COMPARISON OF VARIOUS INOCULA FOR OPTIMIZING THE EFFICIENCY OF SOLID STATE ANAEROBIC DIGESTION OF ORGANIC FRACTION MUNICIPAL SOLID WASTE IN MESOPHILIC CONDITION

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Abstract:

Anaerobic digestion of municipal solid waste was carried out in this study for 45 days at room temperature in batch reactors with various inocula at different inoculum ratios. Inocula used were cow dung, domestic sewage and sheep manure. The digestion was carried out in laboratory scale. The characteristics of the MSW, cow dung, domestic sewage and sheep manure were analyzed. The performance of reactor was evaluated by measuring the daily biogas production.At the end of the study, the biogas yield from the reactors the maximum bio gas production in this inoculums in CD30, DS30 and SM30 was 6890 ml, 6000 ml and 5009 ml respectively. The percentage of methane in the biogas produced with cow dung as inoculum was found to be 68%, percentage of methane in the biogas produced with domestic sewage as inoculum was found to be 62% and percentage of methane in the biogas produced with sheep manure as inoculum was found to be 58%.

Key words— Anaerobic digestion, batch reactor, biogas, municipal solid waste.

I.INTRODUCTION

Solid Wastes are within the useless and unwanted materials in the solid state that are created by people, households or organizations. They are assorted varieties of like food wastes, garden wastes, papers, textiles, rubber, plastics, glass, ceramics, metals, wood wastes, construction wastes, etc. Municipal Solid Waste (MSW) contains organic furthermore inorganic matter. The latent energy gift in its organic fraction may be recovered for paid utilization through adoption of appropriate Waste Process and Treatment technologies. Disposal of municipal solid waste generates Biogas, which include methane (CH4), Biogenic carbon dioxide (CO2) and non-methane volatile organic compounds. Some lesser generated gases are nitrous oxide (N2O), nitrogen oxides (NOX) and carbon monoxide (CO). Conversion of biomass into gas is fashionable in recent times. Recovery of energy from solid waste conjointly has some notable edges that embody waste reduction by 60%, reduction of demand for land, for open dumping or for land filling, reduction in value of transportation, improved efficiency in solid waste management. Therefore, each effort ought to be created to reduce the waste generation to recycle and reuse the item. Many analyses are being allotted for treating varied style of organic solid wastes victimization anaerobic digestion method. It has become a major focus of interest in waste management throughout the planet. The objective of this study is to characterize the municipal solid waste and the inocula and, to evaluating various inocula for efficient anaerobic digestion of municipal solid waste under room temperature by conducting experiment in the laboratory.

II. MATERIALS AND METHODS

A. Inocula

Fresh cow dung, domestic sewage and sheep manure were used as inocula in this study. They contained all the required microbes essential for the anaerobic digestion process. The inocula were characterize for wet content, total solids, volatile solids, total carbon, total atomic number 7, COD, etc. using methods recommended in bureau of Indian standards.

B. Preparation of feed stock

The municipal solid waste was collected from the waste disposal website at Chidambaram. Shredded MSW was characterized for moisture content, total solids, volatile solids, total carbon, and total nitrogen; COD, etc. using methods recommended in Bureau of Indian standards. The substrate was mixed with the inocula. The mixture was utilized in the batch reactor for anaerobic digestion method..

III. EXPERIMENTAL PROCEDURE

Batch reactors with total capacity of 5 L were used in this experiment. The reactors were made of acrylic fibre. This study was programmed to gauge the anaerobic digestion of MSW exploitation total different inocula at numerous inoculants percentages. The inocula used were cow dung, domestic sewage and sheep manure. Nine reactors of 5 L capacity were used; the reactors were named as CD10, CD20 CD30, DS10, DS20, DS30, SM10, SM20 and SM30.The reactorsCD10, CD20 and CD30 were filled with cow dung as inoculums at the percentage of 10, 20, and 30.The reactors DS10, DS20 and DS30 were filled with domestic sewage as inoculums at the percentage of 10, 20, and 30 respectively. The reactorSM10, SM20 and SM30 were filled with sheep manure as inoculums at the percentage of 10, 20, and 30 respectively. Water displacement method was adopted to observe the biogas production. Each reactor was given with the gas assortment system one by one. The percentage of methane concentration and the chromatography peak area has a good linear relationsship. This method was applied for methane content during municipal solid waste in anaerobic digestion in GC analyzer.

IV. RESULTS AND DISCUSSION

The characteristics of the substrate and the characteristics of the inocula are shown in Table 1, Table 2, Table 3 and Table 4. The graph gives a vivid picture that biogas production in R1 which was low in the beginning, was gradually increasing. In the reactors CD10, CD20 and CD30 production of biogas was higher than the reactors DS10, DS20, DS30 SM10, SM20 and SM30. Production of biogas reached the maximum level when cow dung was used as inoculum, whereas in the case of domestic sewage and sheep manure it was considerably low. And also, biogas production was higher in the reactors with higher percentage of inoculum. Therefore, in CD30 the biogas produced was comparatively higher than the biogas produced in other reactors. As the result of decomposition, volume reduction of the feedstock occurred. Mesophilic bacteria were formed and they caused the biogas production. pH increased during the digestion at 7 days. NAOH was added to neutralize the pH value so as to regulate the digestion.

Table 1.Characteristics of the Municipal Solid Waste (MSW)

S.NO	PARAMETERS	VALUES
1	Moisture (%)	76.5
2	pH	5.3
3	Total solids (mg/l)	19.2
4	Total volatile solids (mg/l)	92.3
5	Ash content (%)	10.22
6	Total organic carbon (%)	21.32
7	Total nitrogen (%)	1.1
8	Chemical oxygen demand (mg/l)	3876

Table 2.Characteristics of the Cow dung

S.NO	PARAMETERS	VALUES
1	Moisture (%)	91.5
2	pH	6.7
3	Total solids (mg/l)	8.6
4	Total volatile solids (mg/l)	90.02
5	Ash content (%)	11.23
6	Total organic carbon (%)	13.22
7	Total nitrogen (%)	0.80
8	Chemical oxygen demand (mg/l)	2320

Table 3.Characteristics of the Domestic sewage

S.NO	PARAMETERS	VALUES
1	Moisture (%)	74.8
2	pH	7.32
3	Total solids (mg/l)	6.5
4	Total volatile solids (mg/l)	76.30
5	Ash content (%)	9.51
6	Total organic carbon (%)	11.32
7	Total nitrogen (%)	0.77
8	Chemical oxygen demand (mg/l)	988

Table 4.Characteristics of the sheep manure

S.NO	PARAMETERS	VALUES
1	Moisture (%)	39.87
2	pH	7.7
3	Total solids (mg/l)	500
4	Total volatile solids (mg/l)	63.10
5	Ash content (%)	17.20
6	Total organic carbon (%)	219.40
7	Total nitrogen (%)	1.325
8	Chemical oxygen demand (mg/l)	945

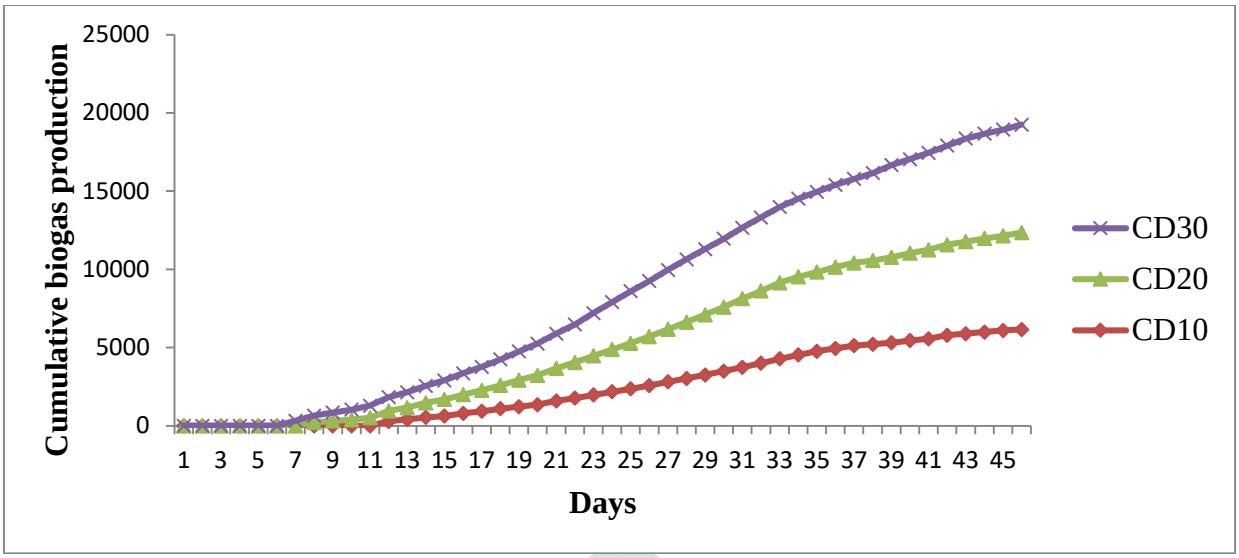

Figure.1 Cumulative Gas Production with Cowdung as Inoculum

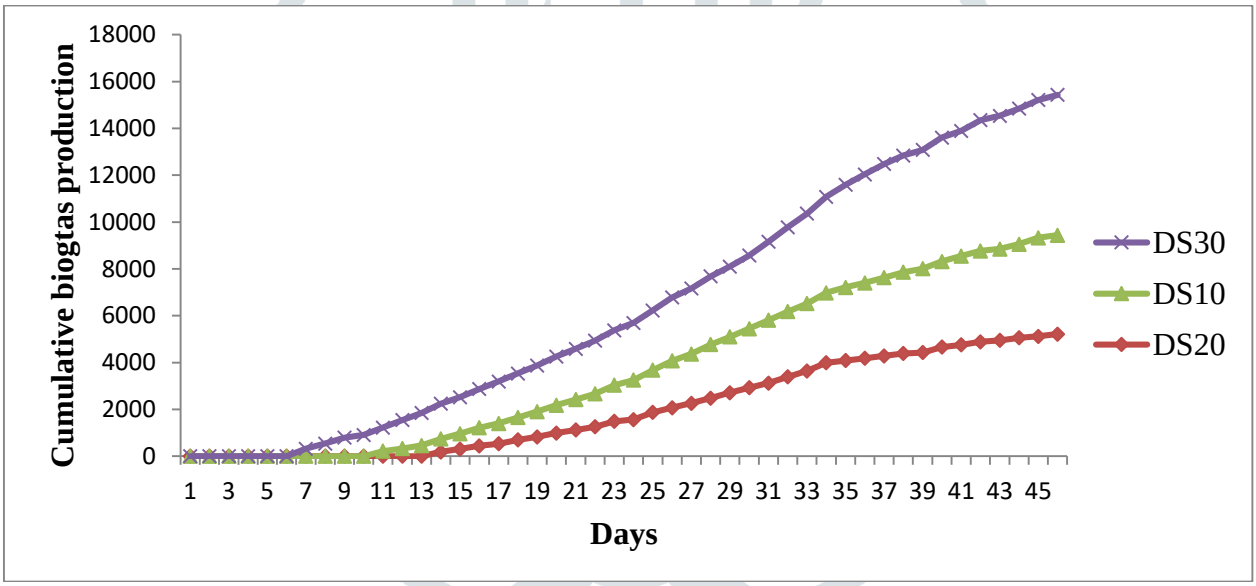

Figure.2 Cumulative Gas Production with Domestic Sewage as Inoculum

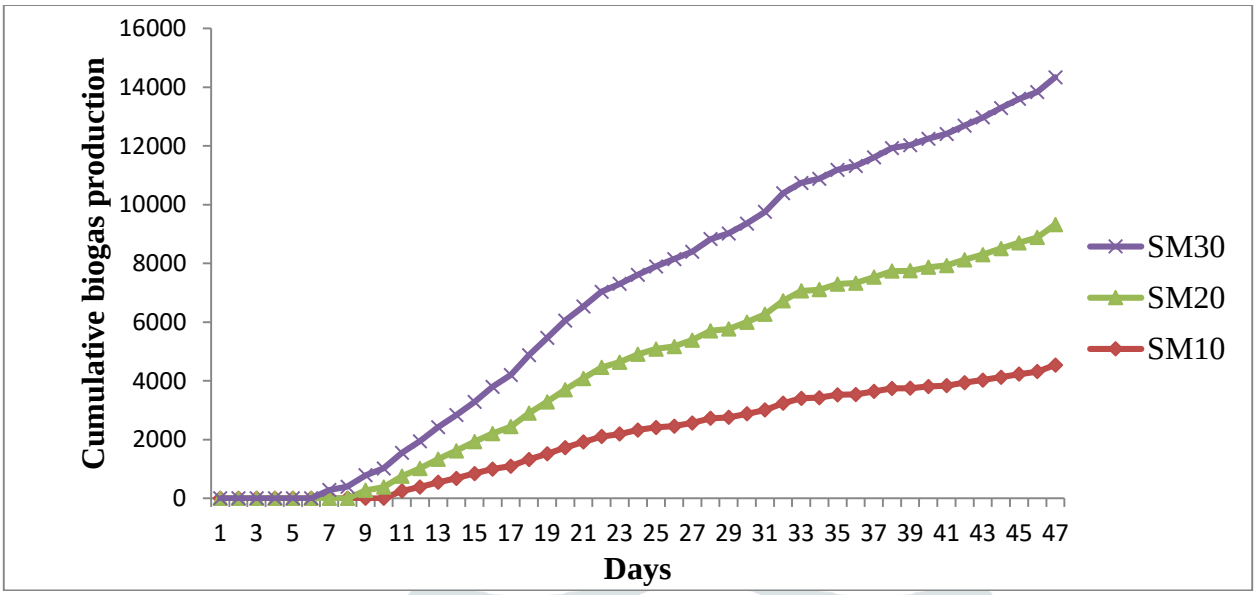

Figure.3 Cumulative Gas Production with Sheep Manure as Inoculum

V. CONCLUSION

From the results obtained, it can be concluded that maximum biogas production was observed in the reactors which contained cow dung as the inoculum than the reactors which contained domestic sewage and sheep manure as the inoculum comparatively, and the reactors with higher concentration of inoculum resulted in production of maximum biogas. At the end of 45 days of digestion, the biogas yield from the reactors in CD30, DS30 and SM30 was 452 ml, 297 ml and 287 ml respectively. The amount of methane in the biogas was found to be 68% in the reactors using cow dung as the inoculum, 62% in the reactors using domestic sewage as the inoculum. And 58% in the reactors using sheep manure as the inoculum.

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