Effect of Cow Dung Inoculum on Biogas Generation from Anaerobic Digestion of Organic Fraction of Municipal Solid Waste – A Case Study of India

ATUL KUMAR

INDIAN INSTITUTE OF TECHNOLOGY (INDIAN SCHOOL OF MINES) DHANBAD, INDIA

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What are we going to learn today?

- Motivation for this study
- Objectives
- Materials and methods
- Key results
- Conclusions

Motivation for this study

- One-third of total world food production gets wasted every year.
- Most of the organic wastes meets with the traditional disposal techniques.
- Scarcity of suitable land for landfilling.
- Stringent regulations.
- Potent renewable energy source.
- Reduce the environmental impacts.

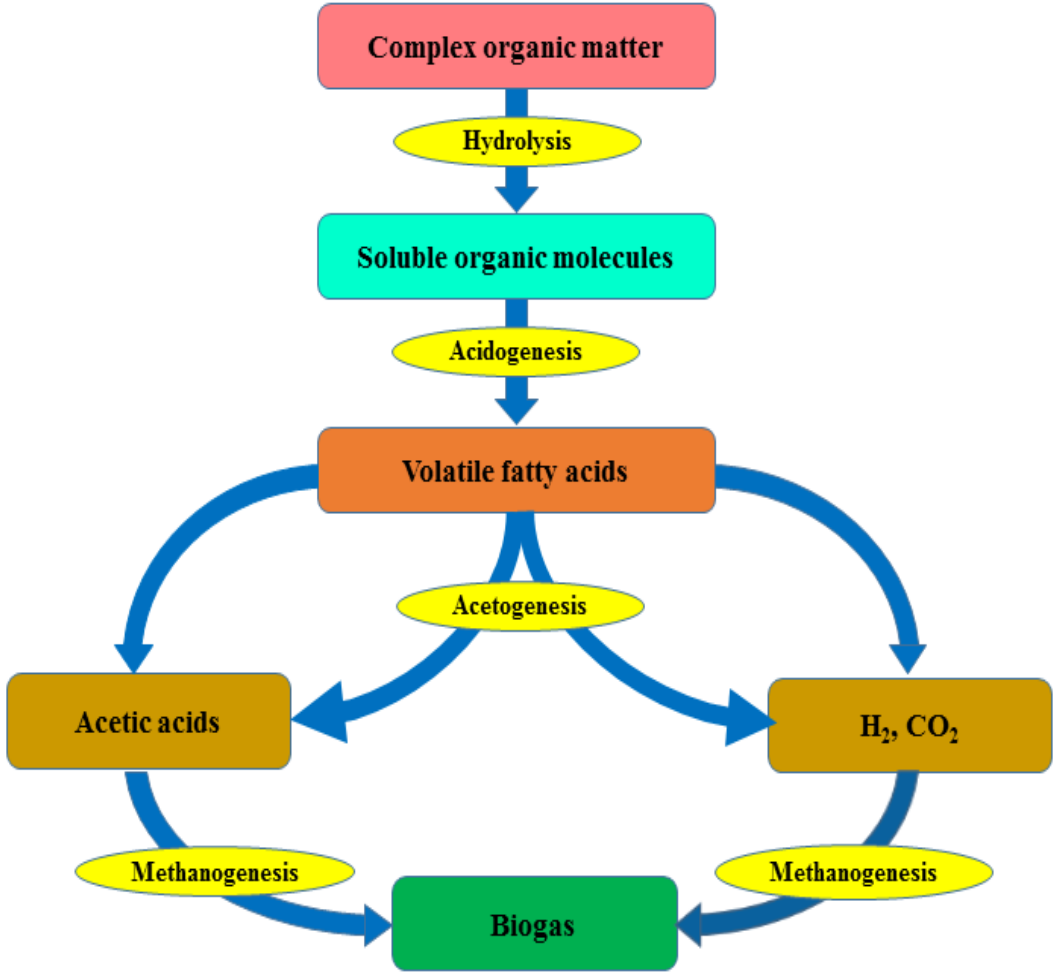

Fig. 1: Anaerobic digestion process

Objectives

- To identify the optimum combination of OFMSW and CM for efficient anaerobic digestion.

Materials and methods

- ***Feedstock materials***
  - Leftover food waste and other degradable wet organic waste.
  - The co-digestion substrate was cow dung (CM) collected from a farm.
- ***Reactor Set-up***
  - Aspirator glass bottles of capacity 1000 mL with bottom sampling port were used.
  - The experiments were performed in batch.

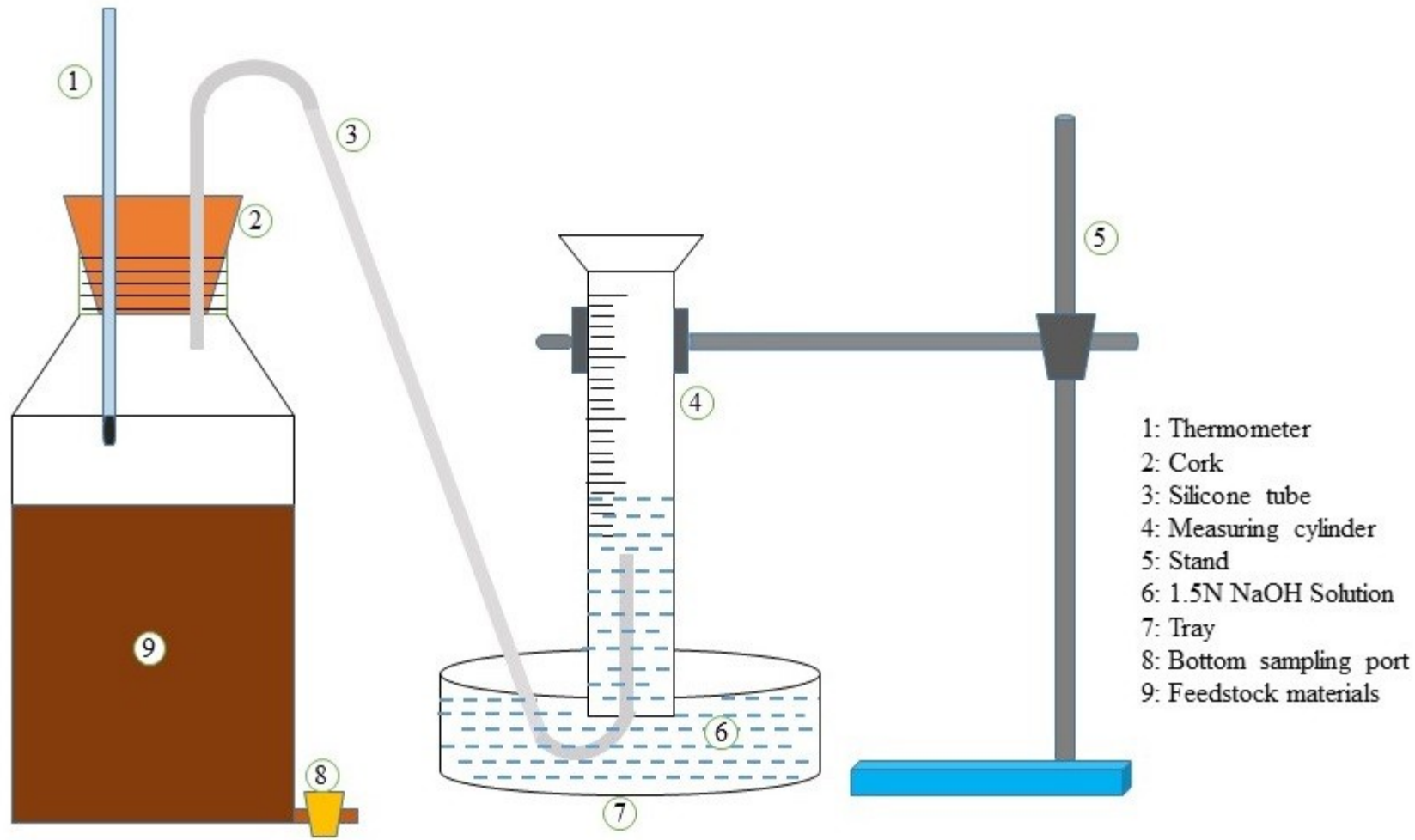

Fig. 2: Experimental set-up of the anaerobic batch reactor

Reactor Set-up (Continue..)

- The reactors were filled with four different substrate to inoculum ratio (0.5, 0.63, 0.75 and 1.0) based on VS contents.
- The inoculum and substrate were thoroughly mixed in the blender before being added to the reactor.
- All the reactors were operated at mesophilic temperature (35 ± 1 °C).
- Water displacement method was used for biogas production measurement at a fixed time every day.
- The other end of silicone tube was inserted in an inverted 50 ml graduated measuring cylinder filled with water, whereas in duplicate it was 1.5 N NaOH solution.
- The reactors were terminated at the end of 30th day.

Analytical methods

- The Characteristics of the collected samples were analysed in the laboratory.

Parameter	OFMSW	CM
Moisture content (%)	81.2	84.4
pH	5.3	7.4
Total Solid (TS) (%)	18.8	15.6
Volatile Solid (VS) (% d.b.)	90	79.3
COD (mg/L)	79800	19600
Carbon, C (% d.b.)	45.12	37.34
Nitrogen, N (% d.b.)	1.58	3.03
C/N ratio	28.56	12.32

ations of feedstock in batch reactors

	Mixing ratio of OFMSW and CM (on VS basis)	OFMSW (g VS/L)	CM (g VS/L)	Organic loading (g VS/L)
R1	-	0	10	10
R2	0.50	5	10	15
R3	0.63	6.3	10	16.3
R4	0.75	7.5	10	17.5
R5	1.00	10	10	20

Key results

Variation of pH in the reactors

- During hydrolysis, the substrates get converted into amino acids and fatty acids which lead to accumulation of volatile fatty acids (VFA) resulting in a decrease in pH of the reactor.
- Till 12-15 days the pH in all the reactors gradually decreases.
- Due to CM as a co-substrate, the pH of the reactors again increases which creates favourable environment for the methanogenic bacteria.

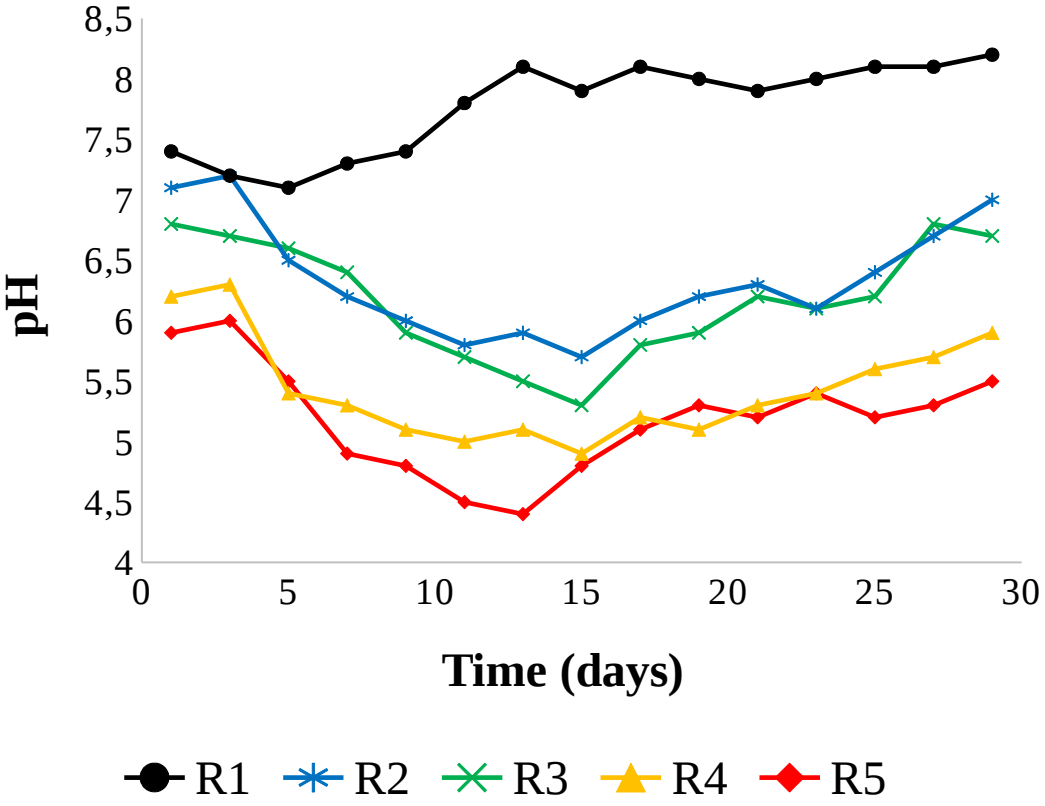

Fig. 3: Variation of pH of the reactors

Biogas generation

- The maximum biogas production was found in reactor R2.
- The percentage of methane in the generated biogas was 62%.

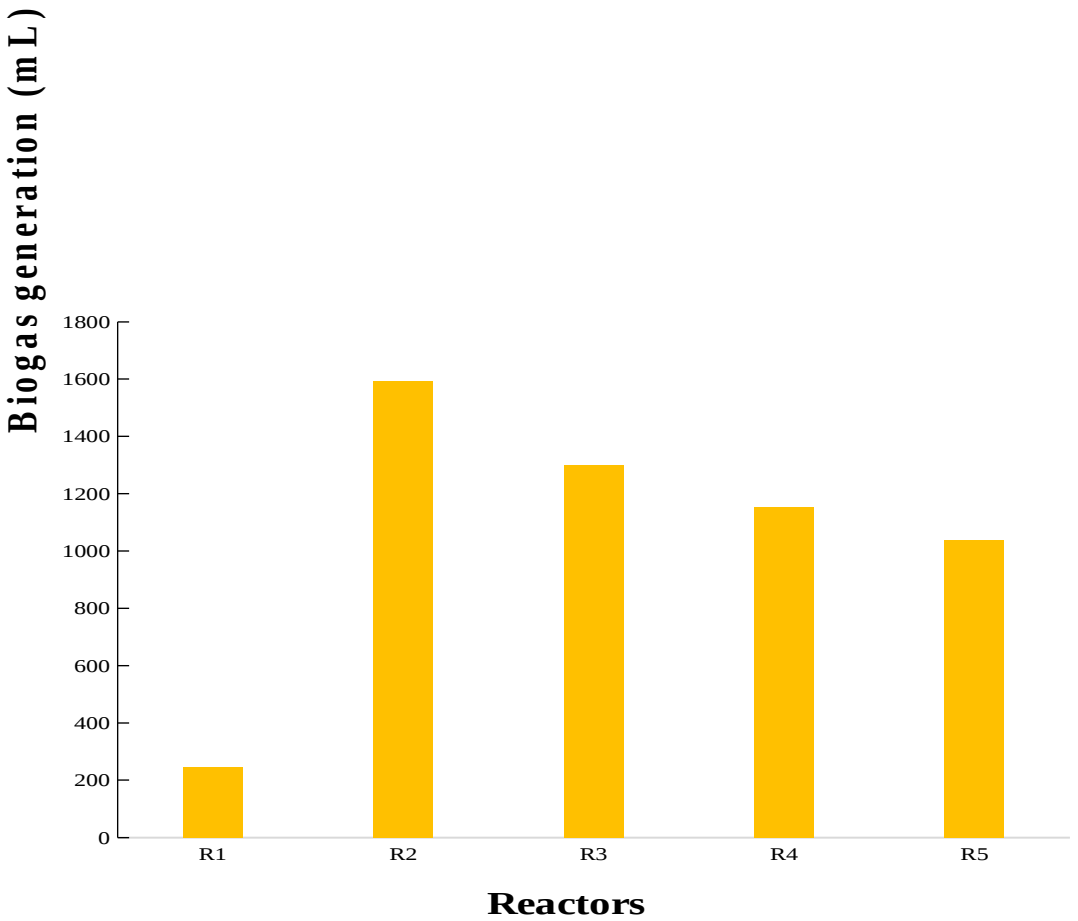

Fig. 4: Biogas generated in the reactors

- The biogas production of 1594 mL at S/I ratio of 0.5, followed by 1301 mL at 0.63, 1152 mL at 0.75 and 1037 mL at 1.0.

- The biogas generation was very less from mono-digestion of CM (R1).

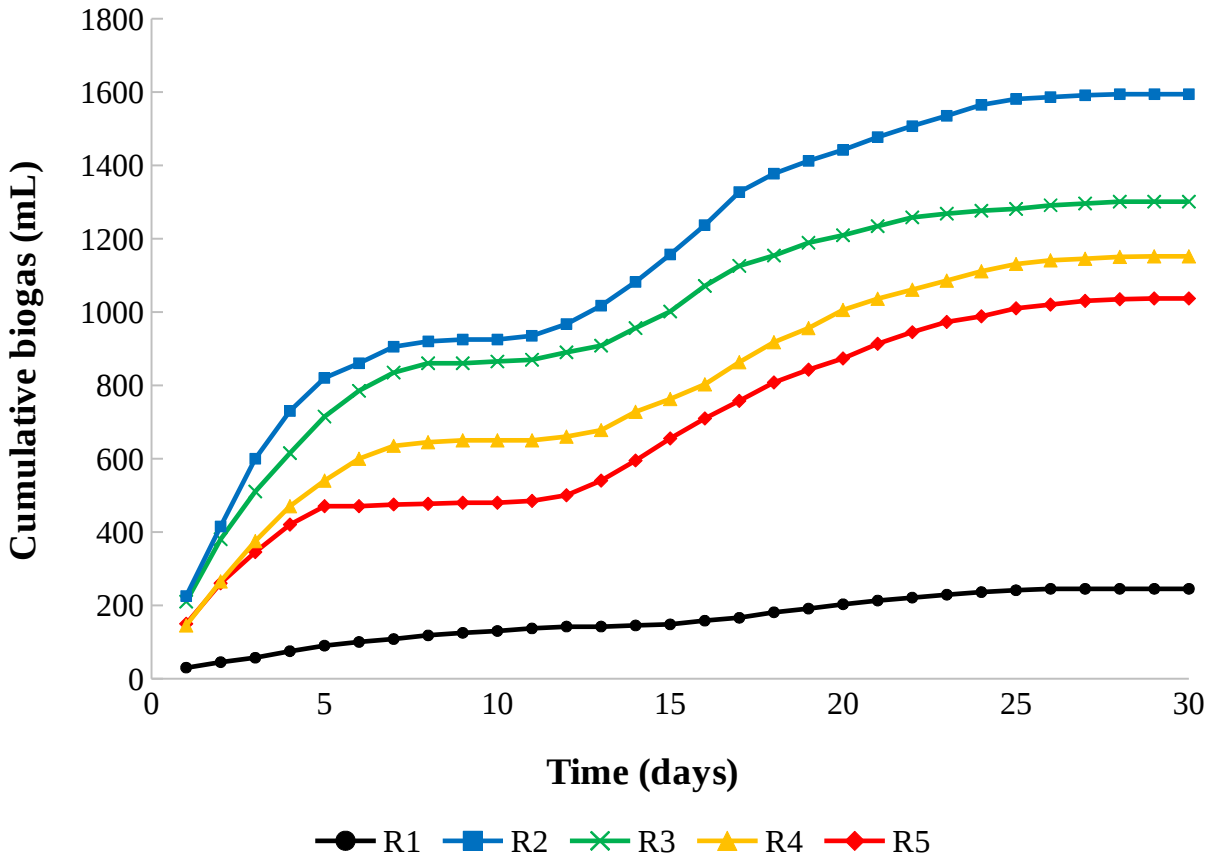

Fig. 5: Cumulative biogas generation

Conclusions

- The biogas yield in the different reactors are not very encouraging.
- The maximum biogas yield of 106.27 mL/g VS was observed in reactor R2.
- The order of biogas yield in all the reactors are R2>R3>R4>R5>R1.
- The reason for lesser biogas production in all the reactors was due to the drop in pH of the reactors at initial stage of the reaction.

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Thank You

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Questions?