing phase: The final stage of the composting process is called curing, ageing or maturing stage and is a long and important one. A safety net for pathogen destruction is provided by a prolonged curing period.
v. Compost that has not been cured can, for instance, produce phytotoxins that deplete the oxygen and nitrogen in the soil and contain high levels of organic acids.

Stage: There are five basic stages involved in all composting practices, namely preparation, digestion, curing, screening or finishing, and storage or disposal. However, the differences may occur in the method of digestion or in the amount of preparation and the finishing required.
Digestion: Digestion techniques are the most unique feature of the various composting processes and may vary from the backyard composting process to the highly controlled mechanical digester

INCINERATION:
Carbon, hydrogen, and other waste components combine with oxygen in the combustion zone to produce heat during an incinerating chemical reaction. Combustion of solid waste necessitates a significant amount of air. Volume Reduction: Incineration reduces the volume of solid waste that must be disposed of by an average of 90%, depending on its composition. The weight of the solid waste that needs to be handled goes down by 70-75 percent. If a distant landfill is used, this has advantages for both the environment and the economy because there is less demand for final disposal at a landfill and there are fewer costs and environmental burdens associated with transportation.
Stabilization of Waste: Incinerator output is considerably more inert than incinerator input, mainly due to the oxidation of the organic components of the waste stream. This leads to a reduction of landfill management problems and the organic compounds present in landfill leachate.

Recovery of energy from waste (EFW): This is more than just a pre-treatment of waste before it is disposed of; it is also a method of valorization. The revered energy from burning the waste is used to generate steam, which can then be exported to nearby factories or district heating schemes or used in on-site electricity generation. As a large part of the energy content of solid wastes comes from truly renewable resources, there should be a lower overall net carbon dioxide production than that from burning fossil fuels, since carbon dioxide is absorbed in the initial growing phase of the biomass.

Sterilization of Waste: The most important step in burning biomedical or clinical waste is this one. In addition, pathogens will be destroyed prior to final disposal in a landfill when solid waste is burned. Carbon and inert materials like glass, metals, silica, and so on will form the solid residue. The Pyrolysis process produces fuel gas as a byproduct and produces fewer emissions. Polymers containing chlorine can also be handled.

LANDFILLING:

Typically, an engineered waste deposit in a pit or trench or on the surface is referred to as a landfill. Also, a sanitary landfill is just a landfill with the right mechanisms in place to control the risks to the environment from disposing of waste and free up the land for other uses after it has been disposed of. Engineered landfills are more likely to have pre-planned installations, environmental monitoring, and an organized and trained workforce than uncontrolled dumping. Sanitary landfill implementation, therefore, requires careful site selection, preparation and management.

The four minimum requirements you need to consider for a sanitary landfill are:
- Full or partial hydrological isolation;
- Formal engineering preparations;
- Permanent control;
- Planned waste emplacement and covering.

Let's talk about the principles, procedures, and operation of sanitary landfills in this context.

Principle: The purpose of land filling is to bury or alter the chemical composition of the wastes so that they do not pose any threat to the environment or public health. Landfills are not uniform and typically consist of cells in which a suitable barrier keeps a small volume of waste isolated from adjacent waste cells. The barriers between cells generally consist of a layer of natural soil, which restricts downward or lateral escape of the waste constituents or leachate.

Land filling relies on containment rather than treatment of wastes. Run-off controls, leachate collection and treatment, monitoring wells, and an appropriate final cover design are all components of an environmentally friendly and sanitary landfill. The phases of a landfill's life cycle are as follows: Preliminary hydrogeological, geotechnical, and geogeological site investigations serve as the foundation for the actual design during the planning phase. The construction phase includes earthworks, the construction of roads and facilities, and the preparation of fill areas. Operation Phase: This phase has a high intensify of traffic; work at the front of the fill, operation of environmental installations and completion of finished sections.

Phase that is Completed: During this phase, the actual filling process comes to an end, and the environmental installations are no longer required to operate. By that point, it's possible that the emissions have decreased to the point where they don't need to be treated anymore and can be freely released into the environment. Final Storage Phase: In this phase, the landfill is integrated into the surroundings or other purposes, and no longer needs special attention.

MANAGEMENT OF SOLID WASTE IN CHENNAI CITY

The City of Chennai is handling municipal solid waste for each of the seven zones. According to schedule II of the Municipal Solid Waste Management & Handling Rules, 2000, the management of solid waste includes the collection of MSW, with an emphasis on segregation at the source and door-to-door collection. Numerous efforts are being made to improve Chennai's MSWM in accordance with the previous regulations. The following are some of the initiatives: In order to facilitate reuse, recycling, and composting, Source Segregation is implemented to separate biodegradable and recyclable materials from the waste stream before they are collected with other MSW. The awareness program comprised of public rallies, meetings, distribution of pamphlets, street plays and advertisements.

Door to Door Collection: Door to door collection is introduced to replace the street bin collection system with a view to reduce the environmental effects. Tricycles outfitted with bells were used to remove municipal solid waste from doorsteps. Abolition of Open Storage: The removal of community bins from the streets helps in part. Due to the lack of financial resources, non-co-operation of the population and inaccessible area/narrow lanes it is difficult to achieve 100% abolition of open storage.

Street sweeping on a daily basis: Corporation employees use brooms, brushes, rotomolded wheeled bins, wheel barrows, and long brooms to sweep the streets at least once a day. Lack of financial support, a lack of sanitary workers, and public holidays are the main obstacles to daily street sweepings. Transportation in covered vehicles: To prevent spills, the CoC has started transporting MSW in covered vehicles. Financial resources, a lack of vehicles, and employees' attitudes all make it difficult to use covered vehicles for transportation. Wastes processing by energy recovery or composting: Ward level composting units were introduced in 106 places to reduce the transportation cost of MSW and the amount of waste reaching dumpsite.

In ward-level composting units, the organic portion of the separated waste is composted, while the non-recyclable portion is transported to dumpsites for disposal. Land disposal in a sanitary manner: According to the recommendations of Environmental Resource Management, open dump sites have been in operation for 20 years. Their lifetime is expected to last until 2011, but they could be extended by upgrading the ones that are already there. Based on the recent investigations CoC has initiated the upgradation process of Kodungaiyur dumpsite.

INSTITUTIONAL FRAMEWORK:

The institutional arrangements generally constitute a set of rules governed relationship among organizations to achieve a set of aim and objectives. Legislation that is both effective and rigorously enforced should be enacted to safeguard the environment and public health. In order to guarantee compliance with established guidelines for environmental protection, legislative and regulatory instruments are created. Without appropriate legal foundations, institutional arrangements for environmental protection cannot exist. The result is often a host of laws, rules and regulations, orders, ministers, departments, divisions, commissions, boards and councils in a complex web of interrelationship.

Environmental protection and management, as the Brundtland Report stated, cannot be delegated to ineffective, underfunded government departments or multiple departments with overlapping responsibilities. Among the environmental challenges and issues, solid waste management is very crucial. Solid waste management is the systematic administration of activities that provides for collection, processing and disposal of solid waste. It is an essential component of the urban environment and the planning of urban infrastructure to ensure a safe and healthy human environment and to encourage sustainable economic growth. The direct and indirect aspects of daily garbage collection and disposal must be examined and considered by planners and policymakers.

The central organization responsible for planning, promoting, and coordinating environmental initiatives is the Ministry of Environmental and Forestry, Government of India. The country's population's health was directly impacted by municipal solid waste management. The CPCB argued that the municipal corporations of the municipalities that are under the administrative control of the respective States or Union Territories were responsible for the management of solid waste. The recommendations were further divided into the following three groups:

- Mandatory recommendations for citizens/associations.
- Mandatory recommendations for local bodies/state government.
- Discretionary recommendations for urban local bodies.

The laws relating to sanitation, pollution control and waste management are scattered in the various Acts, Rules, Regulations, Indian Penal Code, Criminal Procedure Code and Constitution of India. Solid waste management falls under the DPSP's Non-justifiable and Fundamental Duties sections of the constitution. According to Article 47 of the Indian constitution, "steps are taken for the improvement of public health as among its primary duties" is a fundamental principle of governance. Article 51A (g) points out that ‘it is the duty of individual to protect and improve the natural environment, including forests, lakes, rivers and wildlife and to have compassion for living creatures’

The management of solid waste falls under the category of offenses affecting the public's health, safety, convenience, decency, and morals in the Indian Penal Code of 1980. Since, solid waste can seriously affect the health of the community by various diseases; The issue of the solid waste has been treated as 'public nuisance' and has been made punishable. But there is no section in the code which deals with the problem of solid waste.

The judiciary on various cases proclaimed that right to a clean and wholesome environment comes within the purview of Article 21 of the Constitution. The courts have also declared that it is a primary, mandatory and obligatory duty of the municipal corporations/ councils to remove rubbish, filth, night soil or any noxious or offensive matter.

The specific laws that must be followed to maintain a clean and sanitary environment are as follows:

a. The Water (Prevention and Control of Pollution) Act of 1974 requires the establishment of a sanitary landfill site and compost plant to obtain approval from the state pollution control board. The leachate produced by the compost plant or sanitary landfill site should not pollute the water. The Water (Prevention and Control of Pollution) Act, and amendments stipulate the provisions for levying and collection of cess on water consumed for the sanitary land filling, composting and anaerobic digesters.

b. The Air (Prevention and Control of Pollution) Act, 1981 and amendments thereon mandate the need for obtaining consent from the State Pollution Control Board for establishment of the processing plants, disposal site, incineration plants, compost plants and landfill sites.

c. The Environment (Protection) Act of 1986 and subsequent notification stipulate that an EIA report must be submitted before any project can be approved. 4. The Local Body (Municipal) Acts also stipulates certain mandatory requirements for public health and hygiene, toilets, cleanliness, solid waste and liquid waste disposal, drainage, etc. the standards, specification and systems are usually part of their working rules, regulations, guidelines and handbooks. The law for providing such services is also mandated by the building byelaws.

REGULATORY REGIME FOR WASTE MANAGEMENT:

The principles of "sustainable development," "precaution" (measures should be taken to avoid environmental degradation and hazards), and "polluter pays" (the polluter must bear costs for damages and harm caused to the environment by his own actions) underpin Indian waste management regulations.

The MoEF is given authority to make rules in Section 6 regarding a wide range of topics, including standards for ensuring environmental soundness, allowable limits for the emission of pollutants into the environment, how to deal with hazardous substances, the location of industries and how they operate, and measures to prevent accidents and hazards in the environment.

The Municipal Solid Waste (Management and Handling) Rules, 2000:

The MSWMH Rules are the first concrete attempt to address the issue of solid waste. These guidelines aim to make solid waste management more environmentally friendly and cost-effective. The development of infrastructure for the transportation, processing, storage, separation, collection, and disposal of municipal solid waste is mandated by Rule 4. It also imposes duty on the municipal authorities to submit an annual report on implementation to the Ministry of Urban Development.

The rules prohibit the littering of MSW in cities, towns etc. it mandates the collection of wastes on regular basis from areas like, slums, squatter areas, slaughter house, fish market, fruits and vegetable markets, industrial waste, horticultural and construction or demolition waste etc. The Rules provide for the house-to-house collection of waste. In accordance with the collection and segregation system, the Rules require the waste generator to avoid littering and deliver waste. The solid waste management services are provided by the municipal bodies as per the provisions of the respective Municipal Acts. Many of the Acts are quite old and do not keep up with how waste management has changed. Except in metropolitan areas where a separate department exists, SWM and other activities are overseen by the health officer.

Bio-medical Waste (Management and Handling) Rules, 1998:

The Bio-medical Waste (Management and Handling) Rules provide a comprehensive framework for the procedures and mechanisms that must be followed for the efficient disposal of biomedical wastes. These rules also regulate the manner in which biomedical wastes are disposed of. Any waste produced during health care procedures like diagnosing, treating, or immunizing humans or animals, as well as research activities involving the production or testing of "biological" substances, is considered BM Waste.

The human anatomical, animal, microbiological, and biotechnology, discarded medicines, cytotoxic drugs, incineration ash, and chemical-related waste categories of BM Waste are also included in Schedule I. The BMW Rules cover a wide range of establishments, including blood banks, pathological laboratories, hospitals, nursing homes, clinics, dispensaries, veterinary facilities, animal houses, and more. Rule 8(1) requires every occupier7 of an establishment generating, or dealing in BM Wastes in any other manner, and of a treatment facility to make an application for authorization from SPCB. The authorization granted is for 3 years after which it must be renewed. As per the BMW Rules, every occupier must take all necessary steps to ensure that BM Waste is

(i) Handled in a manner that does not harm human health or the environment,

(ii) Segregated in containers at point of generation,

(iii) Handled and disposed off in accordance with prescribed standards.

Rule 5(2), all covered institutions are mandated to either set up treatment facilities like incinerator, autoclave, microwave system, or to ensure that all BM Waste is treated at a common waste treatment facility. An annual return has to be sent in prescribed format by January 31 to SPCB providing details

of categories and quantities of BM Waste handled. Noncompliance will result in a general penalty under the EPA, which includes up to five years in prison for the occupier and/or a fine of up to INR 100,000. Since there is no specific penalty, noncompliance will be punished.

The Batteries (Management and Handling) Rules, 2001:

A regulatory mechanism for dealing with and disposing of used lead acid batteries and their components was announced to be implemented under the Batteries (Management and Handling) Rules. The Batteries Rules apply to each and every manufacturer, importer, reconditioned, assembler, dealer, recycler, auctioneer, bulk consumer (like departments or organizations that purchase more than 100 batteries), and consumer. Rule 6 stipulates that prior customs clearance must be obtained before importing batteries from other nations for recycling in India. In addition, the import of batteries will only require an undertaking in the prescribed format, a copy of the most recent half-yearly return, and a valid registration with the Reserve Bank of India and MoEF. Noncompliance with the BMW Rules also attracts punishment under the EPA whereby the person-in-charge may be imprisoned for up to 5 years and/or fined up to INR 100,000

The E-waste (Management and Handling) Rules of 2011: The E-waste (Management and Handling) Rules of 2011 regulate e-waste disposal, import, and recycling in order to establish an eco-friendly e-waste management system. E-waste collection centers, dismantlers, and recyclers as well as every producer, consumer, or bulk consumer (including factories under the Factories Act) involved in the manufacture, sale, purchase, and processing of electrical and electronic equipment or components are subject to the E-waste Rules.
Rule 3(k) defines e-waste as discarded electrical and electronic equipment in whole or in part or as rejects from the manufacturing and repair process. In accordance with Rule 4, the manufacturer of electrical and electronic equipment must obtain SPCB authorization before collecting electronic waste generated during manufacturing or after end-of-life as part of extended producer responsibility, setting up collection centers, and paying for these centers.

Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008:

The Hazardous Wastes (Management, Handling, and Transboundary Movement) Rules of 2008 were created to regulate hazardous waste generation, storage, reuse, recycling, import, transportation, and treatment. India ratified and signed the Basel Convention of 1992, which dealt with hazardous waste disposal and transboundary movement. The restrictions on cross-border transportation of hazardous waste for purposes of recycling as provided in the Basel Convention are incorporated in the HWM Rules.

Rule 2(l) defines hazardous waste as any waste that, either alone or in combination with other substances, poses a threat to health or the environment due to its physical or other characteristics—such as chemical, toxic, inflammable, reactive, explosive, etc. A list of processes generating hazardous waste is identified in Schedule I which inter-alia includes industries engaged in petro-chemicals, oil & gas, petroleum, mines and minerals, zinc, copper, lead based production, textiles, steel, asbestos, electronic, tannery, etc.
Every occupier of a factory under Rule 5(1) is required to obtain authorization from SPCB, and will be responsible for safe and environmentally sound handling of hazardous wastes generated in the establishment.

Therefore, it is necessary for each occupier to
(i) Sell hazardous waste only to a registered recycler,
(ii) Transport the waste in accordance with the specified method
(iii) Prevent mishaps
(iv) Make people more aware.

In addition, the occupier is required to file annual returns and keep prescribed-form records regarding the generation of hazardous waste. India has a thriving industry that treats hazardous waste, and a lot of it is imported for recycling and treatment. With the objective of regulating illegal traffic of hazardous wastes, it is provided under Rule 17 that prior permission of Central Government must be obtained for importing such waste and further, the import must conform to the shipping details. In the event that the permission is obtained through fraudulent means or the import results in dumping of waste in breach of Basel Convention and the general principles of international environmental law (such as sustainable development), inference of illegal traffic would be drawn.

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