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A STUDY ON "SOLID WASTE MANAGEMENT USING BIOMETHANATION TECHNOLOGY" PALLIPALAYAM MUNICIPALITY IN NAMAKKAL DISTRICT, TAMILNADU, INDIA

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ABSTRACT

This paper presents about Solid waste management using Biomethanation technology in Pallipalayam municipality. The Pallipalayam municipality is situated in Kumarapalayam taluk of Namakkal district. Pallipalayam is a second grade municipality. It is twin city of Erode. The process of Methanogenesis by which organic waste materials are converted an aerobically into methane rich biogas by micro-organism has been studied intensively in recent years. Biomethanation is a feasible method to generate the biogas from organic waste like food waste, human waste, night soil waste, cow dung etc. so we implement the automation in biomethanation plant. This plant has four major processes like waste collection and mixing, digestion, gas collection and gas distribution. Methanogenesis follows three basic process, as an initial step of hydrolysis of complex molecules to simple molecules. An acidification step in which the products of hydrolysis such as glucose, long chain fatty acids, peptides, amino acids are metabolized to form volatile acids, aldehydes, alcohols, carbon dioxides and hydrogen. Methanogenesis step in which formation from Co_2, H_2 and acetate brought about by methanogenesis bacteria. It is generally considered that methanogenic step is rate limiting step. As well in the digestion of cellulosic waste hydrolysis of organic acids rather than methanogenic waste. The generation of electricity by the gasification process.

KEYWORDS: Solid Waste Management, Pallipalayam, Biomethanation, Methanogenesis, Biogas.

Pallipalayam Municipality located in Namakkal District is a second grade Municipality with a total area of 4.70 sq.km. The population of this Municipality is 41010 as per 2011 census. This Municipality consists of 21 wards and it is situated in the river bed by Cauvery in the district of Namakkal and connecting the districts of Namakkal and Erode. The per capital generation of waste as per population of 41010 of Pallipalayam Municipality is estimated to 350 gram thus totalling the 15.00 MT of waste generation per day. Out of the 15.00 MT of garbage, food waste and vegetable waste consist around 2.50 MT.

A sum of Rs.90.00 lakhs had been sanctioned under the solid waste management component of Integrated Urban Development Mission (IUDM) 2012-13 in GO(D)No.225 Municipal Administration and Water Supply (MA2) Department, Dated 05.09.2012 for the construction of one number of Bio Methanation cum power generation plant (5TPD capacity) at Avathipalayam compost yard. At present all works are completed. The permission of operating Bio gas power plant was obtained from District Environmental Engineer, Tamilnadu Pollution Control Board, Namakkal. At present 5nos. of Electric Motors and 13 no. of Lights are operated by using of108 unit power in compost yard area.

The 86 number of street lights (In ward no.1,2&3)burning through Biogas power generation plant by using of 54 units power at an estimated cost of Rs.10.00 lakhs from Municipal General fund for laying of cables in streetlight poles. Totally 162 units power are used through Biogas power generation plant.

STATUS OF SOLID WASTE MANAGEMENT

One of the major problems being faced by cities and towns relate to management of municipal solid waste (MSW). Waste quantities are increasing and municipal authorities are not able to upgrade or scale up the facilities required for proper management of such wastes. In many cities and towns, garbage is littered on roads and footpaths. Citizens are also not accustomed to use the available storage facilities (dust bins) set up by the authorities. At large, lack of organized system of house to house collection of waste has created the littering habits. By and large, hardly we can see any city/town complying with the Municipal Solid Wastes (Management and Handling) Rules, 2000 in 'totality".

Status in India

As per report (May 2000) of Ministry of Urban Development (MoUD), Government of India that 1,00, 000 MT of Municipal Solid Waste was generated daily in the country. During the year 2004-05, Central Pollution Control Board (CPCB) through National Environmental Engineering Research Institute (NEERI). Nagpur conducted survey in 59 cities (35 Metro cities and 24 State Capitals) and estimated 39,031Tons per day MSW generation in these 59

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cities/towns. The survey conducted by the central institute of Plastics Engineering and technology (CIPET) at the instance of CPCB has reported generation of 50,592 tonnes of MSW per day in the year 2010-11 in same 59 cities. As per information received from State Pollution Control Boards/ Pollution Control Committees (in between the year 2009-12) 1, 27,486 TPD (Tons per day) municipal solid waste is generated in the Country during 2011-12. Out of which, 89,334 TPD (70%) of MSW is collected and 15,881 TPD (12.45%) is processed or treated. Municipal Solid Waste generation in 59 cities during 1999-2000, 2004-05 and 2010-11 and State Wise generation of MSW and its treatment is given in Annexure A, B and C respectively.

Study Area

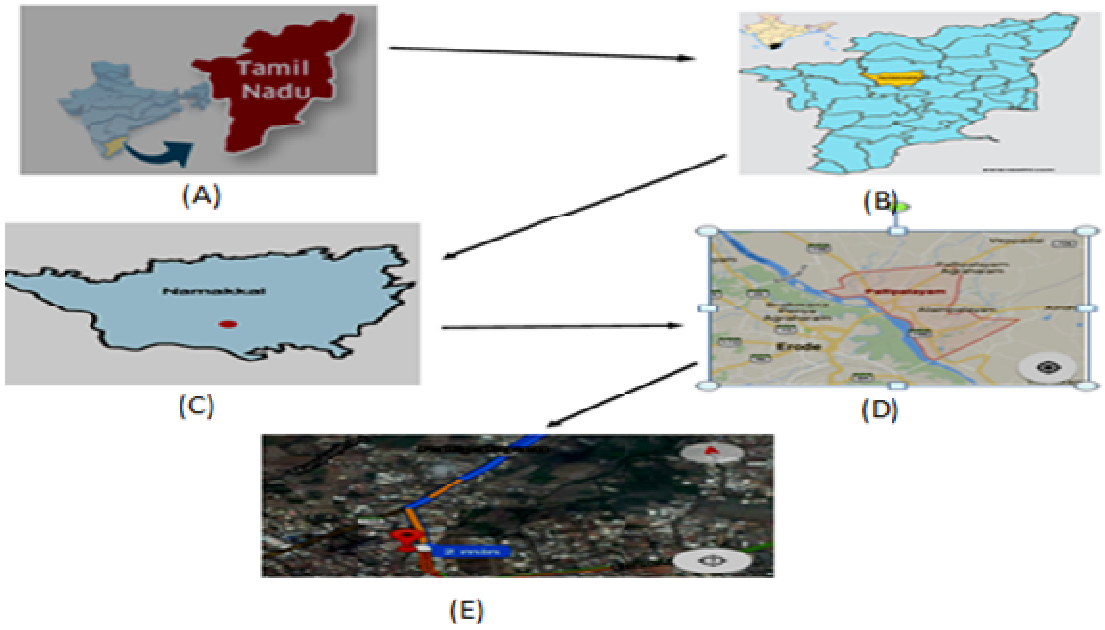

Figure 1: India, Tamilnadu, Namakkal and Pallipayam View

Preamble

Municipal Solid Waste Management (MSWM) is one of the primary responsibilities of the municipal authorities. Over the years the quantum of wastes from different sources (Households, Commercial Centres, Institutions, Industries etc.,) has been increasing with the increase in urbanisation, population growth and associated activities. There has been no systematic and scientific methods for collection transportation, processing and disposal of solid wastes generated from various sources in the cities and towns in India. The improper disposal of Municipal Solid waste (MSW) by open dumping often lead to environmental pollution and public health problems. The garbage has several nutrients and hence can be advantageously processed to produce many by products and end products viz., gas, electricity and also organic manure, which is highly suited for organic farming.

Objectives

1. To create awareness among organic waste accumulation and treatment.
2. To Creating an eco-friendly environment and production of renewable energy.
3. To improve the surrounding environment and to reduce the CO_2 emission.
4. To prevent from infection caused due to dumping of solid wastes in open areas.
5. To promote the advanced technology of solid waste management.
6. To effectively use the waste to produce electricity by bio-gas combustion.
7. Instead of burning & land filling of solid waste we can use advanced technology of solid waste management.

Materials and Methodology

1. The raw materials consisting of bio-degradable fraction of MSW of different composition were

collected and shredded to finer particles. The wastes were collected, segregated, shredded and weighed as per the different compositions. The shredded MSW samples were characterized for moisture content, total solids, volatile solids, total carbon, total nitrogen, C/N ratio and COD using the standard methods.

2. This substrate was mixed with the fresh anaerobic seeding sludge collected from the Sewage treatment plant in Pallipalayam. The resultant mixture, called feedstock was used in the reactors for anaerobic digestion process. A portion of this feedstock was analyzed for its chemical composition.

Characterization of Sample

1. Moisture content
2. Total solids and Total volatile solids
3. pH
4. COD
5. Ammonical nitrogen (NH3-N) and Nitrate (NO3-N)
6. Total phosphorus (TP)

Processing Technology

The recommended treatment practices to be adopted by Urban Local Bodies are as:

- Composting-Aerobic, Vermi composting, Windrow composting
- Bio Methanation -Anaerobic
- Refuse Derived Fuel(RDF)- Palletisation
- Pyrolysis
- Gasification

Biomethanation of Organic Waste

40-45% urban solid waste is the organic can be easily treated by anaerobic digestion. Solids in the organic waste decompose rapidly and can be treated by biomethanation process method. Solid waste is treated in closed vessels where, in the absence of oxygen microorganisms break down the organic matter into a stable residue, and generate a methane-rich biogas in the process. This biogas can then be used as a source of renewable energy to produce electricity. Solid residue can be utilized as manure.

Advantages of Biogas Plants

Disposal of waste at local level Reduction inϒ transportation cost @ Rs.400 per ton of waste, approximately Rs.1.43 Cr. annually (98 tonnes per day). Valuable Bi-Products such as Biogas and Manure. Generated Electricity will be utilized for street lighting. Space requirement of 5000 sq. ft for 5 TPD plant. Reduced Greenhouse Gas Emissions - Stopping release of @ 180 cum of Methane in to the atmosphere per day per plant which is 22 times danger than CO2 for Global Warming.

Need for the Biogas Power Plant

The Municipality having population 41010 and having 1.16 acres of land for composting .But as per the TNPCB recommendations (@ one Acre for 10,000 populations) the ULB should have compost land at 4.10 acres. As the Municipality is not having adequate land for compost yard. Hence this Bio gas plant is proposed for composting the organic waste in the Municipal solid Waste, by collecting directly from the Bulk generators.

Analysis on Various Technologies of Biogas Plant

1. Janata model
2. Industrial kvic model gobar gas (Floating Dome) model.
3. Continuous stirred tank reactor (CSTR).
4. Nisarguna technology.
5. Up flow anaerobic sludge blanket (UASB) process.

Up flow Anaerobic Sludge Blanket (UASB) Process

Among the various configurations of the methane digesters, which forms important equipment in the anaerobic treatment plant design, UASB design of the methane digester has become a very popular design since the introduction of the same by Dr.Lettingah of the Wagneighen University in The Netherlands. Various alternative designs are available all over the world, however the UASB has certain distinctive advantages which are listed here under:-

Advantages of UASB Process

UASB design seems to be highly suitable for the treatment of waste waters containing more than 75% of the Biological Oxygen Demand (BOD) in the form of soluble solids i.e. the waste water containing high ratio of the soluble to suspended solids. The loading rates i.e. kg of BOD5 treated per cubic meter of the digester volume per day are reported to be very high when compared to the alternative designs. The digester design does not use any packing media. This eliminates the need of frequent replacement of the packing media. Therefore the maintenance cost is considerably reduced. Absence of the packing media also reduces the risk of clogging.

Advantages of Modified UASB Process

The main disadvantage in using conventional UASB process is its unsuitability to treat wastes having large percentage of suspended solids. To overcome the

above disadvantage, Modified UASB has been developed which is a special hybrid design to treat solid slurry wastes. This is a two stage design concept. The sizes of the digesters for the first stage and the second stage are decided on the basis of the suspended organic contents of the slurry to be treated. The first stage fermentation is hydrolysis stage and the second methanation and polishing stage. The first stage is designed to give maximum solid retention time for the hydrolysis and the second stage is either proprietary modular UASB construction or specially developed hybrid design. The design has been tried in a number of applications like kitchen, poultry, cow dung and slaughter house waste and now accepted as Modified UASB technology. This technology has by now been well established, hence has been selected to give desired results for treatment of segregated biodegradable organic municipal solid waste. The anaerobic reactors R1, R2 and R3 represent the municipal solid waste compositions of the cities of Pallipalayam, Erode & Salem. From the result above it is clear that the volatile solids breakdown was high for R1 compared to the other two cities. The gas collection was measured by water displacement system and has been recorded daily and tabulated. The graphs showing the cumulative biogas generation has been plotted from the data for the three reactors and are shown below. The biogas generation of each samples was later calculated in per kg COD added and also in per kg VSS added.

Treatment Process

The segregate of Organic Municipal Solid Waste will be brought to the plant site. It will further be crushed using Crusher/pulverizer along with suitable quantity of water to form slurry. The slurry will be collected into the Inlet cum Recycle Chamber and then fed to the anaerobic digester. In the Anaerobic digester, the organic waste is converted into Biogas, Bio manure and Liquid overflow. Part of the treated overflow from the digester will be recycled back for the slurry preparation and the remaining will be discharged for suitable treatment. The bio-manure will be periodically removed from the digester and can be used as good organic manure or soil conditioner. The Biogas generated from the anaerobic digester will be collected in biogas holder, suitably pressurized, cleaned and used for Power generation. If the gas is not used, it would be necessary to flare. Thus, this process will be based on a "zero garbage" concept.

RESULTS AND DISCUSSION

From the above table 1, it is clear that the COD values for the municipal solid waste samples are highly varying. At the end of the process, all the three reactor samples showed a high decrease in their COD values. This COD breakdown in the samples is a clear proof of the anaerobic activity inside the reactors. The sample representing Pallipalayam shown a COD removal of 75.44 %, followed by Erode (67.4%) and Salem (60.7%). The characterization results of the samples clearly show the increase in the concentration of ammonical nitrogen in the effluent samples and decrease in case of nitrate and phosphorus concentration. The anaerobic reactor signifying the MSW composition of Pallipalayam produced a total of 13,870ml of biogas during a course of 60 days and its methane generated has been calculated to be 0.75 m3/kg COD added. The sample for Erode MSW generated 12,360 ml and the Salem MSW sample generated 12,660 ml. The methane generated for these cities was found to be 0.713 m3/kg COD added and 0.668 m3/kg COD added respectively. This is an effective method of solid waste management in the area, solid waste generated contains large amount of organic waste, the organic waste are collected from the market waste, household waste, cow dung and other bio degradable waste. At first the solid waste management in Pallipalyam municipality had the method of solid waste management such as the waste are directly exposed in open areas or landfills the wastes or burning the collected solid waste. After the implementation of Bio-methanation plant in pallipalayam municipality the organic solid wastes are collected, segregated and undergone to the process of bio-methanation. The technology of anaerobic decomposition, pyrolysis & gasification. To create awareness among the solid waste accumulation and treatment to produce methane gas, from the by-products we can produce electricity and the produced methane gas was also used as substitute for fuel. By implementing the Bio-gas power plant in all over the country we can get electricity & fuel substitute from the biogas combustion. Instead of doing other methods to produce methane gas, we can use bio-methanation plant to produce methane gas with less cost and safety. It is one of the best solutions to overcome the people's problem.

Table 1: Characterization of anaerobic reactor samples

Sample No.	Reactor	Stage	pH	COD (mg/L)	Nitrate Nitrogen (mg/L)	Ammonical Nitrogen (mg/L)	Total Phosphorus (mg/L)
1	R1	Initial	7.43	18433.24	288	156	2.8
		Final	5.80	45227	193.5	270.5	1.8
2	R2	Initial	7.26	17328	302	172	4.7
		Final	5.12	6810.44	236	234	3.0
3	R3	Initial	7.01	18941.09	298.5	187.1	4.4
		Final	5.18	6171.49	238	235.5	3.4

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