A REVIEW ON SOLID WASTE MANAGEMENT

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ABSTRACT

Solid waste is the useless, unwanted and discarded material resulting from day to day activities in the community. Solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer, processing and disposal of solid waste. Municipal Solid Waste (MSW) management is one of the vital issues in the contemporary urban environment, more particularly in developing countries. Municipal Solid Waste generation consists of organic and inorganic waste materials generated by various activities of the society. Improper disposal of solid waste can pollute all vital components of the environment (i.e., air, land and water).Even though land filling of waste is the least favourable option in the waste management hierarchy, the majority of municipal solid waste (MSW) in many countries is still land filled. This represents waste of valuable resources and could lead to higher environmental impacts compared to energy recovered by incineration, even if the landfill gas is recovered. Using life cycle assessment (LCA) as a tool, this paper aims to find out which of the following two options for MSW disposal is more environmentally sustainable incineration or recovery of biogas from landfills, each producing either electricity or co-generating heat and electricity. The systems are compared on a life cycle basis for two functional units: 'disposal of tonne of MSW' and 'generation of 1 kWh of electricity'. The results indicate that, if both systems are credited for their respective recovered energy and recyclable materials, energy from incineration has much lower impacts than from landfill biogas across all impact categories, except for human toxicity.

Keyword: *Solid waste,management,landfills,MSW*

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1. INTRODUCTION:

Sustainable management of municipal solid waste (MSW) is a critical issue for municipal authorities around the world. Traditional disposal method by landfill is considered to be the least favourable option in the waste management hierarchy, as that wastes valuable resources and gives rise to methane emissions. Solid waste refers to the refuse, the solid and semi solid waste matters of a community except the night soil. Solid waste contains organic as well as inorganic matters . Solid waste management includes the entire process of dealing with solid waste ,starting from the collection from the primary source to ultimately disposing off it hygienically, so that it may not be a nuisance or create any harmful effect on near by community .The solid waste management involves , management at waste generation level , storage at the source of generation , primary collection , street cleansing , temporary storage at locality level , regular and periodic transportation of this temporarily collected waste to disposing sites and treatment plants.

solid waste management is in the obligatory function of urban local bodies , but in actual practice the solid waste management is given the last priority and the duties are either not performed or poorly performed consequently the city has to face numerable problems related to environment and sanitation . As per the reports of the committee constituted by the Hon'ble Supreme Court of India in March 99, the lack of financial resources,inefficient institutional arrangement,inappropriate technology , weak legislative measures and unawareness in public towards solid waste management has made the service most unsatisfactory and inefficient. Even though landfilling of waste is the least favourable option in the waste management hierarchy, the majority of municipal solid waste (MSW) in many countries is still landfilled. This represents waste of valuable resources and could lead to higher environmental impacts compared to energy recovered by incineration, even if the landfill gas is recovered. Using life cycle assessment (LCA) as a tool, this paper aims to find out which of the following two options for MSW disposal is more environmentally sustainable: incineration or recovery of biogas from landfills, each producing either electricity or co-generating heat and electricity. The systems are compared on a life cycle basis for two functional units: 'disposal of 1 tonne of MSW' and 'generation of 1 kWh of electricity'. The results indicate that, if both systems are credited for their respective recovered energy and recyclable materials, energy from incineration has much lower impacts than from landfill biogas across all impact categories, except for human toxicity. The impacts of incineration co-generating heat and electricity are negative for nine out of 11 categories as the avoided impacts for the recovered energy and materials are higher than those caused by incineration. By improving the recovery rate of biogas, some impacts of landfilling, such as global warming, depletion of fossil resources, acidification and photochemical smog, would be significantly reduced. However, most impacts of the landfill gas would still be higher than the impacts of incineration, except for global warming and human toxicity. The analysis on the basis of net electricity produced shows that the LCA impacts of electricity from incineration are several times lower in comparison to the impacts of electricity from landfill biogas. Electricity from incineration has significantly lower global warming and several other impacts than electricity from coal and oil but has higher impacts than electricity from natural gas or UK grid. At the UK level, diverting all MSW currently landfilled to incineration with energy recovery would not only avoid the environmental impacts associated with landfilling but, under the current assumptions, would also meet 2.3% of UK's electricity demand and save 2–2.6 million tonnes of greenhouse gas emissions per year.

2. PROBLEMS DUE TO SOLID WASTE IN URBON AREA:

Solid waste causes lots of health and noise pollution problems in urban areas. The major problems of solid waste in urban areas are as follows:

1. The biggest threat to a locality is the fact that the waste is a breeding ground for flies, insects, bacteria,fungus and many such microorganisms which could spread diseases which become worse during the rainy,season and the contamination might end up in the drinking water.
2. Bad odor is created around all garbage areas, making an unbearable environment.
3. Poor waste pickers pose a serious threat to public health.
4. Animals like cats, dogs, goats and cow come to the garbage in search of food and end up spreading the garbage around the bins
5. The economical factor is also affected as the market value of a particular area decreases if there is a badly maintained waste area nearby as this is aesthetically bad.
6. Overall waste leaves a bad impression and poses a threat to the environment in the form of epidemic diseases such as cholera, malaria etc.

3.GOAL OF THE STUDY

The goal of the study is to estimate and compare the environmental impacts of MSW disposal by incineration and landfill for the UK conditions, with both systems recovering energy. Two options for energy recovery are considered for each system: generation of electricity only and co-generation of heat and power. To explore how the impacts may be affected by the definition of the functional unit, the options are compared for two units of analysis:
(i) disposal of 1 tonne of MSW; and
(ii) generation of 1 kWh of electricity from MSW.

4. WASTE MANAGEMENT TECHNIQUE:

Waste management includes collection, transportation, processing, treatment, recycling or disposal of waste materials to reduce their adverse effects on human health or amenities. The type of waste management techniques that should be applied for proper management of waste depend on the composition of waste. Although composting is the appropriate for all organic wastes: wastes such as plastic metals and glasses are better handled through recycling.

4.1 Incineration

There are currently 25 MSW incinerators with energy recovery in the UK, 80% of which generate electricity and the rest recover both heat and electricity (DEFRA, 2013a; Nixon et al., 2013).
Although CHP generation is the most efficient option for utilising energy recovered from waste, it requires infrastructure to supply the heat, such as district heating, which is not common in the UK.
The majority of MSW incinerators in the UK are moving-grate plants and are designed to handle large volumes of MSW without any pre-treatment (DEFRA, 2013a). Fig. 1 shows the life cycle diagram of a typical incineration plant with energy recovery. The system boundary considered here includes the following life cycle

Stages:

1. Transport of waste to the incinerator
2. Construction of the incinerator;
3. Incineration of waste;
4. Flue gas treatment;
5. Transport and disposal of air pollution control (APC) residue,
6. Including fly ash;
7. Energy recovery and associated energy credits;
8. Processing of bottom ash into a road aggregate and the credit for the avoidance of virgin aggregates.
9. Recycling of ferrous metals and the related credit for the avoidance of virgin metals.

4.2 Land filling:

In many metropolitan cities, open, uncontrolled and poorly managed dumping is commonly practiced, giving rise to serious environmental degradation. More than 90% of MSW in cities and towns are directly disposed of on land in an unsatisfactory manner. Such dumping activity in many coastal towns has led to heavy metals rapidly leaching into the coastal waters.In the majority of urban centers, MSW is disposed of by depositing it in low-lying areas outside the city without following the principles of sanitary land filling. Compaction and leveling of waste and final covering by earth are rarely observed practices at most disposal sites, and these low-lying disposal sites are devoid of a leachate collection system or landfill gas monitoring and collection equipment.

4.3 Pyrolysis and gasification:

These are methods for managing wastes by heating under controlled conditions to produce low to medium heating fuel gases, tars, char and ash; under a high temperature with limited oxygen. Usually, the process takes place in a sealed vessel under a high pressure. Whereas pyrolysis converts the solid wastes into solid, liquid and gas products, gasification converts organic materials into a syngas (CO and H_2). The effect of pyrolysis to the environment is loss of biodiversity, desertification and emission of acid and green-house gases. Generally, the use of pyrolysis and gasification for waste management is uncommon in developing countries because of the expense of equipment. Another reason why pyrolysis and gasification may not be sustainable is the emission of green house gases during thermal treatment.

4.4 Composting:

Composting is seen as a key process in the waste hierarchy and has an important role in reducing the volume of biodegradable municipal solid waste going to landfill. Composting is a biological process which converts heterogeneous organic wastes into humus like substances by mixed microbial population under controlled optimum conditions of moisture, temperature and aeration. It is the aspect of control that separates composting from natural rotting or decomposition processes which occur in an open dump, sanitary landfill, or unmanaged waste pile In composting, microorganisms convert organic materials such as manure, sludge, leaves, fruits, vegetables and food wastes into product like soil humus. Through composting organic waste materials are decomposed and stabilized into a product that can be used as soil conditioner and/or organic fertilizer. Decomposers include bacteria, actinomycetes and fungi that are widespread in nature. These are indigenous to soil, dust, fruit and vegetable matter and waste of all sorts, so special organisms are not required. Controlled decomposition occurs as a result of activities of these naturally occurring microorganisms.

4.5 Aerobic Composting:

Bacterial conversion of the organics present in waste in the presence of oxygen under hot and moist conditions is called composting, and the final product produced after bacterial activity is called compost (humus). It has very high agricultural value used as fertilizer. It is non odorous and pathogens free. From the composting process, the waste volume may be reduced to 50–85%. The composting methods may use manual or mechanical means and are accordingly known as a manual or mechanical process.Composting is the decomposition of organic wastes in the presence of oxygen, products from this process include CO_2, NH_3, water and heat. This can be used to treat any type of organic waste but, effective composting requires the right blend of ingredients and conditions. These include moisture contents of around 40-60% and carbon to nitrogen ratios (C/N) of 25-30:1. Any significant variation inhibits the degradation process. Generally wood and paper provide a significant source of carbon while sewage sludge and food waste provide nitrogen. To ensure an adequate supply of oxygen throughout, ventilation of the waste, either forced or passive is essential.

4.6 Anaerobic:

Composting is the decomposition of organic wastes in the absence of oxygen, the products being methane (CH_4), CO_2, NH_3 and trace amounts of other gases and organic acids. Anaerobic composting was traditionally used to compost animal manure and human sewage sludge, but recently is has become more common for some municipal solid waste (MSW) and green waste to be treated in this way

Stages of Composting:

A large variety of mesophilic, thermotolerant and thermophilic aerobic microorganisms predominantly bacteria, actinomycetes, yeasts and fungi are involved in the specialized biodegradation process. The process of biocomposting occurs into three phase. (a) the mesophilic phase, (b) the thermophilic phase, which can last from a few days to several months (c) the cooling and maturation phase which lasts for several month. The length of the composting phases depends on the nature of the organic matter being composted and the efficiency of the process, which is determined by the degree of aeration and agitation. At the start of composting the mass is at its ambient temperature and usually slightly acidic. Soluble and easily degradable carbon sources, monosaccharides, starch and lipids are utilized by microorganisms in the early stage of composting. The pH decreases because organic acids are formed from these compounds during degradation. In the next stage microorganisms start to degrade proteins, resulting in the liberation of ammonia and increase in the pH. As the temperature increases, thermophilic microbes develop. These consist of only a few genera of bacteria e.g. Bacillus subtilis, fungi e.g. Aspergillus fumigatus, and actinomycetes e.g. Streptomyces spp. After the easily degradable carbon sources have been consumed, more resistant compounds such as cellulose, hemicellulose and lignin are degraded and transformed into humic acid, fulvic acid and phenolic intermediate metabolites. The humified substances are divided into following groups: humin (not soluble in water at any pH), humic acids (soluble in water under alkaline conditions) and fulvic acids (soluble in water under all pH conditions). The humification of biocompost is a result of complex symbiotic and synergetic microbial interaction finally resulted into humifying earthy fragrances to an ideally compost.

5. CLASSIFICATION OF WASTE:

There may be different types of waste such as Domestic waste, Factory waste, Waste from oil factory, E-waste, Construction waste, Agricultural waste, Food processing waste, Bio-medical waste, Nuclear waste, Slaughter house waste etc.

We can classify waste as follows,

- **Solid waste**- vegetable waste, kitchen waste, household waste etc.
- **E-waste**- discarded electronic devices such as computer, TV, music systems etc.
- **Liquid waste**- water used for different industries, tanneries, distilleries, thermal power plants
- **Plastic waste**- plastic bags, bottles, bucket, etc.
- **Metal waste**- unused metal sheet, metal scraps etc.
- **Nuclear waste**- unused materials from nuclear power plants

Further we can group all these types of waste into wet waste, (Biodegradable) and dry waste (Non Biodegradable).

Wet waste (Biodegradable) includes the following:

- Kitchen waste including food waste of all kinds, cooked and uncooked, including eggshells and bones
- Flower and fruit waste including juice peels and house-plant waste
- Garden sweeping or yard waste consisting of green/dry leaves
- Sanitary wastes
- Green waste from vegetable & fruit vendors/shops
- Waste from food & tea stalls/shops etc.

Dry waste (Non-biodegradable) includes the following,

- Paper and plastic, all kinds
- Cardboard and cartons
- Containers of all kinds excluding those containing hazardous material
- Packaging of all kinds
- Glass of all kinds
- Metals of all kinds
- Rags, rubber
- House sweeping (dust etc.)
- Ashes
- Foils, wrappings, pouches, sachets and tetra packs (rinsed)
- Discarded electronic items from offices, colonies viz. cassettes, computer diskettes, printer cartridges and electronic parts.
- Discarded clothing, furniture and equipment

6. CONCLUSION:

In order to meet the challenges of municipal solid waste management there is a need to develop a better technology or method through which the waste can be converted into useful material. The biodegradable organic waste can be processed

into ecofriendly organic manure. Organic manure nourishes the soil fertility, increases the soil aeration and also minimizes environmental pollution. Now, it has been realized throughout the world that the use of chemical fertilizers and other chemicals is harmful to soil productivity and also a cause of water and air pollution. Municipal solid waste is suitable for composting because of the presence of high percentage of biodegradable organic matter, acceptable moisture content and C/N ratio in the waste. Composting has a lot of benefits like: reduce landfill space, reduce surface and groundwater contamination, reduce methane emissions, reduce transportation costs , reduce air pollution from burning waste, provide more flexible overall waste
management, enhance recycling of materials and can be carried out with little capital and operating costs. It is an environmental friendly, wealth creating and sustainable method rather than directly dumped into earth and is useful to convert organic waste to useful products.

This study examined the costs and revenues of a private waste company in Bahir Dar, Ethiopia engaged in waste collection and transport. Within the given time period of two years (July 2009 –
June 2011), the study revealed that the SWM system in Bahir Dar is not financially sustainable. This situation is quite typical for cities of the developing world where waste services are seldom analyzed using cost-revenue accounting because the service is seen as ‘‘public financed’’ independent of the cost (Guerrero et al., 2013).The situation in Bahir Dar was not evident from the outset as the company was successful in obtaining new grants which were able to cover for some of the running costs although they were not ear- marked for this purpose. The analysis indicates that important adjustments need to be envisaged in order to ensure a solid financial base of the company and long-term functioning of the system. The analysis over two fiscal years show that the costs have increased continuously while revenue streams are not able to match. the gap. The current revenue stream relies entirely on the waste collection tariffs paid by households, commercial enterprise and institutions. Different strategies and options can be envisaged to improve cost recovery of this waste collection and transport system. Although no clear and definite answer can be given as to which option is the most feasible and effective, this paper discusses the advantages and disadvantages of each option using limited data. An alternative to the currently practiced tariff setting is to rely on a variety of financial cost recovery mechanisms, considering that some of the cost be covered by affluent waste generators and other directly by the municipal budget (obtained through property and income taxes) rather than through fixed tariffs. This option, would also take into account that a certain urban poor fraction of the population, which cannot afford the tariff, is nevertheless serviced by waste collection and thus reflects a social equity objective. investments can be justified. Examples given for cost reduction measures are the improvement of road infrastructure which would have a positive impact in terms of reducing on-route time and fuel consumption as well as maintenance cost. Investment in newer trucks and other vehicles could also lower maintenance cost and fuel consumption, however this aspect requires significant equipment investments which would be difficult to achieve at this moment in time. Finally, running cost could be reduced by investing in human resource and capacity development of skills, and cost saving work flow of staff in their daily practice.

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