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Chemical Pretreatment on Flower Waste to Enhance the Production of Biogas through Anaerobic Digestion

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Abstract: *Flowers are extensively used in many occasions in our country irrespective of auspicious or inauspicious functions. It is also adding to another biodegradable waste. But the improper disposal is causing pollution to environment. The same if used effectively will be converted into bioenergy that can find many applications further. Survey was conducted in Kengeri area for the number of temples, party halls, and market areas for producing flower waste. The amount of flower waste collected is estimated. The specific species of flower was taken for experimental study, knowing the species of flower waste it was tested for various parameters such as pH, temperature, moisture content, alkalinity, chloride, carbon and nitrogen ratio, BOD and COD. After obtaining the results for above parameters, sample was taken for pretreatment of physical, chemical Pretreatment and further subjecting to anaerobic decomposition. The investigation was undertaken to find out the biogas production potential of flower waste coming out from temples by building. Laboratory scale digesters of22L capacity and fed with flower waste with physical pretreatment. The waste was digested for retention period of 35 day under batch fed system at total solid concentration of 8 %(w/v) and constant temperature of 32±2°C. The optimum quantity of flower waste inoculums and water was used. The chemical pretreatment with NaOH (0.3N) as alkaline and HCL (0.2) as acid were given and after grinding it was added in the digestion process to enhance biogas production. The pressure of biogas is measured and the concentration of methane gas is determined by the gas chromatographer.*

Keywords: Anaerobic decomposition, BOD, COD.

I. Introduction

There are varieties of flowers available on Indian soil. We are using all varieties of flowers in both auspicious and inauspicious functions. Hence the generation of flower waste are more from all sources. Certain temples in R.R.nagar was identified and the flower waste originated from these sources were calculated and The generated waste is piled up and finally disposed of in to water or dumped on land which takes time in decomposition ultimately causing environmental pollution .

In order to ensure proper disposal techniques and safe methodology of converting it to biogas will help in generating alternate source of energy. With the rising demand for renewable energy and environmental protection, anaerobic digestion of biogas technology which has number of application to society. Bioenergy can play a central role in promoting renewable alternatives. In fact, bioenergy is estimated to be the fourth largest energy resource in the world due to its renewable and widely applicable characteristics and its abundance.

In order to enhance digestion of feedstock pretreatment methods such as physical, chemical treatments were given to rise the production of biogas. The pretreated waste is expected to increase improve delignification levels.

II. Materials and Methodology

1. Digester
2. Sensors

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3. Pressure valve
4. Pressure gauge
5. Flower: Chrysanthemum
6. Cow dung

The above mentioned materials are used in the anaerobic digestion of flower waste.

2.1 Anaerobic Digester

The Capacity of the digester is 26.7 lts .To support the anaerobic digestion the digester is painted in black colour. To monitor the process through the small strip it was left unpainted. To know the volume change a measuring scale was pasted on the digester. Also the process changes are visible; and it is consisting of a valve to measure the pressure, also monitor pH and temperature through the sensor.

2.2 Pressure Gauge

It is used to determine the pressure developed in the digester. It has least count of 0.01kg/cm2.The pressure meter has a sensor that can sense the gases and able to measure the pressure of the biogas developed inside the digester.

2.3 Sensor

- **Bmp180**: Barometric pressure and temperature sensor works on 12c interface (wire connection). Barometric pressure sensors measure the absolute pressure of the air around them. Pressure varies with both the weather and altitude. Wide barometric pressure range of 300 to 1100 hPa (1hpa=100pa); Input voltage: 1.8V to 3.6V.
- **PH Sensor:** PH stands for power of hydrogen, which measures the hydrogen ion concentration. PH sensor consist arduino controller with 12c interface.
- **Node MCU**: NodeMCU is an open source IOT (Internet of things) platform, it generates data from the sensor and transmits through wifi connection, it has USB plug for the power.

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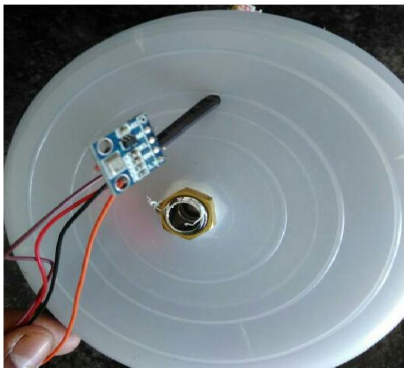
Bmp180


NodeMCU


pH sensor

III. MATERIALS CALCULATIONS

In the beginning optimization of the process parameters were determined for the specified variety of flower waste that is Crysanthamum. The cow dung to water to flower ratio was considered,
For the proportion 1:1: 0.8 i,e. Cowdung to water to flower waste
Volume of the digester = 26.7lt
Flower waste =9%
Volume of the digester =60%
Detention period = 8 days
26.7ltr of 60%=16ltr volume for decomposition.
16ltr of 9% = 1.44ltr volume of flower (grinded condition)
Total volume of flower = 1.44*8=11.52ltr
Volume of C.D+water (16000-11520)=4480 ml
For 8 days = 2240(C.D)+2240(water)+11520(F.W)

3.1 Anaerobic Digestion

Anaerobic digestion is "a process of controlled decomposition of biodegradable materials under managed conditions where free oxygen is absent, at temperatures suitable for naturally occurring mesophilic or thermophilic anaerobic and facultative bacteria and archaea species, that convert the inputs to biogas and whole digestate". It is widely used to treat separately collected biodegradable organic wastes and wastewater sludge, because it reduces volume and mass of the input material with biogas (mostly a mixture of methane and CO2 with trace gases such as H2S, NH3 and H2 as by-product.

3.2 Physical Petreatment

physical pretreatment is generally carried out by mills and either makes the pieces of substrate smaller or squeezes them to break open the cellular structure, increasing the specific surface area of the biomass. This gives greater possibility for enzymatic attack, which is particularly important for lignocellulosic substrates. In physical pretratment we have grinded the flower waste to reduce the size, in order to increase more surface area and also to fasten decomposition process.

3.3 Chemical Pretreatment

The fastest methods to study the effect of pretreatment are analytical chemistry methods including high-performance liquid chromatography (HPLC), structural carbohydrate determination, and soluble chemical oxygen demand (COD). These methods determine how much the lignocellulose has broken down on a chemical level. These values can then be used to calculate theoretical methane yields. However, greater lignocellulose breakdown does not necessarily translate into greater biogas production because substances that inhibit methane production can also be produced during pretreatment. It can be done by

- Acid pretreatment
- Alkali pretreatment

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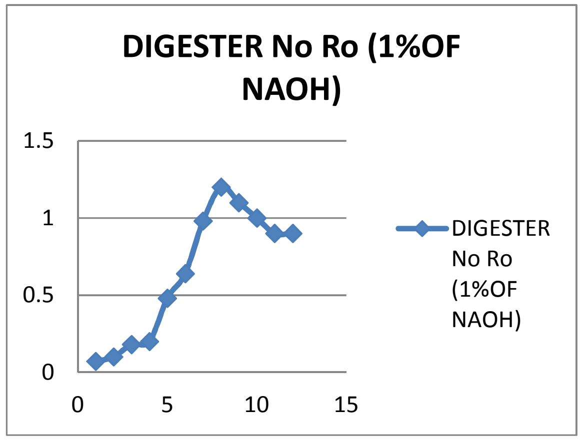
3.4 Acidic Pretreatment

This method was carried out by using 0.2N H_2SO_4 by varying the percentage as 1%,2%,3% for grinded flower waste of 8.64kg. acid was thoroughly mixed with the flower waste . After inclusion of acid flower waste was allowed for half an hour to break down lignocelloluse and thouroughly washed before introducing into the digester.

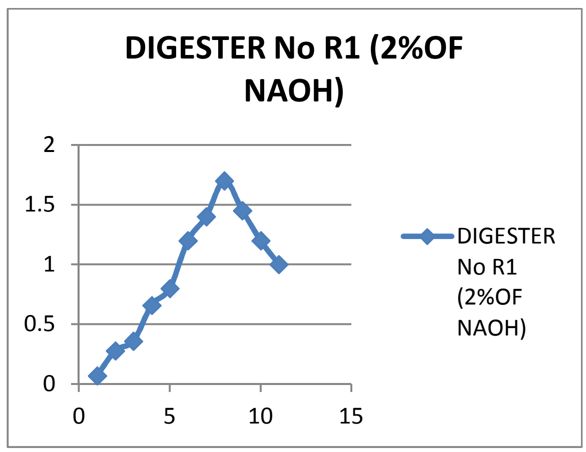
3.5 Alkalie Pretreatment

This method was carried out by using 0.3N NAOH by varying the percentage as 1%,2%,4% for grinded flower waste of 8.64kg. NAOH was thoroughly mixed with the flower waste . After inclusion of NAOH flower waste was allowed for half an hour to break down lignocelloluse and thouroughly washed before introducing into the digester.

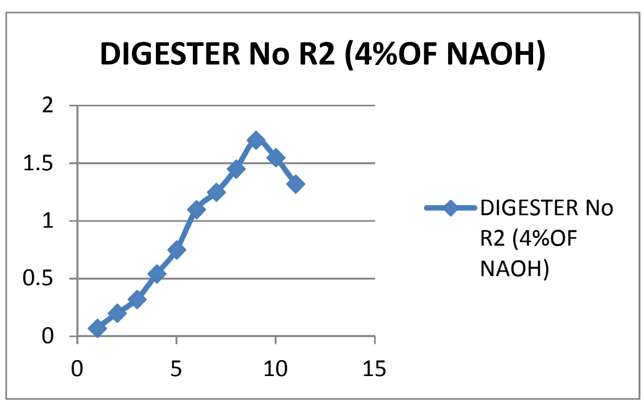
DAYS	TEMP(˚C)	pH	PRESSURE(kg/cm²)
1	28	6.4	0.07
2	27	6	0.1
3	27	5.8	0.18
4	27	5	0.2
5	27	5.2	0.48
6	27	4.9	0.64
7	28	4.9	0.98
8	27	5.2	1.2
9	28	4.9	1.1
10	28	5	1
11	28	4.8	0.9
12	28	4.8	0.9



R	TEMP(˚C)	pH	PRESSURE(kg/cm²)
1	28	6.4	0.07
2	27	6	0.28
3	27	5.8	0.36
4	27	5	0.66
5	27	5.2	0.8
6	27	4.9	1.2
7	28	4.9	1.4
8	27	5.2	1.7
9	28	4.9	1.45
10	28	5	1.2
11	28	4.8	1

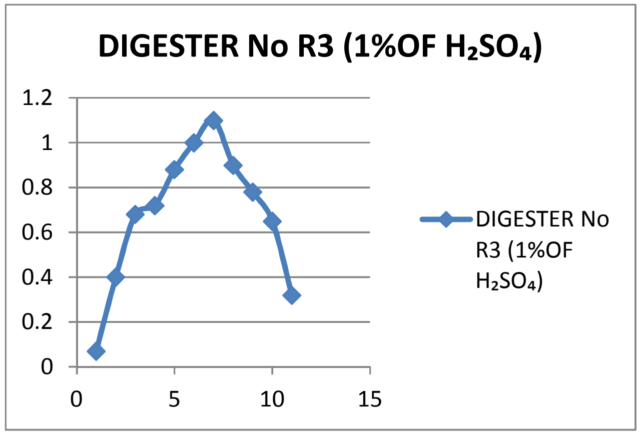


DAYS	TEMP(˚C)	pH	PRESSURE(kg/cm²)
1	28	6.4	0.07
2	27	6	0.2
3	27	5.8	0.32
4	27	5	0.54
5	27	5.2	0.75
6	27	4.9	1.1
7	28	4.9	1.25
8	27	5.2	1.45
9	28	4.9	1.50

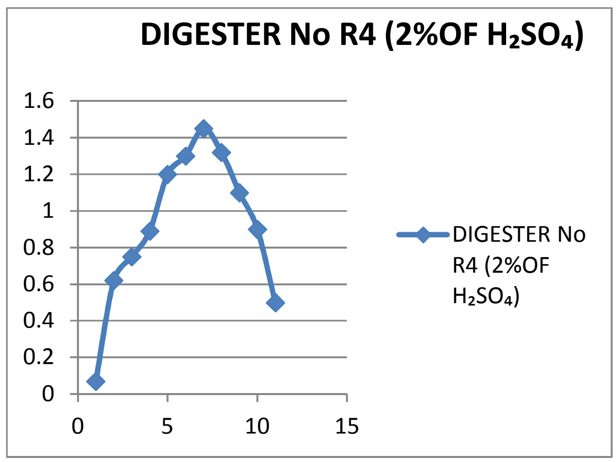


10	28	5	1.35
11	28	4.8	1.22

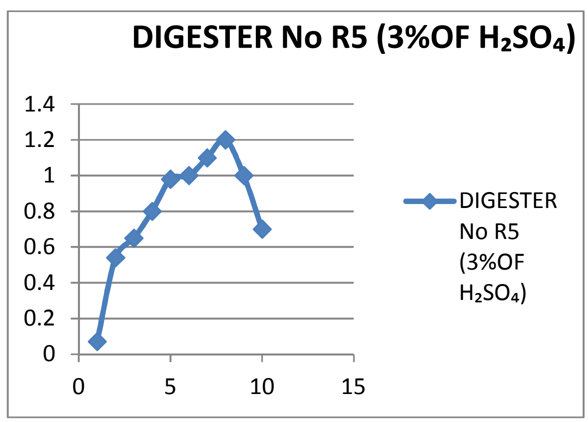
DAYS	TEMP(˚C)	pH	PRESSURE(kg/cm²)
1	28	6.4	0.07
2	27	6	0.4
3	27	5.8	0.68
4	27	5	0.72
5	27	5.2	0.88
6	27	4.9	1
7	28	4.9	1.1
8	27	5.2	0.9
9	28	4.9	0.78
10	28	5	0.65
11	28	4.8	0.32



DAYS	TEMP(˚C)	pH	PRESSURE(kg/cm²)
1	28	6.4	0.07
2	27	6	0.62
3	27	5.8	0.75
4	27	5	0.89
5	27	5.2	1.2
6	27	4.9	1.3
7	28	4.9	1.45
8	27	5.2	1.32
9	28	4.9	1.1
10	28	5	0.9
11	28	4.8	0.5



DAYS	TEMP(˚C)	pH	PRESSURE(kg/cm²)
1	28	6.4	0.07
2	27	6	0.54
3	27	5.8	0.65
4	27	5	0.8
5	27	5.2	0.98
6	27	4.9	1
7	28	4.9	1.1
8	27	5.2	1.2
9	28	4.9	1
10	28	5	0.7
11	28	4.8	0.6



IV. Conclusion

The physical pretreatment of flower waste was given by grinding and introducing in to the digester helped in enhancing the reation rate.The optimization of the process parameters resulted in Temperature of 28^{0}C , pH of 5.4, cowdung : water :

ground flowerwaste as 1:1:0.8, Retention period for the flower waste 8days to yield high presurre of biogas.The chemical treatment given to the grinded flower waste with the use of alkali having a normality of 0.1N and concentration NaoH being 2% volume of flower waste introduced yielding pressure of 1.7 kg/Sq.cm. The gas chromatographer analysis for the compositon of methane in biogas was found to be 67% of the total biogas produced.

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