

Performance Analysis of Anaerobic Digester for Food and Dairy Industries

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Abstract - *Objectives:* To analyze the sample for given industries and check performances of the digester. The samples were tested for various characteristics. *Methods/Statistical Analysis:* To investigate performance of the digester of different industries and check whether the existing digester provides a beneficial result. Check the reduction of different parameters of wastewater samples. Wastewater parameters which were considered are T.S, T.S.S, T.D.S, V.S.S, pH, alkalinity and VFA. *Findings:* The sample1 of food industries showed 83.7% reduction in T.S, 90.43% in T.S.S and 91.03 % in V.S.S. The sample2 of food industries showed 87.31% reduction in T.S, 93.68% in T.S.S and 91.03 % in V.S.S. The sample1 of Dairy industries showed 30.93% reduction in T.S, 54.16% in T.S.S and 87.7 % in V.S.S. The sample.2 of Dairy industries showed 50.96% reduction in T.S, 46.68% in T.S.S and 89.99 % in V.S.S. *Applications:* The digester provide are working within expected efficiency and the reduction are also obtained within the limits

Key Words: Digester inlet, Digester outlet, Total solids, T.S.S, T.D.S, V.S.S, PH, V.F.A, ALKALINITY, V.F.A/ALKALINITY, F.O.G.

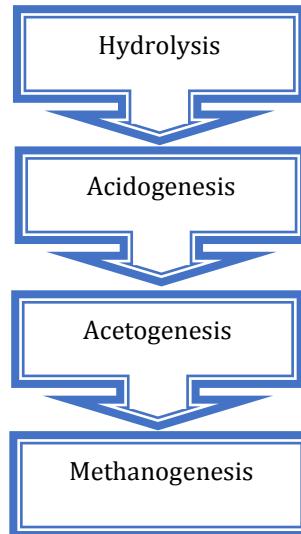
1. INTRODUCTION

Development in the life style of humans has played a vital role in increasing the demand of products. Let it be a food product or dairy product people tend to use more of the packed products from industries. If the demand of these products has increased, production would have also been increased. These food and dairy industries have various solid waste generation trends, depending on the type of production occurring. The food industries analysed in this paper produced Indian snacks, sweets and other packed eatables. The digester designed in the industries were developed after looking forward at the type of raw material used for production such as, in potato chips the raw material used were potato of which 1% of its raw waste used to peeled of removed. This is 1% of total waste generated from the raw material. In case of production of sweets raw material used where white pumpkins of which 50% was waste and only rest 50 % was used for further production. Various products were manufactured in this food industry. The food industry had approximately 3000 people working in it they used canteen on a daily basics. The treatment plant

also has to take care of the leftovers of the people waste generated from the process. The characteristics of waste plays a very important role in the treatment process of waste. Other industries analysed was a dairy industries in which production of butter, ghee, ice cream and other dairy product. The waste generated from this industry had a common particulate present fatty acid. Presences of fatty acid in the process of treatment affects it, as it gets accumulated. Analysis of the working of the digester was the main motive of the paper but it also came across the factors which affect the process in different industries. The anaerobic digestion used for treatment is basically for production of recycled energy in the form of biogas. In various industries the production of biogas varies as there is change in composition of waste.

The anaerobic digestion is a one of most prominent method for digestion, because of which it is used in various industries such as food, dairy, brewery and distilleries etc. it is a controlled decomposition process of biodegradable material under a managed condition where no oxygen is present. The temperature working has two ranges mesophilic (30°C to 40°C) and thermophilic (50°C to 60°). The facultative bacteria and Archaea species converts the input into biogas and whole digest able..

Anaerobic digestion works in following process



2. Materials and Methods

A college laboratory was used for performing the testings of parameters of waste water. The sample were directly collected from the food and dairy industries. From each industry 2 samples were taken, and parameters like Total solids, T.S.S, T.D.S, V.S.S, pH, V.F.A, alkalinity.

Sampling of Waste Water and Analysis

The samples were collected from food and dairy industries in Nagpur the samples were analyzed for different parameters to check the performance of the existing digester.

Methods and Analysis in the two industries of food and dairy having a single digester sample were taken twice in a period of one month to check the performance and workability of the process. Taking two samples in an interval of one month give us an appropriate result.

2.1 Tests Performed

Following tests were performed on soil and waste water:
For T.S

- The sample was kept in oven at a temp of 105°C for 24 hrs and T.S.S was obtained For T.S.S
- Sample was filtered with whatman paper 40 no and the paper was oven dried for 3hrs giving the value of T.S.S
For T.D.S
- The filtered water was kept in oven for 24hrs at 105°C which gave the value of T.D.S

For V.S.S

- The oven dried particulate of T.S.S is kept in Ceramic bowl and is burned at muffle furnace for 30mins giving V.S.S. For pH pH is measured by pH meter.

For V.F.A

- Sample was diluted with distilled water at concentration of 0.1 normality.
- HCL used for titration continuously till the pH was obtained 3.05 (A was obtained)
- Which was further boiled and brought to room temp
- NaOH was added up till the pH values 6.5 (B was obtained)

$$VFA = \{(Bx100) - [(A=101/99.23)]\}/10 \times 60$$

For Alkalinity

$$\text{Alkalinity} = [(A-B) \times 10]/50$$

Bio-gas generation: -

Bio-gas generation was found to be 150m³/ton of the solid waste.

The total solid waste was found 23000kg.

$$\begin{aligned} \text{Bio-gas generation} &= 150 \times 23 \times 4500 = 3450 \text{ kgcal/m}^3 \\ &= 824.01 \text{ kilojoule/m}^3 \end{aligned}$$

$$= 228.89 \text{ watt/hour}$$

$$= 0.31 \text{ HP}$$

The power generated by the bio-gas is 0.31HP

2.3. Result and Discussion

In this study, first we are analyzed the different parameters of the sample provided. Parameters such as total solids, total suspended solids, total dissolved solids, volatile suspended

solids, ph, volatile fatty acids, alkalinity, F.O.G, for food and dairy industry. sample1 was for food industry showed in table-1 in which the reduction is seen 83.7% in total solids, 90.43% in total suspended solids, and 91.03% in volatile suspended solids. And after a month the results of sample-2 are 87.315 reduction in total solids, 93.68% reduction in total suspended solids, and 91.03% in volatile suspended solids. In the food industry the reduction were found between 80-95% in different parameters which portrays that the treatment process is up to the mark. In the dairy industry in which sample-1 showed results as 30.93% in total solids, 54.16% in total suspended solids, and 87.7% in volatile suspended solids. In sample-2 dairy industry 50.965 reduction was in total solids 46.68% in total suspended solids, 89.99% in volatile suspended solids. The results in the dairy industry were not up to the mark but appropriate enough for working. The bio-gas generation was found to be 0.31HP.

Table -1: Sample-1 of Food Industry:
Parameters of FOOD industry

	Digester inlet	Digester outlet
TOTAL SOLIDS	59200	9600
TOTAL SUSPENDED SOLIDS	57500	5500
TOTAL DISSOLVED SOLIDS	1700	4100
VOLATILE SUSPENDED SOLIDS	53000	4750
PH	7.234	7.239
VOLATILE FATTY ACIDS	-	2153.1
ALKALINITY	-	2900

Table -2: Sample-1 of Food Industry
Sampling point calculated of FOOD industry-1 of Sample-1:

	Digester inlet	Digester outlet
TOTAL SOLIDS	59200	9600
TOTAL SUSPENDED SOLIDS	57500	5500
TOTAL DISSOLVED SOLIDS	1700	4100
VOLATILE SUSPENDED SOLIDS	53000	4750
PH	7.234	7.239
VOLATILE FATTY ACIDS	-	2153.1
ALKALINITY	-	2900

Table -3: Sample-1 of Dairy Industry-1:
Parameters of FOOD industry-1 collected

	Digester inlet	Digester outlet
TOTAL SOLIDS	13900	84450
TOTAL SUSPENDED SOLIDS	12000	7000
TOTAL DISSOLVED SOLIDS	1900	1450
VOLATILE SUSPENDED SOLIDS	8375	3478
PH	7.765	8.007
VOLATILE FATTY ACIDS	-	1733.32
ALKALINITY	-	3250

Table -4: Sample-1 of Dairy Industry-1:
Sampling point calculated of Dairy industry-1 of Sample-1:

	Digester inlet	Digester outlet
TOTAL SOLIDS	12900	6325
TOTAL SUSPENDED SOLIDS	10020	5342
TOTAL DISSOLVED SOLIDS	2880	983
VOLATILE SUSPENDED SOLIDS	8996	8997
PH	7.234	7.32
VOLATILE FATTY ACIDS	-	1632.1
ALKALINITY	-	2950

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3. CONCLUSIONS

The food and dairy industries treatment process showed sufficiently workable results. The reduction in the parameters helps the generation of bio-gas which helps in reduction of energy. The composition of the waste plays an important role in reduction of treatment process. The reduction in the food industry was found to be more as compared to dairy industry, which also resulted in more generation of bio-gas. The total energy recovered is approximately 25% of total energy required. In both industries the performance of the digester in the food and dairy industries were significant.