A STUDY ON MESOPHILIC ANAEROBIC DIGESTION OF WASTE ACTIVATED SLUDGE OF PHARMACEUTICAL INDUSTRY

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ABSTRACT

All the industries which use water they also generate wastewater. This wastewater is not directly discharged in natural environment. So, its necessary to treat that wastewater before disposal. During the wastewater treatment process sludge is generated. This generated sludge is another big issue cause of its disposal. There are various treatment available for sludge. From the various methods one method is anaerobic digestion of sludge. By use of this method we can treat the waste activated sludge which is generated during the wastewater treatment. The main goal of this treatment is to reduced the amount of sludge that need to be disposed. Anaerobic digestion is a technologically simple process, with a low energy requirement, used to convert organic material from a wide range of wastewater types, solid wastes into methane. A much wider application of the technology is desirable in the current endeavours towards sustainable development and renewable energy production. For study we were used mesophilic anaerobic digestion process. By this process reduced the sludge volume and generated the methane gas. This process required minimum 40 days for good results.

Keyword : - *Pharmaceutical Industry, Anaerobic digestion, Waste activated sludge, Mesophilic condition , Methane gas.*

1. INTRODUCTION

The Indian pharmaceutical industries are currently top of the India's industries with wide range capabilities in the complex field of drug manufacturing and technology. India's pharmaceutical industry has consisted of 250 to 300 companies. The Indian pharmaceutical sector is high fragmenting with more than 20,000 registrated units. The pharmaceutical industry in India provides around 70% of country demand for drug intermediates, pharmaceutical formations, chemicals, tablets and capsules. According to the "Directors of Pharmaceutical Manufacturing Units in India", there are 10,563 pharmaceutical manufacturing units in the country.

The existence of pharmaceutical substances in the aquatic environment and their possible effects on living organisms are a growing concern. The treatment of pharmaceutical wastewater to the desired effluent standards has always been difficult due to the wide variety of the products that are produced in a drug manufacturing plant.

The wastewaters are produced in different procedure in the production of pharmaceuticals and various medicines are called as Pharmaceutical wastewater. The treatments of effluents of pharmaceutical are a serious problem. This type of wastewater does not discharge directly on surface or in the water media. So that the large amount of effluent to be treated before their disposal.

In the whole pharmaceutical waste water treatment process the sludge is generated due to primary and secondry treatment process. Sludge refers to the semi-solid residual material which is left behind from the treatment of wastewater. The two main types of sludge produced from the wastewater treatment process are primary and secondary sludge.

Primary sludge is a result of the capture of suspended solids and organics in the primary treatment process through gravitational sedimentation, typically by a primary clarifier. The secondary treatment process uses microorganisms to consume the organic matter in the wastewater. The microorganisms feed on the biodegradable material in the wastewater in the aeration tank then flow into a secondary clarifier where the biomass settles out and removed as secondary sludge.

The sludge which is generated by the wastewater treatment is collected and then treated by the anaerobic digestion method .By this process we can produce the methane gas and also produce the good quality manure as a end product. The volume of the sludge may also be reduced by the anaerobic digestion method.

1.1 Bio digester

A digester is an airtight chamber in which anaerobic digestion occurs and biogas is produced. The terms "anaerobic digester" or "bio-digester" are used interchangeably and may be used to refer to the entire biogas recovery system. Digesters also reduce volatile organic solids and the number of disease-causing microorganisms in solids. The amount of products (e.g. methane) produced in a digester depends on the size of the digester and the feedstock composition.

1.2 Types of anaerobic digestion

There are multiple types of configurations and designs for digesters. Digesters can operate at ambient temperature (psychrophilic), mesophilic ranges (in temperatures of 25-38 degrees Celsius/77-100 degrees Fahrenheit) or thermophilic ranges (39-65 degrees Celsius/102-149 degrees Fahrenheit). The anaerobic digester that operate at the mesophilic temperature range(35-38 degree centigrade) is known as mesophlic digestion.The anaerobic digester that operate at thermophilic range (55-59 degree centigrade) is known as thermophilic digestion.

2.MESOPHILIC DIGESTION

The anaerobic digester that operate at the mesophilic temperature range(35-38 degree centigrade) is known as mesophlic digestion. Anaerobic digestion process is operated at various temperature .But generally two temperature range is preferable for digestion process. That process is mesophilic anaerobic digestion and thermophilic anaerobic digestion. In mesophilic anaerobic digestion process the temperature range is required between 37 ± 2^{o}c and in thermophilic anaerobic digestion process the temperature range is required between 57 ± 2^{o}c.Mesophilic temperature is easily achieve in summer season.

3. EXPERIMENTAL

3.1 Sludge containing Wastewater sampling

The untreated wastewater samples were collected from the pharmaceutical intermediate products manufacturing industry located at Bhilad, (Gujarat) India. First the sampling bottle was cleaned and rinsed with using of distilled water. The sample was filled in bottle and seal air tightly. About 4 to 5 cm air space is left in the bottle for proper mixing by shaking. The sample was stored at room temperature in the laboratory.

3.2 Experimental setup

Mesophilic anaerobic process performed under the stainless steel reactor with capacity of 40 liter having size 103 cm height and 28 cm diameter.

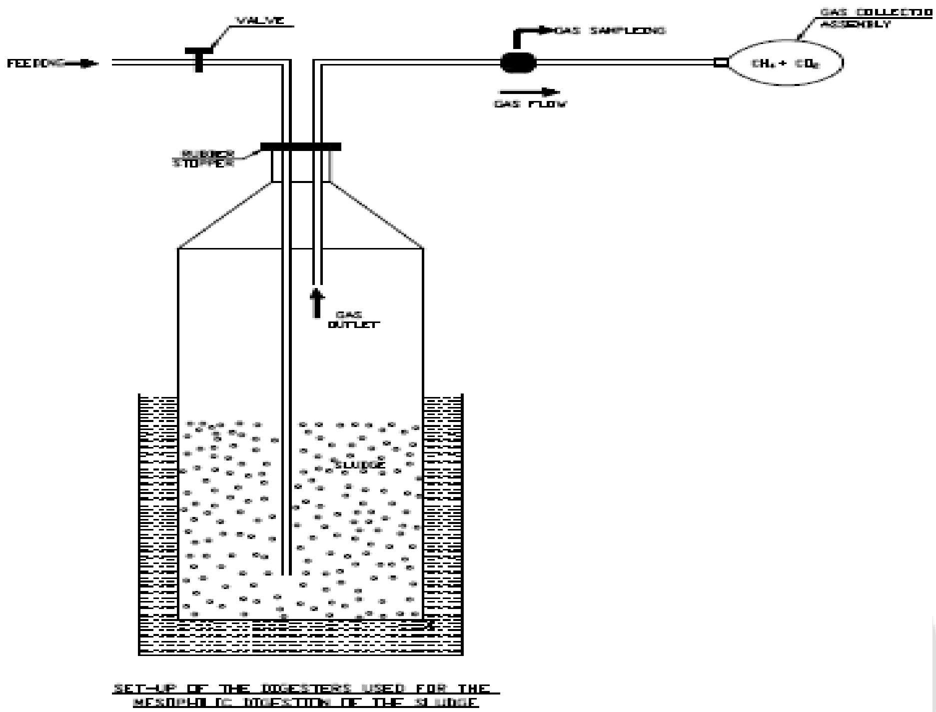

Fig -1: Set up for the mesophilic anaerobic digestion process

Fig -2: Anaerobic reactor

Fig -3: Process assembly

3.3 Experimental Procedure

Collect the activated sludge from the secondary settling tank in the digesting cylinder. The sludge volume is then measured by the volumetric cylinder. The measured sludge is feed in to the digesting cylinder and closed the cylinder air tightly. The whole reactor is put in to the water bath tub to maintain the mesophilic temperature range. By the use of electric heater and temperature sensor achieve the mesophilic temperature. The gas which is generated from the digested sludge is collected in gas collection assembly by the nozzle pipe. Measure the volume of gas after the collection. Also measure the quantity of sludge after completing the digestion process.

4. RESULTS

4.1 Raw wastewater characterization

Full characterization of water which filtered from the activated sludge which collected from the secondary setting tank.

Table: **1** Characterization of sludge containing wastewater

Parameters	Results	Test method
pH at 25^0C	7.58	IS 3025 (PART 11) 1983, APHA 22^{nd} Ed.2012,4500-H+,B
Temperature	25^0C	IS 3025(Part9)1984
COD	274.12	IS 3025 (PART 58) 2006, APHA 22^{nd} Ed.2012,5220-B
TDS	3608	IS 3025 (PART 16) 1984, APHA 22^{nd} Ed.2012,2540-C
TKN	88.2	IS 3025 (PART 34) 1988, APHA 22^{nd} Ed.2012,4500 NH_3-B &C
MLSS	6340	APHA 22^{nd} Ed.2012,4500-H+,B
MLVSS	4380	IS 3025 (PART 58) 2006, APHA 22^{nd} Ed.2012,2540-C
Total hardness	846	IS 3025 (PART 21) 2009,
Alkalinity	711	IS 3025 (PART 23) 1986,

5. RESULTS OF ANAEROBIC TREATMENT

5.1 Batch-1

SR NO.	PARAMETER	INITIAL	FINAL
1.	COD	274.12	244
2.	TDS	3608	3500
3.	TKN	88.2	73
4.	Total hardness	846	814
5.	MLSS	6340	6820
6.	MLVSS	4380	4730
7.	Ratio	69%	70%
8.	Sludge quantity	40	39
9.	SVI	56.78	45.45

Period:15days
Temperature: Natural temperature

Sludge reduction in 15 days is 2.5%.

5.2 Batch-2

Period: 15 days

Temperature: 37^{o}c

SR NO.	PARAMETERS	INITIAL	FINAL
1.	COD	292	258
2.	TDS	3816	3280
3.	TKN	89	68
4.	Total hardness	870	788
5.	MLSS	6920	6990
6.	MLVSS	4460	4320
7.	Ratio	64%	61%

8.	Sludge quantity	40	28.5
9.	SVI	57.8	37.2

Sludge reduction after 15 days is 28.75%

5.3 Batch -3

Period : 40 days

Temperature: 37^{o}c

SR NO.	PARAMETERS	INITIAL	FINAL
1.	COD	11611	5282
2.	TDS	8640	4568
3.	TKN	N.D.	N.D.
4.	Total hardness	4278	2250
5.	MLSS	3920	3820
6.	MLVSS	2770	2060
7.	Ratio	70%	53%
8.	Alkalinity	663	3116
9.	Sludge quantity	40	22

Sludge reduction after 40 days is 45%.

6. CONCLUSIONS

From the series of experiments carried out to study the digestion process, it was observed that the amount of sludge volume and methane gas production rate was various at different temperature level. By the study, it was defined that we can achieved 29% sludge reduction at mesophilic temperature during 15 days period and achieved % reduction during the 40 days period at mesophilic condition .Even addition of cow dung in the digestion process given go od results. when temperature increased the performance of digestion process was increased. From the study it was defined that the mesophilic anaerobic digestion process is effective process for activated sludge digestion of pharmaceutical industries.

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