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Inevitability of Solid Waste Management in Environmental Concern

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Abstract*: Waste is presenting immense role in environmental pollution sources, not only for the soil and ground water but the malodorous smell of the waste also for the contaminate the purity of air. In the present decomposition of solid waste is one of the major environmental issues in the world. Improper management of municipal solid waste (MSW) causes hazards to inhabitants. It is convincing evidence of a high risk of gastrointestinal problems associated with pathogens originating at sewage treatment plants. In case of quality improvement and usefulness of epidemiological studies applied to populations residing in areas where waste management facilities are located or planned. In this paper many of advance techniques & treatment technologies for MSW are critically reviewed, along with their advantages and limitations with a few fruitful suggestions, which may be beneficial in waste management in practical aspects.

Keywords : MSW, mining, agriculture, manufacturing, and municipalities.

Introduction

Waste management is the collection, transport, processing, recycling or disposal, 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 residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities.

All organisms produce wastes, but none produces as many wastes of such diverse composition as humans. Society's wastes arise from many different activities; growth is worldwide still accompanied by increasing amounts of waste, causing unnecessary losses of materials and energy, environmental damage and negative effects on health and quality of life. It is a strategic goal of most developed countries to reduce these negative impacts, meaning to reduce waste or applying a correct management system to exploit it.

Waste management is already governed by a substantial body of regulation but there remain opportunities for further improving the management of some major waste streams. The several kinds of waste produced by a technological society can be categorized in many ways. Some kinds of wastes are released into the air and water. Some are purposely released, while others are released accidentally. Many wastes that are purposely released are treated before their release. There are wastes with particularly dangerous characteristics, such as nuclear wastes, medical wastes, industrial hazardous wastes, and household hazardous wastes. The novel worldwide and EC strategy set out three national goals for municipal solid waste management: Increase source reduction and recycling, increase environmental friendly disposal capacity and improve secondary material markets, and improve the safety of solid waste management facilities, by using the energy content of the waste. Solid waste is generally made up of objects or particles that accumulate on the site where they are produced, as opposed to water, and airborne wastes that are carried away from the site of production. Solid wastes are typically categorized by the sector of the economy responsible for producing them, such as mining, agriculture, manufacturing, and municipalities.

Waste production:

Mining waste is generated in various ways. First, in most mining operations, large amounts of rock and soil need to be removed to get to the valuable ore. This waste material is generally left on the surface at the mine.

Site second, milling operations use various technologies to extract the valuable material from the ore. These techniques vary from relatively simple grinding and sorting to sophisticated chemical separation processes. Regardless of the technique involved, once the valuable material is recovered, the remaining waste material, commonly known as tailings, must be disposed of. Solid materials are typically dumped on the land near the milling site, and liquid wastes are typically stored in ponds. It is difficult to get vegetation to grow on these piles of waste rock and tailings, so they are unsightly and remain exposed to rain and wind. Finally, the water that drains or is pumped from mines or that flows from piles of waste rock or tailings often contains hazardous materials (such as asbestos, arsenic, lead, and radioactive materials) or high amounts of acid that must be contained or treated - but often are not. Many types of mining operations require vast quantities of water for the extraction process. The quality of this water is degraded, so it is unsuitable for drinking, irrigation, or recreation.

Industrial Waste: Solid wastes are generated from various processes in small and large scale industries, from sources other than mining includes a wide variety of materials such as demolition waste, foundry sand, scraps from manufacturing processes, sludge, ash from combustion, and other similar materials. These wastes are highly heterogeneous in nature. These wastes are consists of both hazardous and non hazardous components.

Municipal solid waste (MSW): consist of all the materials that people in a region no longer want because they are broken, spoiled, or have no further use. It includes waste from households, commercial establishments, institutions, and some industrial sources. Specialists and local communities, in addition to governmental agencies and local authorities generally decide how waste will be managed whether by landfill, incineration, recycling, composting, waste reduction or a combination.

Bio-waste: It is defined as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. It does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood, that are biomass categories, as well. It also excludes those by-products of food production that never become waste. Bio-waste is a putrescible, generally wet waste. There are two major streams, first is green waste from parks, gardens etc. and second is kitchen waste.

Hazardous waste means waste that requires special precaution in its storage, collection, transportation, treatment or disposal to prevent damage to persons or property, and includes explosive, flammable, volatile, radioactive, toxic and pathological wastes. This category includes the management of three types of hazardous wastes from their source to ultimate disposal: (i) the radioactive materials, which are primarily the responsibility of specials national and international authorities, (ii) medical wastes, and (iii) the non-radioactive liquid industrial wastes, which are mainly under state or provincial jurisdiction. Hazards in the environment may arise also from natural occurrences like floods and hurricanes, from human environmental disturbances like CO_2 build-up and acid rain, and from the improper treatment and disposal of the toxic and hazardous wastes generated by an industrialized society.

Agricultural waste is the second most common form of waste and includes waste from the raising of animals and the harvesting and processing of crops and trees. Other wastes associated with agriculture, such as waste from processing operations (peelings, seeds, straw, stems, sludge, and similar materials). Since most agricultural waste is organic, it is used as fertilizer or for other soil-enhancement activities. Other materials are burned as a source of energy, so little of this waste needs to be placed in landfills. However, when too much waste is produced in one place, there may not be enough farmland available to accept the agricultural waste without causing water pollution problems associated with runoff or groundwater contamination due to infiltration.

Solid Waste Treatment:

Solid waste processing reduces the amount of material requiring disposal and, in some cases, also produces a useful product. Examples of solid waste processing technologies include material recovery facilities, where recyclable materials are removed or sorted; composting facilities where organics in solid waste undergo controlled decomposition, and waste to energy facilities where waste becomes energy for electricity and from prehistory through the present day, the favoured means of disposal was simply to dump solid wastes outside of the city or village limits. Frequently, these dumps were in wetlands adjacent to a river or lake. To minimize the volume of the waste, the dump was often binned. Unfortunately, this method is still being used in remote or sparsely populated areas in the world. As better waste-disposal technologies were developed and as values changed, more emphasis was placed on the environment and quality of life. Dumping and open burning of wastes is no longer an acceptable practice from an environmental or health perspective. While the technology of waste disposal has evolved during the past several decades, options are still limited. Realistically, there are no ways of dealing with waste that have not been known for many thousands of years. Essentially, five techniques are used: (i) landfills, (ii) incineration, (iii) source reduction, (iv)composting, (v) recycling.

i. Landfills:

In this method of disposal refuse is carried and dumped into the low lying area as not to cause any nuisance or hazards to public health or safety. The refuse is dumped into the low laying area an engineered operation, designed and operated according to acceptable standards.

The refuse is dumped and compacted in layers of 0.3- 0.6m and after the day's work when depth of filling becomes about 1.5m; it is covered by good earth of 15 cm to 30 cm thickness, so that refuse/ waste is not exposed directly. The filling is done by dividing the site into smaller portions. The compaction is done by bull dozer, trucks etc. Filling of low lying areas should generally be done by leaving a minimum distance of 6m from the surrounding area. Insecticides like DDT, cresol, creosote etc. should be sprayed on the layers to prevent breeding of mosquitoes and flies. A final cover of about 0.6 m of earth is laid and compacted at the top of the filled up land to prevent rodents from burrowing into the refuse.

As the time passes, the filled up refuse will get stabilised due to decomposition of organic matter and subsequent conversion into stable compounds. The land filling operation is a biological method of treatment of waste is stabilised by aerobic and anaerobic bacteria process.

in trapped air gets exhausted in few and therefore long term decomposition occurs under anaerobic conditions. The whole period of refuse/ waste stabilisation may be divided into five phases.

• During first phase of operation, aerobic bacteria and fungi, are dominant, deplete the available oxygen to effect oxidation of organic matter. Due to aerobic respiration, temperature in the fill increases.

• In the second phase, anaerobic and facultative bacteria develop to decompose organic matter and H_2 and CO_2 gases are evolved through acidogenic activity.

• In the third phase, methanogenic bacteria develop to cause evolution of methane gas.

• In the fourth phase of decomposition the methanogenic activity gets stabilized.

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• In the fifth stage, the methanogenic activity subsides, representing depletion of organic matter, and ultimately, the system returns to aerobic conditions within the landfill.

The refuse in landfills get stabilized within a period of 2 to 4 months and settle down by 20-40% of its original height. The filled up land, can be used for developing green land, parks, or other recreational spots.

(ii). Incineration:

Incineration is an oxidation process where organic constituents react with oxygen and release heat during the process. Combustion may be defined as the rapid chemical combination of oxygen with the combustible elements of fuel. The two major combustible chemical elements of significance are carbon and hydrogen. Chlorine and sulfur are minor significance as sources of heat. An incineration system is comprised of several components. It must have a waste reading system, also referred to as a loading or charging system, to ensure uniform loading of the incinerator. The incinerator itself generally consists of primary chamber, a secondary chamber, an auxiliary fuel system, air supply systems, a hearth or a grate area, and either moving grates or rams to move the waste and the ash through the unit. The incineration system must also have an ash removal system: both wet and dry ash removal systems are available. Air pollution equipment will most likely be required on all new incineration systems. Many municipal incinerators also are equipped with efficient steam and or electricity generators, The types of incinerators used in municipal waste combustion include fluidized bed incinerators, rotary water wall combustors, reciprocating grate systems are related modular incinerators The basic variations in the design of these systems are related to the waste feed system, the air delivery system, and the movement of the material through the system. As an illustration of typical system configurations, following figure depicts a modular incinerator, and Figure 11 depicts a rotary combustor. Both are equipped with a heal recover boiler. Finally flue gas treatment is available. Several reference texts are available which provide further details on the various system designs. Gross electric power output from a resource recovery system ranges from 340 kWh per ton of raw solid waste incinerated. Output is dependent on the type of incineration technology utilized and the type of waste fed. Electricity generated by a resource recovery facility will usually be used to supply the total electrical need for in-house power consumption, which ranges from 10 % to 15 % of the gross amount generated. The remaining 85-90 % can be sold to the local utility.

(iii). Gasification:

Gasification is a process that converts organic- or fossil fuel-based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide. This is achieved by reacting the material at high temperatures (>700 °C), without combustion, with a controlled amount of oxygen and/or steam. The resulting gas mixture is called syngas (from synthesis gas) or producer gas and is itself a fuel. The power derived from gasification and combustion of the resultant gas is considered to be a source of renewable energy if the gasified compounds were obtained from biomass.

The advantage of gasification is that using the syngas (synthesis gas H2/CO) is potentially more efficient than direct combustion of the original fuel because it can be combusted at higher temperatures or even in fuel cells, so that the thermodynamic upper limit to the efficiency defined by Carnot's rule is higher or (in case of fuel cells) not applicable. Syngas may be burned directly in gas engines, used to produce methanol and hydrogen, or converted via the Fischer–Tropsch process into synthetic fuel. Gasification can also begin with material which would otherwise have been disposed of such as biodegradable waste. In addition, the high-temperature process refines out corrosive ash elements such as chloride and potassium, allowing clean gas production from otherwise problematic fuels. Gasification of fossil fuels is currently widely used on industrial scales to generate electricity.

(iv) . Recycling Of Organic Waste:

a) Composting:

Compost is organic matter that has been decomposed and recycled as a fertilizer and soil amendment. Compost is a key ingredient in organic farming. At the simplest level, the process of composting requires making a heap of wet organic matter known as green waste (leaves, food waste) and waiting for the materials to break down into humus after a period of weeks or months. Modern, methodical composting is a multi-step, closely monitored process with measured inputs of water, air, and carbon and nitrogen rich materials. The decomposition process is aided by shredding the plant matter, adding water and ensuring proper aeration by regularly turning the mixture. Worms and fungi further break up the material. Bacteria requiring oxygen to function (aerobic bacteria) and fungi manage the chemical process by converting the inputs into heat, carbon dioxide, and ammonium. The ammonium (NH+4) is the form of nitrogen used by plants. When available ammonium is not used by plants it is further converted by bacteria into nitrates (NO−3) through the process of nitrification.

Compost is rich in nutrients. It is used in gardens, landscaping, horticulture, and agriculture. The compost itself is beneficial for the land in many ways, including as a soil conditioner, a fertilizer, addition of vital humus or humic acids, and as a natural pesticide for soil. In ecosystems, compost is useful for erosion control, land and stream reclamation, wetland construction, and as landfill cover. Organic ingredients intended for composting can alternatively be used to generate biogas through anaerobic digestion.

b) Vermicomposting:

Vermicompost is the product of the composting process using various species of worms, usually red wigglers, white worms, and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Vermicast (also called worm castings, worm humus, worm manure, or worm feces) is the end-product of the breakdown of organic matter by earthworms. These castings have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than the organic materials before vermicomposting Vermicompost contains water-soluble nutrients and is an excellent, nutrient-rich organic fertilizer and soil conditioner. It is used in farming and small scale sustainable, organic farming.

One of the species most often used for composting is the red wiggler or tiger worm (Eiseniafetida or Eiseniaandrei); Lumbricusrubellus is another breed of worm that can be used, but it does not adapt as well to the shallow compost bin as does Eiseniafetida. European nightcrawlers (Eiseniahortensis) may also be used.

Conclusions:

The study suggests increases the composting process for waste decomposition. The study also highlights the importance of Education and awareness in the area of waste and waste management are becoming increasingly important from a global perspective of resource management. The study also indicates new industry in the era of waste decomposition for creates employment opportunities and contributes to rural development and regeneration. The study also acts as base for competent authorities/researchers to work towards further improvement of the present system.

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