



Emphasis on the Policies, Technology and Management of Solid Waste

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Abstract

Management is one of the important aspects in our day-to-day life. We talk about time management, work management, financial management and many others to reach our required destination. It is often an organized planning, control and coordinated strategies in the form of policies, missions, objectives and progress. Most of the time, the environment is not cared to that level it has to be maintained. The reasons may be lack of knowledge, unawareness or busy schedule. An overview of waste management and steps taken to maintain environment for a better living is described in the review here.

Keywords: *Ecosystem, solid waste, biomasses, waste management, compost, fertilizers,*

Introduction

Any material which is not in use is regarded as waste. Various ways to control solid waste in the environment is referred to as its management. Human activities and toxins released from industries (especially petrochemical industry) cause undesirable effects to the atmosphere and imbalance the ecosystem. The use of solid materials leads to accumulation of huge amount of degradable and non-degradable waste globally. Almost 100 billion tons of subsoil is being removed to extract fossil fuels. Most of the harm is caused due to the oil waste having a capacity to form resinous substances. With growing population, construction activities have been increased exponentially hence the demolition waste also piles up causing which can be recycled and reused. Waste is an asset for a developed nation.

The most abundant biomasses are the celluloses and hemicelluloses which provides demand for bioenergy. The

activity of crude enzyme is characterized based on the degradation of filter paper.

Types of waste

Classification of waste is done based on the design of the material and its size. Various categories of wastes have been defined; a few of them includes: Agricultural waste, Animal by-products, Biodegradable waste, Biomedical waste, Commercial waste, Composite waste, Construction and demolition waste (C&D waste), Domestic waste, Electronic waste (e-waste), Food waste, Hazardous waste, non-hazardous, Household waste, Industrial waste, Inorganic waste, Municipal solid waste, Nuclear waste, Organic waste etc.

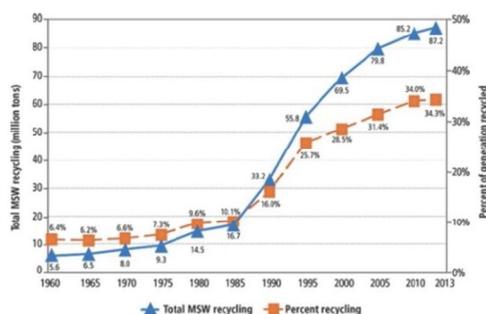
Generation of waste

The rising and better standards of living today might provide ways to ensure a better environment in certain parts of the country. Every country manages and regulated policies for waste management. China is a biggest generator of e-waste accounting to 64% worldwide MSW which

are generated every day. High concentrations of organic pollutants are generated in the waste waters from dairy industry nowadays [1]. Sources of waste include plastic, metals, paper, glass, rubber, leather, wood, yard trimmings and others.

Almost 40% of agricultural waste is being produced from an estimated overall 500

million tons of waste in UK. Solid waste in india-7.2 million tons of hazardous waste is generated and 1600 crore rupees is being spent to treat this waste. Studies reveal that 44% of sea bird and turtle species, 22 % of cetaceans, many fish species have been accumulated with large amounts of plastics in their body [2].



MSW Recycling Rates, 1960-2013

Figure 1: Graph depicting MSW generated and percentage recycled.

Waste in the form of Tablets dumped wastes, plastics, bottled water are thrown but only 23% of water bottles are recycled and the rest takes years to perish (Figure1) [3]. We use one trillion plastic bags per year; it takes 1000 years to breakdown polyethylene bags, hence the biodegradable materials have to be used. Biodegradable products are naturally broken down by microbes such as bacteria and fungi.

Processing of waste

The options involved in processing and disposal of municipal solid waste includes

Control of generation → handling and sorting → storage → collection → transport and transfer → processing → disposal

the conversion of waste into compost, energy sanitary landfills. Transport of Solid waste can be onsite/bulk storage, probable measures of transport based on geographical information system involving financial expenditure. Stakeholders form a major part involving regulators, generators, and each stakeholder plays an effective role and active participation and responsible to segregate and properly discard the waste. A broad view of the processing of waste is mentioned in the (Figure 2).

Figure 2: The Processing of solid waste on a large scale

Solid waste and human health

With the increase in population, there generates a huge amount of uncontrolled waste everyday causing serious health problems if not disposed properly. The residents living closer to the open dumped sites shows signs of similar diseases such as skin infections, malaria etc. World Bank report shows an increase in MSW from 1.3 billion to 2.2 billion tones by the year 1022 where a great climatic change has to be faced. The contamination of ground and surface water with animal and human excreta is another serious major concern of society. Children being more vulnerable to hazardous materials which are polluted and improper operation of the

incinerated plants cause diseases and pollute the atmosphere. Contact of solid waste directly results in chronic diseases in the workers handling them.

Solid waste management

Solid waste management is the collection, treatment and disposal of solid materials which are no longer utilized (Figure 3). The improper disposal of these materials might create unhygienic conditions and diseases which inturn lead to an impact on the environment and economic and social problems. Satisfactory healthcare management strategies were proposed by WHO.

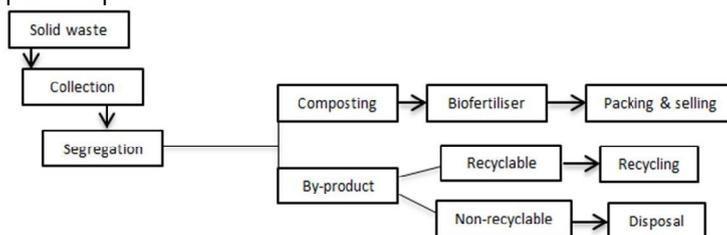


Figure 3: Management of solid waste, an outline

Eco pro environmental service provides a preparation of project, quantification and composition of waste, design of collection and collecting systems, composting plant consulting, public awareness program, assessment of landfill sites, reuse and recycle technology, private public partnership model for solid waste management [4]. Waste management has increased drastically in the last decade as it is challenging problem in the developing countries due to rapid urbanization and industrialization. Municipal solid waste management and handling rules 2000 emphasizes on peoples participation in segregation, and proper disposal of waste. Hazardous waste management and handling rules

1989 discusses the mechanism to regulate treatment and disposal of waste. Biomedical waste and handling waste 1998 ensures handling of hospital waste without causing human health problems. The recycled plastics manufacture and usage rule 1999 regulates the containers, plastics and bags. The amendment of recycled plastic manufacture and usage 2003 will ensure the proper disposal of plastic waste.

The physical treatment of managing waste is by lagooning which is a prolonged storage or sedimentation in tanks and sludge whereas chemical treatment is through the process of oxidation-reduction, neutralization etc.



biologically the involvement of microbes, composting, incineration, landfilling takes their form. Composting also improves fertility of the soil.

For an effective waste management **4R'S** are to be followed:

Refuse: Avoid unnecessary buying of items which pile up to waste and overflow of resources

Reuse: Use of shopping bags instead of throwing them at one use and sale of plastic tins and cans for recycling rather than dumping them.

Recycle: Segregate waste into degradable, non-degradable and use of biodegradable materials is highly recommended

Reduce: Reduce generating waste

Integrated solid waste management: (ISWM)

Integrated solid waste management concerned on technical aspects to overcome a range of problems and achieve its successful management in developing countries. A few guidelines to access information regarding solid waste management and regulating institutions and resources covering a large amount of services and technology is described in ISWM (Figure 4) [5]. Lifecycle based integrated solid waste management is based on the production and consumption so that there is less amount of waste generated at the end of cycle at its final disposal. The management-based ISWM depends on laws, regulations, financial institutions and the involvement of various other governmental and non-governmental organizations in the management cycle. Data and information should be gathered from institutions, technology, policies, stakeholder participation at the individual levels.



Figure 4: A sketch of integrated waste management.



Policies and regulations associated to management of waste

Government is taking steps to bring awareness among public and effective solid waste management to achieve the goal of clean country but still a planned strategy is still required to bring in more participation. For a successful implementation of global food standards, any manufacturer to issue a global certificate should have a look at good manufacturing practices, good hygienic practices, education and training, customer interactions.

The solid waste management under resource conservation and recovery act/ laws (RCRA) prohibits the open dumping and sets guidelines for municipal waste landfills [6].

Policies:

1) Laws and acts: environmental protection act/ hazardous waste management act/clean air act incineration/public services act/recycling recovery law

2) Regulations: regulation on construction and operation of composting plant/regulation on construction and operation of incineration and landfills/regulation on collection and transportation of industrial waste /regulation on handling of hazardous waste/regulation on e-waste/regulation to extend producer's responsibility/regulation on segregation of recyclable and non- recyclable waste / regulation on production and consumption measures.

3) Economically there are subsidies for recycling in industrial production and power generation at landfills and there is also penalty on hazardous waste.

Finally there is a valid enforcement of these policies which has become a challenging task at certain levels; hence there must be a proper assessment. There is a huge involvement of public and private sectors for the effective management and various sectors for recycling and transportation are being involved. Consumer waste treatment and responsibility for its management is dealt in the French law (15 July 1975) in which recycling of waste forms is given priority.

Penalty, environmental bonds and funds, national subsidies, annual budget, private sector participation forms its financial management mechanism. Private sectors participate in the form of open market system, contractual based or commercially municipal waste collection. Zero Waste International Alliance (ZWIA) visions for an economic and ethical benefit to design and manage products from solid wastes [7]

Effect on environment and balance in ecosystem

Is clean environment essential to stay healthy? A question which each one of us should understand the necessity of hygienic environment. Most of the medical organizations and hospitals are aware of health care wastes but do not realize the importance of environmental pollution. Agricultural sector has major impact on degradation of environment which might have an impact on the waste production. We should find ways and march ahead for a healthy life. We find harmful particles in air, water, soil today [8]. Waste clogs the sewage lines and a number of migratory birds and animals have been reduced due to the consumption of the contaminated foods. Fish eating birds and large predatory are on verge of extinction as pesticides are

taken either by plant eaters or aquatic organisms. Progressive technology improves possibility of disposal, recycling and waste management. One of the vital and non-renewable natural resource is soil whose health is indicated by soil microorganisms. Organic fertilizers in the form of recycled Municipal sewage sludge

(SS) and manure can be used as alternative to chemical /synthetic fertilizers. Urease activity was enhanced upon embedding soil with SS and manures. Groundwater can be purified with Na- Thomsonite as it helps extraction of heavy metal ions like Pb, Fe.



Figure 5: Garbage and plastic waste near river Ganga

Sewage water contains the solid waste materials, which is a home for many disease causing microbes and often pollute the streams. Bathing and washing clothes near river water bodies will mix toxic chemicals and harm marine species leading to their extinction (Figure 5)[9]. Few places often reveal the presence of Idols which haven't been recovered since years and the same is being continued until recently and the difficulty it shows to purify and having an indirect impact on health.

Natural environment has to be protected at individual, community, organizational and governmental levels. At times its permanent degradation occurs due to overconsumption of resources, population growth and various other factors. Since 1998, Environment Improvement Trust (EIT) works for environment & forest protection. Environment plays a key role in person's health. Clean environment prevents diseases. Approximately 25% of deaths occur due to environmental effects. Rapid population growth and mis-

management of waste will lead to illness and diseases, often degrading the natural environment.

Technological aspect and developments

Interfacial separation of oil waste has been designed which facilitates separators, centrifuges, thus a high yield of commodity oil is being filtered. Light thermal cracking can be used to technically process a large amount of oil waste wherein the products are utilized for in motor oil and production of fuel. Organic waste is converted into biogas anaerobically and the process depends on physicochemical, microbiological vegetation of soil (Figure 6). The utilization of anaerobic Digester Sludge (ADS) empowers ecofriendly manure to the soil and essential nutrients for plant growth. Disposal of battery waste and methods to remove heavy metals from waste waters [10] is described using electrolyte precipitation and electrochemical degradation of textile dye effluents an petrochemicals which is a

challenge environmentally. With depleting world's energy supply, bioethanol can be a substitute as it is derived from fermentation of sugars and can be a food material and a renewable

resource where an effective use of agro-waste can be collected. Activated alumina and ion exchange removes arsenic from water.

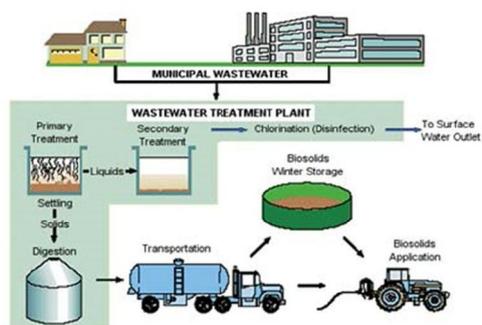


Figure 6: waste water treatment and transportation of solids

Bioventing is a technique to technically degrade a compound aerobically and biosparging increases the volatilization and often used for mid-weight petroleum products. Bioaugmentation is the use of microorganisms to the contaminated solid waste but monitoring this method is quite tough. Exsitu bioremediation involves biopiling and composting but there are certain limitations to bioremediation.

Waste generation and management in the city of Hyderabad and future trends for measuring solid waste management and adequate design of landfills seems to be properly formulated but still the establishments and operational standards needs a check. A specialized landfill treatment involving high pressure and vacuum mode of jet cleaning is shown in leachate treatment systems (figure 7) [11].



Air stripping and extended vacuum extraction and aeration system



Dissolved air floatation multimedia and carbon filtration

Figure 7: Leachate treatment system

Bio-hydrogen is produced from organic waste by microbial electrolysis cell which is an alternative strategy for valorization. Bioethanol can be produced using fruit waste study reveals that grape waste has a higher efficiency while there a many other raw material for the eco-friendly

production of ethanol. Technologies for disposal of solid waste involve composting, vermicomposting, sanitary landfills, incineration. Processing and treatment of waste is provided with biogas plant, Pelletization, pyrolysis biomass gasifier or biomass power plant.

One should carefully dispose of the hazardous waste which includes chemicals toxic to environment and human health.

Incineration: The combustion of solid waste at 1000oC where the materials get converted into gas, fuel, and the heat is used to generate electric power. This is mostly advantageous as one-fourth is reduced and minimum land required but the method is cost effective and requires skilled labor, also the chemicals released might destroy ozone layer in the atmosphere.

Landfills: the most traditional method of disposal of waste. Disposed waste (mostly domestic waste) is compacted with soil. This is a cheap method created by local people. The gases given off by the landfill sites are used for generating power and energy can be recovered. The site looks ugly and local streams are polluted. Landfills help in managing waste and sites help in renewing the natural resources and they operate to reduce the amount of trash and prevent hazards to people (Figure 8) [12].



Figure 8: A Landfill

Compaction involves compressing the fragile items of waste to break and control the deposits. Pyrolysis is the thermal degradation of waste. Proper collection and treating waste is necessary in the country and better options for composting and financial resources have to be implemented. Other technologies involved in waste management include heat treatment mechanically, biodrying, tunnel composting, Upflow anaerobic sludge blanket, Gasification etc.

Role of different organizations in management of waste

Environmental information center on municipal solid waste management in urban areas deals with the environmental concerns and related issues and the stored information is spread through newsprints, reports, publications [13]. It

maintains an update of databank for the management and environment issues. ENVIS was a scheme set up in 1982 in India and maintains balance between demands and resources. A broad perspective of awareness through media reviewed for the solid waste and environmental management. It recommends for a regular campaigns and conferences, seminars in a broad perspective by NGO's, Governmental organizations and discussions.

Swachh Bharat Mission

The mission was launched by the honorable PM Shri Narendra Modi on 2nd October 2014 as a mark of tribute towards the father of nation mahatma Gandhi on his 150th birth anniversary in 2019 to fulfill his dream of hygienic India (Figure 9) [14]. This drive was initiated



with a famous quote “Na gandagi karengi, Na karne denge.” and a mobile based application was developed to buy and sell waste [15]. The mission started

to take its shape with a huge participation from government officials and communities to individual level.



Figure 9: Logo of Swachh Bharat Mission

Conclusion

It is necessary to maintain hygienic conditions, not only at home but also our nearby localities. People often throw waste to nearby open areas as it is left barren and no construction yet. But it is so important to realize that it is also our own locality and maintaining is often essential. Each one of us play essential role in maintaining and effective balance in the ecosystem. Many organizations and government is taking part in strategizing and maintaining the solid waste to minimize and bring about its awareness. But where proves the assurance that there is no adulteration and we are receiving pure raw materials. The construction materials and other ornamentals can be recycled n number of times but the food materials which indirectly intake toxins from the stagnant water bodies and polluted air from nearby industries will definitely have an effect on health. We should also check once about our role in protecting the environment and what is the necessity. There is a need to revolutionize the system and bring awareness so that the policies and laws made can be enacted at large so that our future generations have a healthier living.

Different categories of wastes (esp. the House-hold waste) can be sorted out

before being dumped in the garbage so that it would not pile up and increase the growth of a number of microbes. Strategies have been modified according to the needs and at times to solve these environmental issues but very few countries try out to follow them and reach a level creating an impact public health and care. Apart from humans various other living organisms including flora and fauna, marine species are also affected. Due to industrial waste and chemicals expelled from factories there grows another issue related to contamination and its difficulty to degrade to soil and air and hence they remain stagnant for years, leading to soil pollution. Various health problems evolve due to mismanagement of waste as it expels to nature. We evolve by nature and if we fail to safeguard the same, thus falling as victims to many untreated, Skin related, respiratory problems and chronic diseases and disorders. Waste management is one such option to clean the environment and recycle to reuse the resources

The uncontrollable population started exploding to darken this planet, unless diseased, contaminations, dirt and all shadows of this globe removed; recovering to a live and colorful present. Only then we will be able to consume



nature's blessings purely. We are born in her and will end in the same, so let us save mother earth and keep our surroundings clean and green. It is the positive ways of innovations which opens the eye and lead us forward and help us save a lot. Let us join hands to make and create a clean and green environment. And safeguard the natural resources and retain its beauty to us and for the future generations to come. It is necessary to create balance in nature for a bright future.

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