Anaerobic digestion of textile effluents

Lecture-28
Anaerobic digestion is a series of processes in which microorganisms breakdown biodegradable material in the absence of oxygen.

It is used for industrial or domestic purposes to manage waste and/or to release energy.

• The digestion process begins with bacterial hydrolysis of the input materials to break down insoluble organic polymer such as carbohydrate, and make them available for other bacteria.

• Acidogenic bacteria then convert the sugar and amino acids into carbon dioxide, hydrogen, ammonia and organic acids.
There are four key biological and chemical stages of anaerobic digestion:

- Hydrolysis
- Acidogenesis
- Acetogenesis
- Methanogenesis
Batch process or a continuous process.

- Anaerobic digestion can be performed as a batch process or a continuous process.

- In a batch system biomass is added to the reactor at the start of the process. The reactor is then sealed for the duration of the process.

- In its simplest form batch processing needs inoculation with already processed material to start the anaerobic digestion. In a typical scenario, biogas production will be formed with a normal pattern over time.
Batch or Continuous process

Operator can use this fact to determine when they believe the process of digestion of the organic matter has completed. There can be severe odour issues if a batch reactor is opened and emptied before the process is well completed.

- A more advanced type of batch approach has limited the odour issues by integrating anaerobic digestion with in vessel composting. In this approach inoculation takes place through the use of recirculated degasified percolate.

- In continuous digestion processes, organic matter is constantly added (continuous complete mixed) or added in stages to the reactor (continuous plug flow; first in – first out). Here, the end products are constantly or periodically removed, resulting in constant production of biogas. A single or multiple digesters in sequence may be used.
Acidogenic bacteria

- Acidogenic bacteria then convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide.

- Finally, methanogens convert these products to methane and carbon dioxide.

- The methanogenic archaea populations play an indispensable role in anaerobic wastewater treatments.
Anaerobic digestion is an attractive method for sludge treatment. It has the following advantages; considerable reductions in solids, BOD and COD, nitrates and phosphate, production of biogas, and bio-fertilizer.

The method has cheap operating cost. In India, climatic conditions are favourable for the treatment method and there is a considerable capacity to develop and optimize the process.
Butyric acid production from textile wastewater sludge by anaerobic digestion

Increasing textile wastewaters and their biotreatment byproduct—waste activated sludge are serious pollution problems.

Butyric acid production from textile wastewater sludge by anaerobic digestion was investigated. Adding starch to textile wastewater sludge increased the butyric acid concentration and percentage accounting for total volatile fatty acids (TVFAs) to 21.42 g/L, as compared with 10.6% of textile wastewater sludge alone.

The maximum butyric acid yield (2.25 g/L d).

The biological toxicity of textile wastewater sludge also significantly decreased after the anaerobic digestion.
High-rate anaerobic wastewater Treatment

The feasibility of high-rate anaerobic wastewater treatment for cold wastewater depends primarily on:

1. the quality of the seed material used and its development under sub mesophilic conditions;

2. an extremely high sludge retention time under high hydraulic loading conditions because little if any viable biomass can be allowed to wash out from the reactor;

3. an excellent contact between retained sludge and wastewater to utilize all the available capacity within the bioreactor; (4) the types of the organic pollutants in the wastewater; and (5) the reactor configuration, especially its capacity to retain viable sludge.
Anaerobic treatment

- Anaerobic treatment often is very cost-effective in reducing discharge levies combined with the production of reusable energy in the form of biogas. Anaerobic treatment of domestic wastewater can also be very interesting and cost-effective in countries were the priority in discharge control is removal of organic pollutants.

- Economy and technologies today largely depend upon energy resources that are not renewable.

- It is therefore necessary to identify and develop alternative sources of energy that are sustainable.