IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

TITLE: CRITICAL STUDY OF ANAEROBIC DIGESTION

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Abstract

A lot of waste produced in nature, industry and in homes is in liquid form and cannot be composted. Under carefully controlled conditions, the waste can be stabilized in the absence of air known as "anaerobic digestion". The method has economic value as it generates biogas rich in methane. The oxygen source for these microorganisms can be the organic material itself or alternatively may be supplied by inorganic oxides from within the input material. This is the decomposition of organic wastes in the absence of O2, the products being methane (CH4), CO2, NH3 and trace amounts of other gases and organic acids. Anaerobic ponds require temperatures above 10°C, and so work very well in warm climate. Anaerobic wastewater action differs from conventional aerobic action. In which micro-organisms do not require oxygen in order to function. Their requirement is met from the oxygen chemically contain in the organic materials. The treatment of waste water is done by anaerobic micro-organisms more than 10 days. After treating, waste water can be used for various purposes such as gardening purpose, floor washing, disposal in inland surface water etc. So this is much reliable and economical method for the treatment of waste water. Septic tanks are suitable for domestic wastewater treatment at the single household level or shared between several households. UASB (Up flow anaerobic sludge blanket) reactors are used for the municipal waste water treatment process. Activated sludge digesters have been commonly implemented in large amount industrial countries. The main purpose of this report is to study the anaerobic digestion process which we can implemented at domestic, industrial, institutional level for utilizing the waste water that is the main cause of environmental pollution.

Keywords: *Anaerobic digestion, Biogas, Anaerobic Digester, Reuse, Micro-organisms.*

1. INTRODUCTION

Wastewater is any water that has been affected by human use. Wastewater is "used water from any combination of domestic, industrial, institutional, commercial or agricultural activities, surface runoff or storm water, and any sewer inflow or sewer infiltration. For utilizing such wastewater, we have to use anaerobic treatment. Anaerobic digestion is the biological decomposition of organic matter in the absence of oxygen. Even though it is a slow process, it is relatively low cost method compare to aerobic digestion. In anaerobic pond, the entire depth is in anaerobic condition except extreme shallow top layer.

2. OBJECTIVES

1. To promote the treatment and reuse of wastewater.
2. To decrease the environmental pollution.
3. Prevents the scarcity of water.
4. Methane can be utilized as renewable energy source.

3. ANAEROBIC DIGESTION OCCURS IN FOUR STEPS:

a. Hydrolysis
b. Fermentation or Acidogenesis
c. Acetogenesis
d. Methanogenesis

4. MECHANISM OF ANAEROBIC DIGESTION

The digestion process begins with bacterial hydrolysis of the input materials. Insoluble organic polymers, such as carbohydrates, are broken down to soluble derivatives that become available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia and organic acids. These bacteria convert these resulting organic acids into acetic acids, along with additional ammonia, hydrogen

and carbon dioxide. Finally, methanogens convert these products to methane and carbon dioxide. The methanogenicarchea populations play an indispensable role in anaerobic wastewater treatment.

A. Hydrolysis
Hydrolysis is the first important step in anaerobic digestion. Very large number of organic polymers constitutes in anaerobic digester. In this process, these large polymers such as proteins, fats and carbohydrates are broken down into simple soluble organic molecules such as monosaccharaides, fatty acids and amino acids.

B. Fermentation or Acidogenesis
It is the next step of anaerobic digestion. The process of acid genesis is similar to the way that milk sours. In which acidogenic bacteria convert fatty acids, amino acids and sugars into alcohols, carbonic acids, hydrogen, ammonia and carbon dioxide.

C. Acetogenesis
In general, it is nothing but a derivative of acetic acid, from carbon and energy sources by acetogens. In which simply the acetogenic bacteria covert these resultant organic amino acids into acetic acids along with ammonia hydrogen and carbon dioxide. So this is much important step in anaerobic digestion**.**

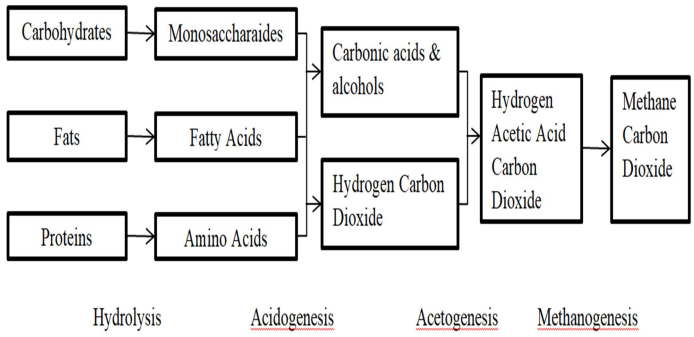
D. Methanogenesis
Methanogenic bacteria are finally are able to convert acetate, hydrogen to methane and carbon dioxide.

Fig: Anaerobic digestion prototype

5. METHANE FORMING BACTERIA
Methanobacterium

a. Convert CO2 and H2 to CH4 • Reductive methane formation
b. About 30% of methane formed
Methanosarcina
a. Convert acetate to CH4 and bicarbonate
b. Acetate decarboxylation
c. About 70% of methane formed.

Stages of anaerobic digestion:



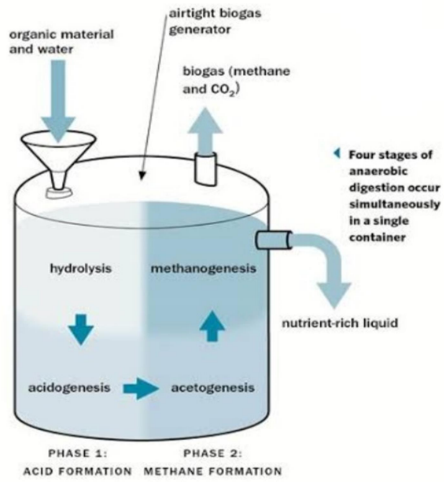


Fig. Single container anaerobic digester

ADVANTAGES OF ANAEROBIC DIGESTION
1. Wastewater pollutants are transformed into methane, carbon dioxide and smaller amount of bio-solids.
2. The biomass growth is much lower compared to those in the aerobic processes.
3. They are also much more compact than the aerobic bio-solids.
4. Anaerobic digestion reduces the emission of landfill gas into the atmosphere.
5. Anaerobic digestion is a renewable energy source because the process produces a methane and carbon dioxide rich biogas suitable for energy production helping replace fossil fuels.

6. The nutrient-rich solids left after digestion can be used as fertilizer.
7. Almost any organic material can be processed with anaerobic digestion.
8. This includes biodegradable waste materials such as waste paper, grass clippings, leftover food, sewage and animal waste.
9. The exception to this is woody wastes that are largely unaffected by digestion as most anaerobes are unable to degrade lignin found in wood.

DISADVANTAGES OF ANAEROBIC DIGESTION

1. Longer start-up time to develop necessary biomass inventory.
2. May require alkalinity and/or specific ion addition.
3. May require further treatment with an aerobic treatment process to meet discharge requirements.
4. Biological nitrogen and phosphorus removal is not possible.
5. Much more sensitive to the adverse effect of lower temperatures on reaction rates.
6. May need heating (often by utilisation of process gas) to achieve adequate reaction rates.
7. May be more less stable after 'toxic shock' (e.g. after upsets due to toxic substances in the feed).
8. Increased potential for production of odours and corrosive gases.
9. Hazards arise from explosion.

RESULT AND DISCUSSION

Factors Influencing Enhancement of Biogas and Reuse of Wastewater -

1. pH – It is one of the important factor that must be considered. Methanogenesis occurs within the pH 6.5 to 8.5 ranges and greater amount of biogas produce within the range from 7.0 to 8.0.For reusing for the purpose of land irrigation, plantation, and disposal in water bodies should be 5.5 to 9.0 ranges.
2. Temperature- Anaerobic digestion commonly applies two optimal temperature ranges: mesophilic with optimum temperature around 30^{o}C- 40^{0}C and thermophilic with optimum temperature around 55 °C. It is not only accelerating metabolic activities of micro-organisms but also enhance transfer of gases. For disposal in water bodies it should not be greater than 5^{0}C of receiving temperature of water bodies.
3. Hydraulic Retention time (HRT) - The hydraulic retention time (HRT) is the determination of average time that a certain substrate exist in a digester. If the HRT is shorter, the system will fail due to disaster of the slowest rising microbes that are essential for the anaerobic process. Besides, a shorter HRT gives a higher biogas production rate, but less efficient of decomposition organic matter (as volatile solids or COD), related with less process stability must be expected. It can range from as low as 2h to as high as 30d.
4. Organic Loading Rate- Increasing rate of OLR provides a better production of biogas. It is defined as the amount of organic matter that must be treated by certain volume of anaerobic digester in a certain period.
5. Biochemical Oxygen Demand (BOD)- It is nothing but the amount of oxygen needed by micro-organisms to break down the organic matter present in a given water sample. It should be less than 30 mg/L for land irrigation and to dispose in any water bodies.
6. Chemical Oxygen Demand (COD)- It is commonly indirect measure of organic compounds in a given water sample. It should be less than 250 mg/L for inland surface water.

CONCLUSION

This study defines us advices for optimizing the construction of anaerobic bioreactors to determine the optimal formal parameters of the digester. This study helps us to design the biogas digester and mainly indicates the importance of wastewater treatment and its horticulture purposes.

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