

Thermal Pretreatment on Dairy Slurry for the Production of Biogas by an Aerobic Biodegradability Assay Method

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Abstract: Biogas is a renewable energy, which can be produced by slurry coming from different Industrial waste water treatment plant. Particularly, dairy industry slurry does not contain any heavy metal. So biogas production is easier and it can be produced by anaerobic degradation assay method. Because of long retention time the slurry should be pretreated. One of the easiest, simplest and cost reduction methods is thermal pretreatment. The aim of this study is to explore the thermal pretreatment of dairy slurry for the production of biogas by anaerobic biodegradability assay method. In this study first, the physical, chemical parameters were analyzed. After that slurry is pretreated at different temperature (100-2200C) at different time interval (0-30 min) with the key parameters of TSS, SCOD and the optimum temperature can be determined. The optimum temperature can be taken for anaerobic biodegradation depends based on the thermophilic range. In the optimum temperature range final physical, chemical parameters of slurry were analyzed. Finally anaerobic degradation of dairy slurry will be conducted by active inoculums (cow dung). After by anaerobic decomposition the generation of biogas can be measured. In the same way biogas production in the untreated slurry will be measured. The optimum temperature range for the TSS and SCOD are 180° C. The biogas production from the untreated thermally pretreated slurry is 78 mg/l, 123mg/l. The maximum biogas production obtained in the optimum temp range i.e., 180°C and also i hope that thermally Pretreatment of dairy slurry will enhance the biogas production. This gas can be used for many purpose.

I. INTRODUCTION

Nowadays water resources are polluted by city sewage and industrial waste discharge. The water pollution is caused by some of the industrial sub sectors such as food processing industries, paper and pulp industries, textile, agro based industries and chemical industries, which release toxic wastes and organic pollutants (Kansalet *al.*, 1998). Among all these industrial sub sectors, food-processing industries are the major role for wastewater generation. There are over 19,850 food processing industries in India, discharging large quantities of wastes in to the water bodies. The universal increasing environmental vigilance and its successive policies have led to the application of improved technologies in wastewater purification plants. This has resulted in higher wastewater and slurry productions. These wastes if uneconomically utilized or disposed of without treatment can cause serious pollution problems.

Wastewater from a dairy operation consists of water that has been used for plant washing, processing and cooling purposes (CPCB, 1997). Water management in the dairy industry is well described (Bevg et al., 1983) but effluent production and disposal remain a major issue for the dairy industry. The dairy industry in Nagercoil, per day 2 lakhs litter of water was used. About that 1 lakh liter of waste water treated in each day and its having a large quantity of slurry. So the dairy industry has to offer efficient and cost-effective effluent treatment technology has to be developed. Commonly, two treatments widely used for control the slurry management problem. The aerobic treatment method slurry only decomposed but biogas cannot be produced. The main disadvantage is smell problem. For this

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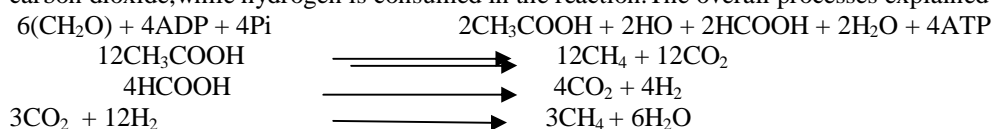
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reason, anaerobic digestion offers a sole treatment option to the dairy industry. The anaerobic digestion not only reduces the COD of an effluent, but modest amount of microbial biomass is produced. The major advantage is energy recovery in the form of CH₄ and up to 95% of the organic matter in a waste stream can be converted into biogas (Orhon et al., 1993)

Thermal pretreatment is successfully applied in food processing industry as a factor increasing the hydrolysis reaction. Thermal pretreatment have also been used in the process of sewage slurry hygenization, dewatering and drying. The studies concerning the slurry pretreatment by means of heat treatment before anaerobic digestion mostly concern influence of thermal waves on the conversion of organic matter into easily accessible substances for fermentative microorganism. The conversion of organic matter contained in the slurry flocs is usually reflected by the increase value of SCOD/TCOD ratio and also higher value of COD during thermal pretreatment. The COD value was increased in the slurry by the variation of temperature. The disintegration of cell membranes loads also to the release of enzymes located in the protoplasm, which are responsible for hydrolyse decomposition of organic nitrogen and phosphorous compounds

Anaerobic digestion process is an efficient waste treatment technology that reduces waste volume and generates biogas. (chen, et al.2008).Biogas typically contains 75% of methane and 24% of carbon dioxide and 1% of other gases(Igoni, et al.2008).The process consists of four phases such as hydrolysis, acidogenesis, acetogenesisand methanogenesis (Ciborowski. 2004). Hydrolysis is a process of splitting up of one or more water molecules are split into hydrogen and hydroxide ions which may lead to participate in further reaction Cellulose and other polysaccharides are not digested easily, because of the presence of some amount of ligin along with them. The lignin prevents the digestion of cellulose into simple sugars. But there are some cellulolytic bacteria which hydrolyse the cellulose into simple sugars.Acidogenesis is a process of biological reaction in which simple monomers are converted into volatile fatty acids.Acetogenesis is a biological reaction in which volatile fatty acids are converted into acetic acids,carbon dioxide and hydrogen.Finally methanogenesis is a biological reaction in which acetates are converted into methane and carbon dioxide,while hydrogen is consumed in the reaction.The overall processes explained in the following equation.



An important aspect of the anaerobic digestion process consists of temperature,hydrogen ion concentration,C/N ratio, loading rate as well as moisture and heat contents which should be considered to achieve optimal condition for biogas production.To achieve high amount of biogas production,the applied improvement methods such like pre-treatment and post treatment.

Some of the microorganism has the capacity to produce methane under the anaerobic condition.Methanobacterium genus includes typical,long rod shaped,gram negative bacteria.Their cell walls contain psedomurin.They use formate as substrate for the production of methane.Examples are methanobacterium arbophilicum strain DC,Methanobacterium arbophilicum strain AZ and methanobacterium mobile.Methanobrevibacter genus include short,rod shsped,gram positive bacteria.Their cell wall contains pseudomurine and they use formate as substrate for the production of methane.Methanococcus genus includes gram negative bacteria which are small and irregular in shape.The cell wall is composed of protein subunits with a very small amount of glucosamine.They utilize formate as substrate for the production of methane.Example for the bacteria is Methanococcus vannielii.Methanomicrobium genus includes gram negative bacteria which are small and rod like in structure.Their cell wall contains a number of protein subunits. They use formate as substrate for the production of methane. Methanogenium includes gram negative bacteria which are small, coccoid in nature. Their cells walls consist of protein subunits. These bacteria are also use formate as substrate for producing methane. Methanospirillum, Methanosarcina also produce methane. All the methanogenic bacteria are strictly anaerobic bacteria. The stages of microbial population involved in the anaerobic decomposition are explained in the Figure 1.1.

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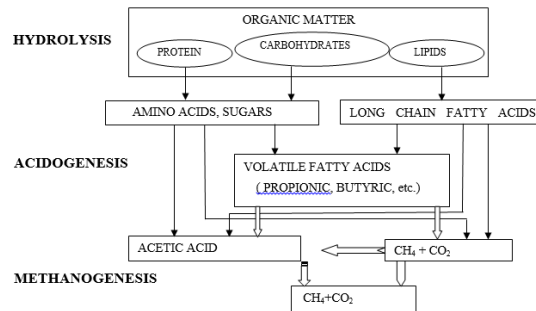


Fig 1.1 Stages and bacterial populations involved in anaerobic digestion

Biogas is a colorless, odorless gas. It does not release smoke while burning. It does not release kitchen refuse while burning. The need for the study is biogas can be used for heating, lighting, water pumping, electricity generation. Biogas also used in a gas engine to convert the energy in the gas into electricity and heat. Biogas can be compressed; such like natural gas. Biogas replace around 17% of vehicle fuel. Pollution can be controlled by handling the slurry. The waste coming from the biogas plant can be used as the fertilizer.

II. MATERIALS AND METHODS

The present study was carried out for biogas production from the dairy slurry. The methodology is explained in figure 2.1.

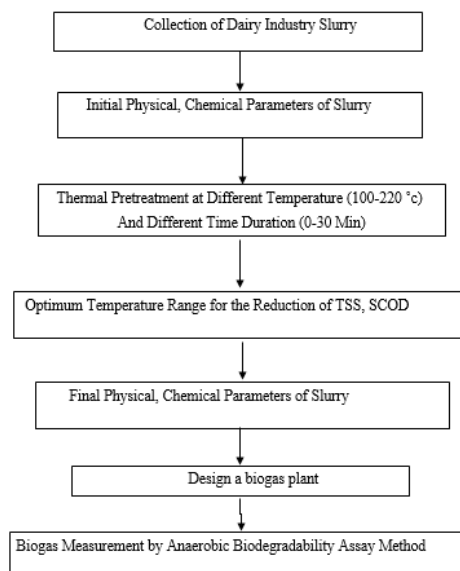


Fig 2.1 schematic representation of methodology

In this study, effect of Thermal pretreatment on the dairy slurry for the production of biogas by anaerobic biodegradability assay method. For this, dairy slurry was collected and physical, chemical parameters were analyzed. Then the slurry was subjected to Thermal pretreatment at various temperatures (100-220°C) for different time (0-30 min) duration mainly to increase COD solubilisation, reduce the TSS. Optimum temperature was found by reduction of

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TSS, SCOD. Final physical and chemical parameters of slurry were analyzed in the optimum temperature range. Biogas can be measured by water displacement method. The biogas production is compared with the pretreated and untreated slurry.

The waste activated slurry was collected from dairy treatment plant in nagercoil district at Tamil Nadu. The Dairy treatment plant has a conventional aerobic activated slurry. The flow chart of dairy treatment plant is shown in figure 2.2.

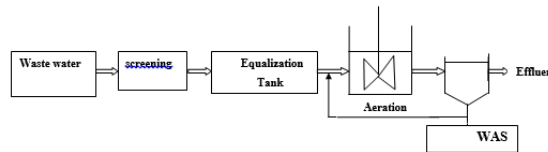


Fig2.2 Flow chart of dairy treatment plant

Physical parameters such as TS, TSS, VSS, SCOD, TCOD, pH, COD Solubilization %, Turbidity and Electrical conductivity were analyzed. TS, TSS, VS, TCOD, SCOD and COD Solubilization % were analyzed by APHA (2005) standard method. pH, Conductivity, and Turbidity were analyzed by pH meter, Conductivity meter and Turbidity meter

Twenty milliliters of the sample was taken in a clean and weighed evaporating dish and dried at 103°C in a water bath and cooled in desiccators. After cooling, the weight of the dish with the waste contents was noted. Calculation was done in the following equation number (1).

$$\text{Total Solids (\%)} = \frac{(A-B)}{(C-B)} \times 100 \quad \dots\dots\dots (1)$$

Where,

- A = Weight of the evaporating dish (g) + sample after drying (g)
- B = Weight of the evaporating dish (g)
- C = Weight of the evaporating dish (g) + wet sample (g)

Twenty ml of the sample was taken and passed through the dried filter paper (0.45-2µm). The filter paper with the solids was dried in the oven for one hour at 105°C and cooled in desiccators. After cooling, the weight of the filter paper with the contents was noted. Calculation was done in the following equation number (2)

$$\text{Total Suspended Solids (\%)} = \frac{(A-B)}{(C-B)} \times 100 \quad \dots\dots\dots (2)$$

Where,

- A = Weight of the filter paper (g) + sample after drying (g)
- B = Weight of the filter paper (g)
- C = Weight of the filter paper (g) + wet sample (g)

The TCOD is used as a measure of the oxygen equivalent to the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant. Ten ml of sample was taken in a 250ml refluxing flask to which pinch of mercuric sulphate and few glass beads were added. 15ml of sulphuric acid was added slowly, followed by 7ml of 0.25M potassium dichromate solution. The mixture was refluxed for two hours. Then, the sample was diluted to twice its volume with distilled water and titrated against ferrous ammonium sulphate using ferroin indicator. The appearance of a pink color was noted as the end point. Calculation was done in the following equation number (4).

$$\text{TCOD (mg/l)} = \frac{(A-B) \times N \times 8000}{\text{Sample volume}} \quad \dots\dots\dots (4)$$

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Where,

- A = Volume of FAS consumed for blank (ml)
- B = Volume of FAS consumed for blank (ml)
- N = Normality of FAS.

The 20 ml of sample was centrifuged at 10,000 rpm for 10 min. collect the supernatant. Ten ml of sample was taken in a 250ml refluxing flask to which pinch of mercuric sulphate and few glass beads were added. 15ml of sulphuric acid was added slowly, followed by 7ml of 0.25M potassium dichromate solution. The mixture was refluxed for two hours. Then, the sample was diluted to twice its volume with distilled water and titrated against ferrous ammonium sulphate using ferroin indicator. The appearance of a pink color was noted as the end point. Calculation was done in the following equation number (5).

$$\text{SCOD (mg/l)} = \frac{(A-B) \times N \times 8000}{\text{Sample Volume}} \dots\dots\dots (5)$$

Where,

- A = Volume of FAS consumed for blank (ml)
- B = Volume of FAS consumed for blank (ml)
- N = Normality of FAS.

COD Solubilization

COD solubilization was calculated using the following equation number (6)

$$\text{COD Solubilization(\%)} = \frac{\text{SCOD after thermal treatment}}{\text{TCOD of raw sludge}} \times 100 \dots\dots\dots(6)$$

pH

The electrodes of the p meter were calibrated with standard buffer solution of known pH. 50 ml of effluent was taken in a beaker. The electrodes were washed with distilled water and wiped with filter paper. The electrodes were immersed into the beaker containing the effluent and meter reading were recorded.

Turbidity

Turbidity can be measured by turbidity meter. At first, set the meter using turbidity free Distilled water. At second, set the meter to 100 using 100 NTU standards. After that measure the turbidity for the sample. If the sample turbidity is high, dilute and measure the turbidity. Calculation was done in the following equation number (7)

$$\text{Turbidity} = \text{NTU for sample} \times \text{Dilution factor}$$

Electrical conductivity can be measured by conductivity meter. At first, set the electrical conductivity meter to 1412 standard solution. After that measures the conductivity of the sample. If need an accurate conductivity, using two or more standard. Calculation was done in the following equation number (8)

$$\text{Electrical conductivity} = AT + [((CO - AO)/(BO - AO)) \times (BT - AT)] \dots\dots\dots (8)$$

Where

- AT = Theoretical EC for next lower standard
- CO = Observed EC for sample
- AO = Observed EC for next lower standard
- BT = Theoretical EC for next higher standard

CHEMICAL PARAMATERS

Glassware such as beakers, Erylen-Meyers flasks, burettes and pipettes used for experiments were first cleaned with detergent and then soaked in chromic acid cleaning mixture [concentrated sulphuric acid (1000ml) plus saturated sodium dichromate solution (35ml)]. They were thoroughly rinsed several times with tap water and then with distilled water

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THERMAL PRETREATMENT

A commercial domestic hot air oven and slurry is taken in the silicon crucible. The thermal pretreatment for slurry is explained in Table 2.1.

Table 2.1 Experimental setup parameters of Thermal pretreatment

Sample	Operating Parameters	Optimization	Parameter
slurry (250ml)	Temperature (°C)	100-200	SCOD increment and TSS reduction
	Time (min)	6,12,18,24,30	

Slurry thermal pretreatment was performed as batch tests using 250ml in a silicon crucible. All test samples were subject to temperature of initial, 100°C, 120°C, 140°C, 160°C, 180°C, 200°C, 220°C respectively. During thermal pretreatment experiments, the effect of time on the efficiency of pretreatment was studied by using the time from 1 to 30 minutes. The efficiency of pretreatment was analyzed by measuring COD solubilization, TSS reduction.

A full quantity of water was taken in the 500 ml measuring cylinder. A beaker is placed at the top of the cylinder. The whole setup is inverted. A Measuring cylinder is fixed with the help of pipette stand. A reagent bottle having one hole at the center, insert one rubber tube, another end of rubber tube inserted into the measuring cylinder. A 60 ml sample of slurry, was seeded with 150 ml of active inoculum (cow dung) and was fed into a 250 ml reagent bottle.

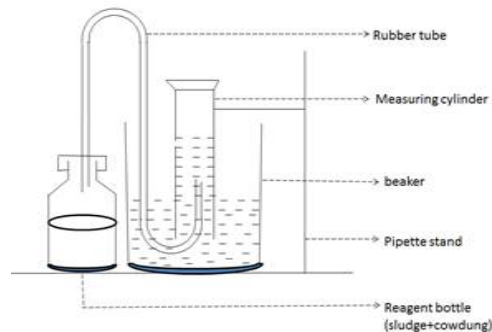


Fig 2.2 Designing a biogas plant

ANAEROBIC BIODEGRADABILITY ASSAY

The biodegradability assay was used to evaluate biogas recovery from slurry after microwave pretreatment. The experimental setup of an anaerobic biodegradability assay is shown in Figure 2.3

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Fig 2.3 Experimental setup of anaerobic biodegradability assay

A full quantity of water was taken in the 500 ml measuring cylinder. A beaker is placed at the top of the cylinder. The whole setup is inverted. A Measuring cylinder is fixed with the help of pipette stand. A serum bottle having one hole at the center, insert one rubber tube, another end of rubber tube inserted into the measuring cylinder. A 60 ml sample of untreated slurry, was seeded with 150 ml of active inoculum (cow dung) and was fed into a 250 ml serum bottle is shown in Fig 3.4 first setup. The remaining four were 100^oC, 140^oC, 180^oC, and 220^oC thermal pretreated sample. A separate 60ml sample of untreated slurry was used as a control sample. The biodegradability assays were performed at room temperature (37°C). The cumulative gas production was measured using a water displacement method. The serum bottles were shaken every 12h to allow for sufficient blending

III. RESULT AND DISCUSSION

The present study envisages physical, chemical parameters of slurry and effect of thermal pretreatment of dairy slurry for the reduction of TSS were discussed in this chapter. TS, TSS, VS, TCOD, SCOD, pH, COD solubilization %, Turbidity, Electrical conductivity were presented in the table 4.1

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Table 3.1 Initial Physical parameters of raw dairy slurry

PARAMETER	VALUE
TS (mg/l)	17,241
TSS (mg/l)	8610
VS (mg/l)	14,007
TCOD (mg/l)	35,000
SCOD (mg/l)	1,370
pH	6.3
COD Solubilization (%)	3.92 %
Turbidity (NTU)	16
Electrical conductivity $\mu\text{mS/cm}$	1499

Table 3.1 shows the initial characterization of raw dairy slurry. It was found that the total solids were 17,241mg/l, total suspended solids were 8610mg/l, volatile solids were 14,007mg/l, TCOD was about 35,000mg/l, SCOD was about 1,370mg/l, pH was about 6.3 and the COD solubilization was about 3.92%, Turbidity was about 16 NTU, Electrical conductivity was about 1499 $\mu\text{mS/cm}$.

The above result was compared with Woon –Ji parket *al.*, (2011) which showed that raw thickened secondary slurry had the following characteristics as pH= 6.5, TS= 19,372± 713mg/l, VS=13,050 ± 704 mg/l, TCOD= 17,808 ± 1,206 mg/l, SCOD= 520± 140 mg/l and the COD solubilization was evaluated as 2.9 ± 0.8%. Also, B.Parket *al.*, (2007) showed that raw waste activated slurry had the initial characteristics as pH= 6.22, TS= 30070mg/l, VS=19210mg/l and the COD solubilization was recorded as 2%. Also, Qiao Wei *et al.*, (2009) worked with the raw waste activated sludge which had the initial characteristics as pH = 6.07, TSS = 2.8% and VS = 70%.

Chemical parameters such as alkalinity, Total hardness, Ca, Mg, Na, K, Mn, NH₃, NO₂, NO₃, F, PO₄ and allowable limit were presented in table 4.2. Chemical parameters of slurry such as alkalinity was measured by titration against H₂SO₄, Total hardness and Ca were measured by titration against EDTA, Na and K by flame photometer, Fe by ammonium thiocyanate method, Mn by ammonium persulphate method, NH₃ by zinc sulphate method, NO₂ and NO₃ by brucine sulphate method, Cl by titration against Silver nitrate, F by SPADNS method and Sulphate by Nephelometer method.

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S.NO	CHEMICAL PARAMETERS	VALUE	PERMISSIBLE LIMIT (WHO)
1.	Alkalinity(mg/l)	256	200-600
2.	Total hardness (mg/l)	280	200-600
3.	Calcium (mg/l)	60	75-200
4.	Magnesium (mg/l)	31	30-150
5.	Sodium(mg/l)	168	200
6.	Potassium(mg/l)	32	12
7.	Iron(mg/l)	0.35	0.1-1
8.	Magnanese(mg/l)	0.33	-
9.	Free ammonia (mg/l)	12.31	5-25
10.	Nitrite(mg/l)	0.11	7
11.	Nitrate(mg/l)	5	45
12.	Chloride(mg/l)	305	200-1000
13.	Fluoride(mg/l)	0.4	1-1.5
14.	Sulphate(mg/l)	14	200-400
15.	Phosphate(mg/l)	3.70	-
16.	BOD	52	-

Table 3.2 Initial Chemical parameters of slurry

The Table 3.2 shows that alkalinity value of sample is 256 mg/l and allowable limit is 200-600 mg/l. The total hardness value of sample is 280 mg/l and allowable limit is 200-600 mg/l. The amount of potassium present in the sample is 32 mg/l and allowable limit is 12 mg/l. K is higher the permissible limit, it is a substrate of methanogenic bacteria. The amount of iron present in the sample is 0.35 mg/l and allowable limit is 0.1-1 mg/l. The amount of free ammonia present in the sample is 12 mg/l and allowable limit is 5-25mg/l. The amount of nitrite present in the sample is 0.11 mg/l and allowable limit is 7 mg/l. The amount of nitrate present in the sample is 5 mg/l and allowable limit is 45 mg/l. The amount of chloride present in the sample is 305 mg/l and allowable limit is 200-1000 mg/l. The amount of fluoride present in the sample is 0.4 mg/l and allowable limit is 1-1.5 mg/l. The amount of sulphate present in the sample is 14 mg/l and allowable limit is 200-400 mg/l. The amount of manganese and phosphate present in the sample is 0.33, 3.70. NH₃, NO₂, NO₃, Cl, F, SO₄ are polluted test. The presence of toxic, refractory compounds are present during thermal pretreatment which is a major drawback of biogas production (Delgenes et al., 2002). The permissible limits show that, the sludge is not polluted.

At different temperature 100-220°C and time duration 0-30 min the reduction of TSS was recorded in the following table 3.2

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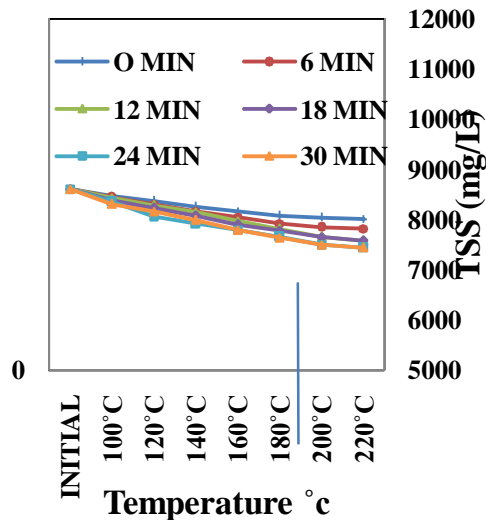


Fig 3.1 Optimum temperature range for the reduction of Total suspended solid

The Fig 3.1 shows that temperature and duration of time increases TSS reduced. At particular temperature (180°C) the TSS cannot reduce maintain at the constant level. All suspended solids present in the slurry decomposed at constant temperature. So optimum temperature range for the reduction of TSS is 180°C sometimes vary from 180°C-200°C. Reduction of total TSS depend upon the characteristic of slurry. The maximum value of TSS in the slurry is 8610 mg/l. The minimum value of TSS is 7440 mg/l at 220°C. The TSS of the sludge at 140°C is 8150 mg/l where the sample kept in the hot air oven at 12 min interval after that TSS measured. The initial temperature means samples were taken from the refrigerator.

Wang Wei *et al* (2005) found that in microwave heating process, slurry solid structure was destroyed and organic components dissolve into soluble parts. Hence the solid content of the slurry is decreased and leads to the reduction of sludge amount. A fraction of solid components present in the slurry decomposed at high temperature. The volume of TS and SS were reduced in the thermal pretreatment. At particular temperature slurry reduction maintain at the constant level. High temperature range would bring high TS and SS dissolving ratio. Compared with TS, SS was usually used to analysis the effect of slurry reduction.

At different temperature 100-220°C and time duration 0-30 min the reduction of SCOD was recorded in the following table 3.3. The maximum value of SCOD is 7650 mg/l. The minimum value of SCOD is 1370 mg/l at 220°C. The SCOD of the sludge at 140°C is 4060 mg/l where the sample kept in the hot air oven at 12 min interval after that TSS measured. The initial temperature means samples were taken from the refrigerator.

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Table 3.3 Increment of soluble chemical oxygen demand

S. No	Temperature:°C	Time					
		0 min	6 min	12 min	18 min	24 min	30 min
		SCOD	SCOD	SCOD	SCOD	SCOD	SCOD
1	INITIAL	1370	1370	1370	1370	1370	1370
2	100°C	1720	1920	1990	2040	2200	2830
3	120°C	2440	2870	3190	3410	3590	4060
4	140°C	3490	3900	4060	4290	4490	5210
5	160°C	4390	4710	4850	5160	5380	5940
6	180°C	5310	5640	5890	6190	6580	6940
7	200°C	5600	6060	6420	6690	7070	7430
8	220°C	5910	6330	6740	6960	7320	7650

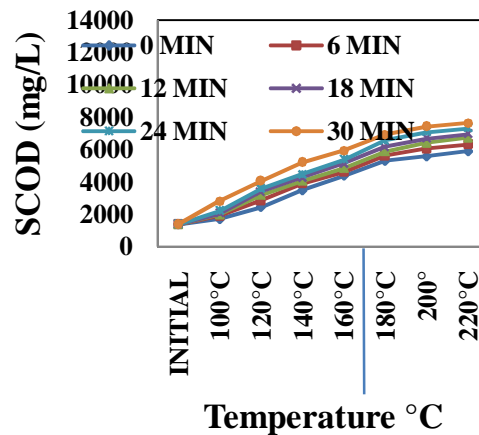


Fig 3.2 Optimum temperature range for the increment of SCOD

The Fig 3.2 shows that temperature and time duration increases SCOD increased. At particular temperature (180°C) the SCOD cannot increased maintain at the constant level. At 180°C all the complex material present in the slurry break down into simple material. The thermal pretreatment results indicated a potential of damaging floc structure and releasing 4.4, 4.5 fold higher soluble proteins, sugars. So the SCOD value increased. (Eskicioglu et al., 2007).

INITIAL AND FINAL PHYSICAL PARAMETERS OF SLURRY

The initial chemical parameters of slurry were analyzed by samples were taken from the effluent treatment plant. The final chemical parameters of slurry were analysed by optimum temperature range (180°C). TS, TSS, VS, TCOD, SCOD, pH, COD solubilization %, Turbidity, Electrical conductivity were presented in the table 3.4

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Table 3.4 Initial and Final Physical parameters of raw dairy slurry

Parameter	Initial Value	Final value
TS (mg/l)	17,241	14,327
TSS (mg/l)	8610	7640
VS (mg/l)	14,007	11,207
TCOD (mg/l)	35,000	–
SCOD (mg/l)	1,370	6940
pH	6.3	7.2
COD Solubilization (%)	3.92 %	19.8%
Turbidity (NTU)	16	14
Electrical conductivity µmS/cm	1499	1499

Table 3.4 shows that changes of initial, final physical parameters of slurry. The above result was compared by Woon –Ji park *et al.*, (2011) which showed that raw thickened secondary slurry had the following characteristics as pH= 7.2, TS= 14,327mg/l, TSS=7640 mg/l, VS=11,207 mg/l, SCOD=6940 mg/l and the COD solubilization was evaluated as 19.8%. The turbidity value is 14 NTU. The Electrical conductivity is 1499 micS/cm. The reduction of TS after the thermal pretreatment is 2,914 mg/l. The reduction of TSS after the thermal pretreatment is 970 mg/l. The reduction of VS after thermal pretreatment is 2800 mg/l.

INITIAL AND FINAL CHEMICAL PARAMETERS OF SLURRY

The initial, final Chemical parameters and Permissible limit were presented in table 4.6.

Table 3.5 Initial and Final Chemical parameters of slurry

S.no	Chemical parameters	Initial value	Permissible limit	Final value
1.	Alkalinity (mg/l)	256	200-600	256
2.	Total hardness (mg/l)	280	200-600	201
3.	Calcium (mg/l)	60	75-200	60
4.	Magnesium (mg/l)	31	30-150	31
5.	Sodium (mg/l)	168	200	168
6.	Potassium (mg/l)	32	12	32
7.	Iron (mg/l)	0.35	0.1-1	0.35
8.	Magnesium (mg/l)	0.33	–	0.33
9.	Free ammonia (mg/l)	12.31	5-25	12.31
10.	Nitrite (mg/l)	0.11	7	0.11
11.	Nitrate (mg/l)	5	45	5
12.	Chloride (mg/l)	305	200-1000	305
13.	Fluoride (mg/l)	0.4	1-1.5	0.4
14.	Sulphate (mg/l)	14	200-400	14
15.	Phosphate (mg/l)	3.70	–	3.70
16.	BOD	52	–	48

The initial chemical parameters of slurry were analyzed by samples were taken from the effluent treatment plant. The final chemical parameters of slurry were analyzed by optimum temperature range. The final value of total hardness

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value only changed due to the thermal pretreatment process. The temporary hardness can be removed by pretreatment. A biodegradability assay was used to evaluate biogas recovery from slurry after thermal pretreatment. The biogas production was monitored two days interval.

IV. CONCLUSION

There are currently considerable in developing efficient and environmental friendly ways to convert waste slurry to biogas. It releases 22-28 MJm⁻³ energy during burning. The energy contents of 28m³ of biogas are equal to 20.8 liters of petrol or 18.4 liters of diesel. So in this biogas production physical, chemical parameters of slurry were analyzed. To enhance the biogas production means Thermal pretreatment is needed. The thermal pretreatment was promising to enhance the anaerobic degradability of the slurry. The efficiency of slurry pretreatment was measured in terms of optimum temperature range for the reduction TSS, SCOD. The optimum temperature range for reduction of TSS, SCOD is 180°C. The biogas production was higher in the optimum temperature range. The thermal pretreatment methods increase the degradation of slurry than the untreated slurry. The physical parameters such as TS, TSS, and VS can be reduced. SCOD, COD solubilization % value can be increased. No change in chemical parameter of slurry except total hardness. The maximum biogas production in the untreated slurry is 79 ml/day. The maximum biogas production in thermal pretreated slurry is 123 ml/day at 180°C. It concluded that use of thermal pretreatment was promising to enhance the anaerobic degradability of slurry, and also decrease HRT of the anaerobic digestion.

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International Journal of Innovative Research in Science, Engineering and Technology

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