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**Rate of biogas production in three different types of
biodegradable solid wastes**

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Grade: 9

Abstract:

Scientists are working hard to find a substitute for fossil fuel and to switch over to the conventional method, using biomass for the production of biogas. A modified engine can be utilized to power up any mechanical device. Therefore, as a team, we have chosen to investigate the production of biogas from different kinds of biodegradable solid wastes that can be used to power up vehicles. Both the vehicles and the engine should be designed to carry the bio-digester and payloads. The gas produced by the process of decomposition can be also used to power a fuel cell which in turn can be utilized for the commercial production of electric power. As the gas yields only carbon dioxide and water after combustion, carbon particle emission or smoke formation will not happen. Hence it does not cause lung disorders and skin allergies. The sludge thus produced is safe for the soil microflora and increases the water-holding capacity of the soil.

Introduction:

The current population of India is 1,455,414,757 (November 2024) based on Worldometer's elaboration of the latest United Nations data¹. To meet the growing demands of this population, transport plays a vital role in the distribution of all goods across the globe. The transport industries are also increasing their production that includes passenger & commercial vehicles, two and three-wheelers and quadricycles are about 2,84,34,742 between the years 2023 and 2024 in India as stated by the Society of Indian Automobile Manufacturers². Even though so many sophistications and improvements have been upgraded in many of the modern vehicles, yet they are running only on fossil fuels. As the exhausts not only cause health issues to humans, animals and plants it also troubles the entire environment. We want to break through this to cut carbon emissions to prevent increased global warming. Hence we are working with the production of biogas using different kinds of solid waste that can be used to power up the vehicles.

Justification of the research question:

As the transport system plays a vital role in society for transporting people and goods, their production and sales increase every year. Their exhausts not only produce harmful gases such as oxides of carbon, sulphur and nitrogen, hydrocarbons, ozone, aldehydes, lead and other metals but also particulate matter and soot (L. R. Sassykova)³. So we wanted to find a solution for this challenge. Burning of biogas of course produces carbon dioxide, but other harmful substances are not produced. Hence we decided to work to find out the type of solid waste that would suit our idea.

Hypothesis:

Utilization of biogas in the transport system will minimize the release of toxic gases, especially particulate matter and carcinogenic compounds.

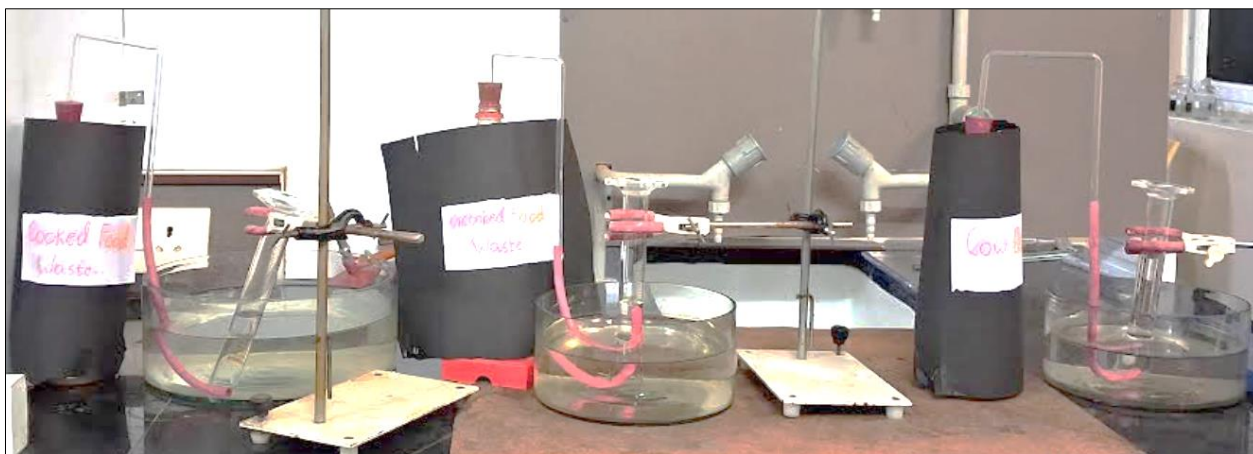
Keywords: Biogas, vehicle exhaust, global warming, vehicle design, modified engine, solid waste

Materials & Methods:

1. 3 large trough
2. 3 measuring cylinders
3. 3 rubber tubes
4. 3 same-sized plastic bottles.
5. 3 rubber socks.
6. 3 different kinds of Solid wastes – Raw vegetable waste (Sample 1)
Cooked vegetable wastes (Sample 2)
Cow dung (Sample 3)
7. 3 black charts of the same size.

Experimental setup:

A measured quantity of three different kinds of biodegradable solid wastes such as raw vegetable waste, cooked vegetable waste and cow dung are taken in three labeled plastic bottles respectively. Only one fourth of the bottle was filled with solid waste in all the bottles. The mouth of the bottles was closed with one holed rubber cork. A glass delivery tube was inserted into the one holed rubber cork. To the one end of the delivery tube a silicone tube was fixed to collect the gas produced from the solid waste as a result of decomposition process. The gas was collected using the measuring cylinder by downward displacement of water. The experimental set up was kept undisturbed at 28°C for 24 hours. The amount of gas collected was estimated and recorded periodically. The plastic bottles were covered with black paper.



Experimental Setup

Observation:

Production of gas from the three different kinds of solid waste started after 26 hours. More volume of gas was produced from the sample 3 than the sample 1. No gas production in sample 2.

Samples / Time (hours)	Volume of gas collected (mL)		
	Sample 1	Sample 2	Sample 3
26	5	0	10
28	7	1	22
30	15	1	26

Conclusion:

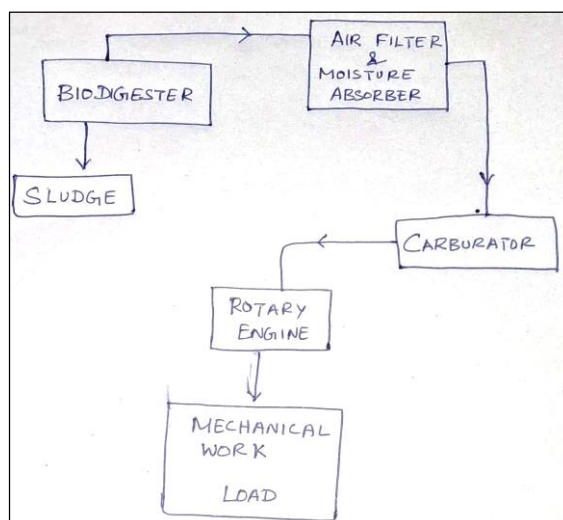
The production of bio gas was more in sample 3 than sample 1. Hence we can conclude that cow dung can produce more volume of gas in a short period when compared to all the other samples.

Future plan:

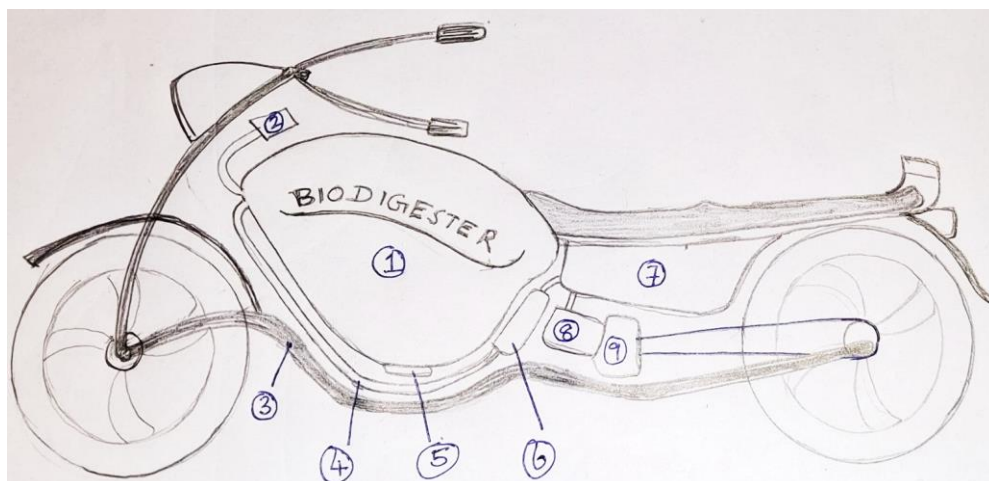
As more volume of gas was produced from cow dung when compared to raw vegetable waste, we can mix sample 1 and sample 3 and can be studied. We are also planning to repeat his experiment in various temperature ranges with triplicate.

How the gas can be utilized?

Based upon the results of future experiments, the right kind of solid waste will be taken in a digester and allowed for decomposition. The gas produced will be filtered to absorb moisture and will be checked with a simple petrol engine. We would design the structure of the digester including the vehicle. Schematic diagram is given below to show how the biomass can be utilized to power up the vehicle.



Schematic diagram



1. Biodigester
2. Pressure gauge
3. Frame
4. Gas delivery pipe
5. Drain valve
6. Air filter
7. Carburetor
8. Rotary engine
9. Clutch

Rough design of a futuristic vehicle that runs on biogas

Advantages :

1. The raw material is chiefly available and its utilization prevents land pollution.
2. It is possible to control the release of particulate carbon and other harmful carcinogenic substances.
3. The cost-effectiveness of biogas production is lower than that of fossil fuels and it is a onetime investment that continues to produce the products for many years when maintained properly.
4. Low maintenance cost.
5. The country's poverty rate can be reduced by creating job opportunities.
6. They boost the economy and lessen the amount of waste that ends up in landfills.

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