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Review article

EVALUATE TECHNO-ECONOMIC FEASIBILITY OF DEVELOPING AN ENERGY SELF SUSTAINABLE SEWAGE TREATMENT FACILITY

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Abstract: The goal to operate economically self-sustainable sewage treatment facilities throughout India to identify and implement energy efficient facility and technology improvements. This paper will provide a case study of 180 MLD pirana, Ahmedabad. The plant is formed by a coupling of aerobic treatment followed by anaerobic digestion system for sludge treatment. We find that energy consumption in plant is mainly in aeration and sludge treatment units. Biogas produced from digesters can be used to drive mechanical energy for aeration requirements and in whole unit and this combined system could become completely self sustainable in energy consumption.
Keywords: Energy generation, Energy self-sustainable, Sustainability.

1. INTRODUCTION AND GENERAL CONTEXT

Providing reliable wastewater services and safe drinking water is a highly energy intensive activity in the India. The most important goal in wastewater treatment is to fulfil the demands stated by the government concerning the effluent water quality to ensure the environmental wellbeing. The second most important goal is to perform the required wastewater treatment as cost effective as possible, for the sake of the taxpayers as well as for the nature in form of reduced energy usage deriving from e.g. fossil fuel.

This research paper aims to analyse the use of sewer biogas to electricity production in India. The study is being done in a sewage treatment plant located in Pirana, Ahmedabad.This plant operates with aerobic digestion process followed up by anaerobic digestion system, which has asmainly products biogas (composed mainly by methane) and sludge.

The main advantage in using anaerobic digestion process is that the sludge treatment process is followed by energy production as biogas. Currently, part of the methane produced is burnt in an open air can be either used to generate the electricity and use it to operate the equipment

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or biogas directly can be provide to the CNG manufacturer.

The methane reminiscent is burnt in flare to reduce the impacts causedby gases emissions. An alternative to burn it in flare is the biogas conversion into electricitythrough engines or micro turbines. This paper describes the proposed system to convertbiogas in electricity using gas engine.

2. BIOGAS PRODUCTION IN SEWAGE TREATMENT SYSTEMS

Biogas is a gas combustible mixture produced during the organic matter anaerobic digestion, sludge, in the sewage treatment. The amount of each gas in the mixture depends on many factors as the type of digestors and the kind of organic matter. In any way this mixture is basically made of methane (CH4) and carbon dioxide (CO2), and its heating value is straight linked to the methane content.

Table 1: General Biomass Mixture Composition

GAS MIXTURE COMPOSITION	
Methane (CH4)	66.5%
Carbon Dioxide (CO2)	30.5%
Oxygen (O2) + Nitrogen (N2)	0.5%
Humidity (H2O)	2.5%

There are different kinds of technology to convert the chemical energy in the biogas into electricity. Energy conversion means a process where one type of energy is converted to other one. In biogas conversion the chemical energy in the molecules is converted to mechanical energy in a controlled combustion system, then, this mechanical energy activates a generator producing electrical power.

3. CASE STUDY (180MLD SEWAGE TREATMENT PLANT)

The present flow rate at 180 MLD Sewage treatment plant Pirana, Ahmedabad is approximately 100 MLD. With the present flow rate the gas generation is around 10000 m^3/day. It is estimated that the incoming flow will increase up to 180 MLD (limiting capacity of the plant) within next 3 months. This will lead to gas generation capacity of approx. 16000 m^3/day.This can be sell to CNG manufacturers directly at a rate of Rs. 6/m^3. The capital investment will be zero for AMC as the entire capital cost (investment) and O & M cost will be taken care by private manufacturer only.

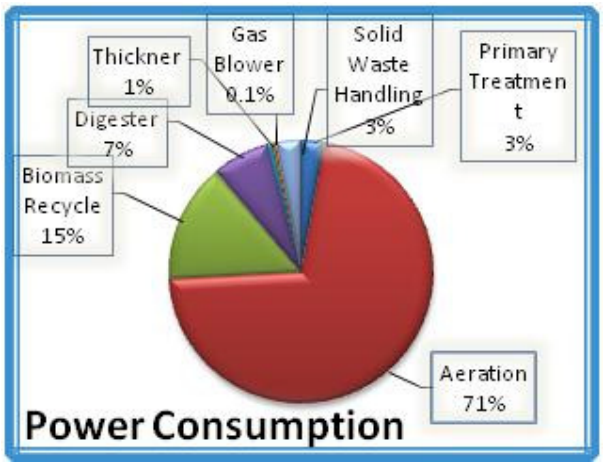
Calculations for energy free sewage treatment as per Electrical energy concerns:

(16000 m^3/day gas generated) X (Rs. 6/m^3) X (365 days/yr) = 3.5 Cr/ yr.

Approx. Energy consumption per year is 17.20 lack units. As per price rate of torrent power the total cost for electricity is 105 lacks per year. Hence approx. 30 % of the total revenue generated from the selling of biogas (near about 105 lacks) will be consumed as electricity power bill. And rest of the 70 % revenue generated is purely a profit for AMC.

ENERGY REQUIREMENT BEFORE IMPLIMENTATION of ECM

Table No. I : Power requirement in Kwh	
Primary Treatment	868
Aeration	21584
Biomass Recycle	4429
Digester	2148
Thickner	228
Gas Blower	107
Solid Waste Handling	919

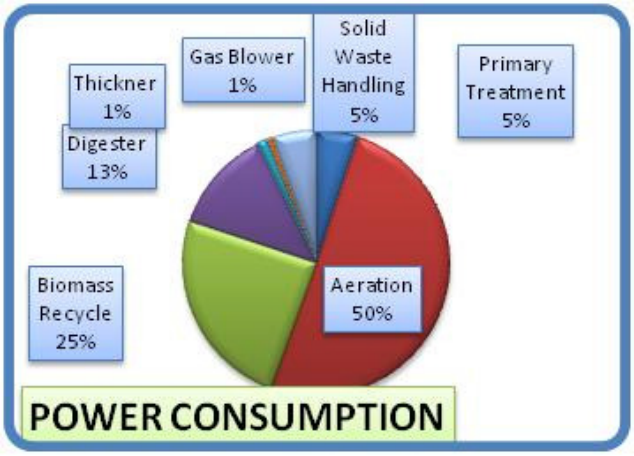


ENERGY CONSERVATION OPPORTUNITIES

Use of VFD (Variable frequency drives) along with online DO meter will reduce the power consumption up to 60 % in aeration basin, also using high efficiency pump in Return activated sludge pump & Digester sludge mixing pump will also decrease the major power consumption.

ENERGY REQUIREMENT AFTER IMPLIMENTATION of ECM:

Table No. II : Power requirement after implitation of Energy Conservation method	
Primary Treatment	868
Aeration	8633
Biomass Recycle	4200
Digester	2148
Thickner	228
Gas Blower	107
Solid Waste Handling	919



Avg. calorific value of biogas: 21-23.5 MJ/m3

1MJ = 277Wh, so 1 m^3 of biogas can generate 6.1 Kwh power but due to electrical conversion efficiency of 35%, 1 m^3 biogas can generate only 2.14Kwh power.

At present flow rate the energy requirement is around 27000 Kwh on daily average basis. Total energy generation with the full flange capacity which is 16000 m^3 BIOGAS is about 34240 Kwh. Rest of the power can be sell to others for revenue generation.

RESULT AND DISCUSSION

It is possible to design energy positive sewage treatment plants, Designs to improve energy efficiency of an existing works by reducing the energy used and/or increasing the energy produced can be used to generate energy positive sewage treatment plant from existing plant. In 180 MLD sewage treatment plant, pirana the gas generated is being flare off in open and it can be utilize in different ways and make whole plant running as an energy self sustainable sewage treatment facility.

REFFERENCES

- LiseAppels, J. Baeyens, J. Degrève, R. Dewil"Principles and potential of the anaerobic digestion of waste-activated sludge" in Progress in Energy and Combustion Science, Volume 34, Issue 6, December 2008, PP 755-781.
- Rosso, D. Larson . E. &Stenstrom, M. K. 2009. Real-time aeration efficiency monitoring in the activated sludge process and methods to reduce energy consumption and operating costs.Water Environ. Res. 81(12), PP. 2471–2482.
- Lutz, A.J. 2005.Economic opportunities in wastewater treatment.Energy Engineering 102(1), PP. 21–38.
- http://www.ehp.qld.gov.au/sustainability/publications/qs_fsheet_sewerageplantsenergyeff.pdf
- http://ec.europa.eu/energy/renewables/bioenergy/doc/anaerobic/08bm_077_1994.pdf