A Review on Process of Upflow Anaerobic Sludge Blanket Reactor

[1]C.Baraniya, [2]Dr.C.Jodhi
[1]PG Student, [2]Assistant Professor
Department of Civil Engineering, Annamalai University, Chidambaram, India.
[1]Email ID: baraniyac95@gmail.com, [2]Email ID: jee.ezhiljodhi@gmail.com

Abstract: *Up flow Anaerobic Sludge Blanket (UASB) reactor is a largely used technology which is suitable for wastewater treatment. In this anaerobic treatment complex organic matters are get converted into methane gas through the four main stages like hydrolysis, acidogenesis, acitogenesis and methanogenesis. UASB is extensively applicable for treating various types of wastewater such as sugar industry, distillery, dairy industry, slaughter house and high strength municipal wastewater. This technology has many advantages over aerobic treatment. At present, there has been a growing concern in favor of anaerobic developments as compared to the available conventional techniques for wastewater treatment. The potential of producing utilizable energy in the form of biogas formulates this biological anaerobic treatment process very unique. Because of this idiosyncratic characteristic, it has leads to important essential investigation on anaerobic treatment technologies such as UASB. In this present review, the four main stages in UASB reactor are explained.*

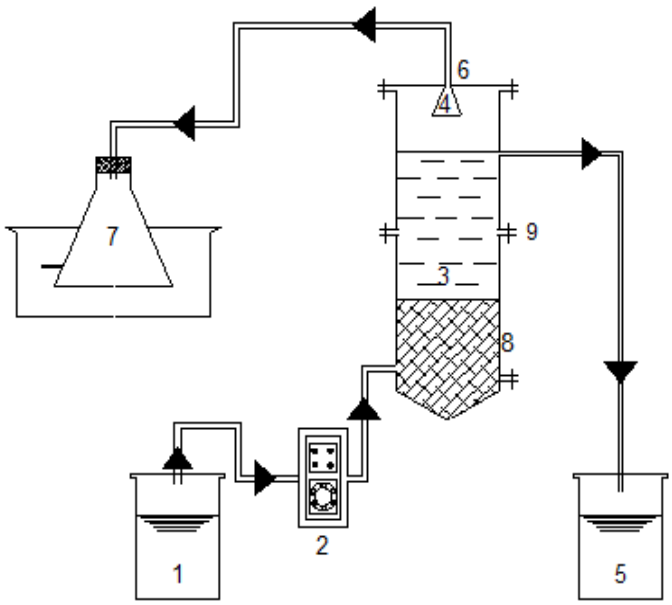
Keywords: *UASBR, Hydrolysis, Acidogenesis, Acitogenesis, Methanogenesis*

1. INTRODUCTION:

Nowadays, there is an enormous pressure on social and environmental policies to reduce the environmental impacts of developmental activities mainly in the industries managing of wastewater or sewage [1-2]. Due to rapid industrialization and urbanization, India facing severe trouble on collection, treatment and disposal of effluents. There are two types of treatment process can be done on effluents i.e. aerobic treatment and anaerobic treatment process. In aerobic treatment, external energy is mandatory for aeration and also it produces excess sludge. Nowadays, anaerobic treatments are extensively used in treating high strength waste water. It does not necessitate any external energy and itself it produces the energy in the form of methane gas. UASB is the process is based on the anaerobic treatment converts the organic matter in the waste water into small amount of sludge and produces large amount of biogas as an energy source [3]. Following parameters are responsible for the better performance of UASB is formation of sludge granules which ensures high specific methenogenic activities and better settling characteristics [4]. UASB reactor is extensively applicable for treating variety of industrial wastewater like Sugar wastewater, dairy wastewater, distillery wastewater textile wastewater, slaughterhouse wastewater, oil industry wastewater, potato processing wastewater.

2. UASB Technology

The schematic diagram of a UASB reactor is shown in Fig.1. Up flow anaerobic sludge blanket (UASB) is a type of anaerobic wastewater treatment technology which converts the organic matter in the effluent into tiny sludge granules and huge amount of biogas as an energy resource [3,5]. In the early 1970's, Lettinga and his co-workers developed the UASB technology in Holland [6]. The explanation to this technology was the innovation of anaerobic sludge naturally has enhanced settling character and floc forming character; specified that physico-chemical environment for floc formation by sludge are suitable [7]. The foremost reasons for the achievement of UASB technology is that it has enormous potential to embrace a higher amount of biomass, because a bulky thick layer of sludge is formed, which is composed of fine settleable sludge pellets to form methane. The growth of fine settleable sludge granules allows the dissociation of sludge retention time (SRT) and hydraulic retention time (HRT) in order that well-organized technology can be accepted with higher amount of organic load and significant size reduction in UASB reactor [8].



1. Influent tank
2. Peristaltic pump
3. Granulated UASB reactor
4. Gas/liquid/solid separator
5. Effluent tank
6. Gas outlet
7. Gas collection system & measurement of the displaced gas
8. Granulation zone
9. Sampling port

Fig. 1 Schematic diagram of UASB Reactor

3. Advantages of UASB technology

- Higher amount of reduction in BOD
- Can endure high organic loading rate and hydraulic loading rate
- Low amount of sludge is produced
- Biogas produced in the reactor can be used as fuel
- It does not requires aeration system
- Treated effluent from the reactor is rich in nutrients and it can be used for irrigation purpose
- It requires less area and can be constructed with locally available material.

4. Process of UASB reactor

The upflow anaerobic sludge blanket reactor (UASB) is a single tank practice. In this process, effluent enters the reactor from the bottom and flows upward. The suspended sludge blanket acts as filters and treats the effluent passed through it. The sludge blanket consists of microbial granules which has a size of 1 to 3 mm in diameter. The microbes in the sludge blanket degrade the organic compounds. As a result, bio-gases i.e., methane and carbon dioxide are produced. The rising bubbles mix the sludge without the aid of any mechanical components. A sloped wall redirects the material that reaches the top of the reactor to downwards. The clarified wastewater is extracted from the top of the reactor in an area above the sloped walls. After several days, smaller granules are converted into larger granules which act as filters for the smaller particles as the effluent rises through the sludge blanket. Because of the upflow profile, granule-forming organisms are preferentially accumulated, while others are washed out. Generally there are four main biological and chemical stages in UASB process i.e. Hydrolysis, Acidogenesis, Acetogenesis and Methanogenesis. Fig.2 shows the four stages in the UASB process [5].

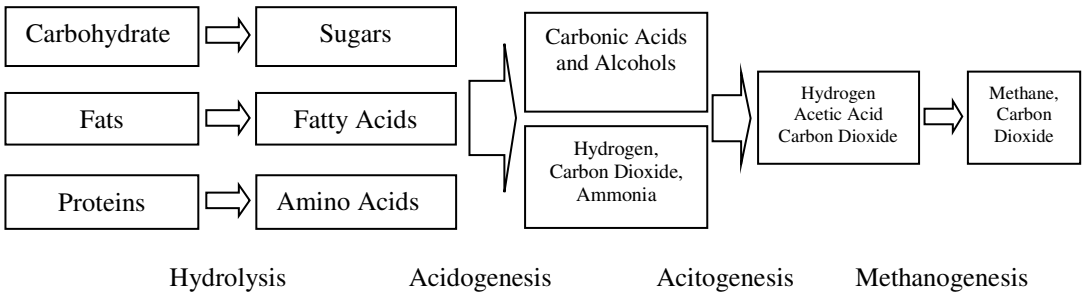


Fig. 2 Process of UASB

A. Hydrolysis

This is the initial stage of degradation where the complex matter is converted or hydrolyzed into dissolved compounds with lower molecular weights. These complex organic matters should break down into smaller components by the anaerobic bacteria to access the energy from the material. This smaller components or monomers such as sugars are readily available to other bacteria. The process of breaking these chains and dissolving the smaller components into solution is known as hydrolysis. During hydrolysis, the composite molecules are break-down into simple sugars, amino acids, and fatty acids. In reality, this process is a rate limiting step for the overall efficiency of anaerobic digestion. If the temperature falls below 20°C, the alteration rate for lipids also decreased.

B. Acidogenesis

The dissolved products from the liquefaction are then taken up in the cells of the fermentative bacteria. After acidogenesis, simple organic compounds are excreted such as volatile fatty acids, alcohols, lactic acid and mineral compounds such as carbon dioxide, hydrogen, ammonia and hydrogen sulphide gas.

C. Acetogenesis

The third process is acetogenesis. In this process, the intermediates products are converted into end products for methanization, namely acetate, hydrogen and carbon dioxide by acetogenic bacteria or also called as acetogens. In this stage, the Chemical Oxygen Demand and Biological Oxygen Demand are decreased. Around 70% of the COD in the influent is converted into acetic acid and the remainder of the electron donor capacity is concentrated in the formed hydrogen.

D. Methanogenesis

The final stage in the anaerobic digestion of organic waste is the biological process of methanogenesis. Here, the intermediate products from the previous stages are converted into methane, carbon dioxide, and water by methanogens. Huge volumes of biogas are produced by Carbon dioxide and methane in the system. Methanogenesis are sensitive to fluctuations in pH and pH occurs between 6.5 and 8. A simplified general chemical equation for the overall processes outlined above is as follows:

$$C_6H_{12}O_6 \rightarrow 3CO_2 + 3CH_4$$

E. Applications of UASBR

An extensive and detailed literature is available for researchers on applications for up flow anaerobic sludge blanket reactor. UASB reactor is appropriate technology for the treatment of a wide variety of wastewater both for industrial effluents and municipal discharge. These may include dairy, sugar, metal plating, textile, distillery, tannery, oil industry, slaughterhouse, print pastes, potato processing and domestic effluent etc.

5. CONCLUSIONS:

Up to date improvements in the field of wastewater treatment by the means of anaerobic, have proved that the anaerobic techniques particularly UASB process is not embarrassed to the elevated potency of effluents conversely they can efficiently be practical for lower potency of domestic wastewater. The most significant motives for major use of UASB process in wastewater treatment are production of vast quantity of lower strength waste which can be regularly disposed of untreated owing to its higher cost and secondly it's probable of stabilizing the organic matter

through the production of valuable energy by-product (biogas). The UASB reactor was set up to implement better and the process was conventional method for the treatment of industrial and municipal waste effluent such as sugar, dairy, textile, distillery, tannery, metal plating, oil industry, slaughterhouse, print pastes, potato processing and domestic effluent etc. finally it can be said that UASB reactor has been recognized as one of the suitable and cost effective treatment process bearing in mind the environmental requirements in India.

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