OPTIMIZATION OF FOOD-WASTE BASED BIOGAS DIGESTOR AND ITS IMPLEMENTATION IN RURAL AREAS

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INTRODUCTION:
A biogas plant is an anaerobic digester that produces biogas from animal, food waste or plant waste. Biogas can provide a clean, easily controlled source of renewable energy from organic waste materials for a small labour input, replacing firewood or fossil fuels (which are becoming more expensive as supply falls behind demand). Biogas is generated when bacteria degrade biological material in the absence of oxygen, in a process known as anaerobic digestion. Since biogas is a mixture of methane (also known as marsh gas or natural gas, CH₄) and carbon dioxide. It is a renewable fuel produced from waste treatment. Food waste is the best feedstock for Biogas Production. It is 20 times more efficient than conventional methods. Constant stirring increases the rate of production. Three staged digester not only provides complete utilisation of foodwaste. But also provides stirring effect.

OBJECTIVES:
The main objective of the project is to design a prototype and to study the efficiency on using a three staged digester for production of biogas with foodwaste and also to study the feasibility of implementation in rural areas as a community reactor.
The objectives can be listed as below-
1. To design two prototype biogas digesters and test them for biogas production from food waste.
2. To study the production of biogas with normal digester and a three staged digester.
3. To quantify the biogas produced with both normal and three staged digester and thus obtaining the biogas yield at constant percentage of feedstock for both prototypes.
4. To optimize the production of biogas using higher temperature with heat exchanger.
5. To regulate the pH of slurry in the digester and thus promoting bacterial activity.
6. To obtain the efficiency of using a three staged digester over normal digester.
7. To survey a rural area and develop a design a biogas digester design by considering yield and food waste produced.

Literature study
Foodwaste is a very good feedstock for biogas production. It is 20 times more efficient than the conventional methods of using cowdung. Multi-stage anaerobic digestion has the advantage of achieving superior performance compared with single-stage
conventional digestion. The multi-stage process is capable of a higher volatile solids (VS) reduction with shorter residence times, production of biogas of higher quality, and elimination of foaming. The purpose of stirring is to distribute the nutrients in the biogas digester uniformly, to form a suspension of liquid and solid parts, to avoid sedimentation of particles, to ensure uniform heat distribution, to prevent foam formation and to enable gas lift from the fermentation substrate at high dry matter (DM) contents.

**METHODOLOGY:**
1. A normal biogas digester was designed and it was fed with constant feedstock of 0.2% the size of the digester.
2. The gas produced was quantified daily and the conditions like pH and temperature were regulated.
3. The yield per 100L size of the digester was calculated.
4. A new technique three-staged digester was designed and even that was fed constantly with
5. 0.2% the size of the digester.
6. The yield produced was quantified daily and yield for 100litre size of the digester were calculated.
7. From the results the optimisation by using the three staged digester were studied.
8. A survey was made on quantity of food waste produced in Nekkilady village, near Uppinangady.
9. The quantity of LPG cylinders used and the waste produced in college were studied.
10. Based on the results a digester was designed for the school which would replace the use of LPG completely.

**RESULTS:**
The following results were obtained from the experiments conducted on the prototype biogas digesters-
1. A new technology digester was obtained.
2. Biogas produced was flammable and was quantified.
3. Biogas yield is optimum at a pH range of 6.5-7.5.
4. The bacterial activity is high at mesophilic temperature (35-45°C) and greater water feed ratio.
5. Three staged digester offers more productivity compared to the conventional reactors.
6. Three staged digester is 25% more efficient than the conventional digester. Three staged digester efficiently uses all the waste and produces more gas.
7. The production can be increased by 25% if a conventional digester produces 42L of gas, three staged digester produces 67L gas.
8. The three staged digester not only provides more time for digestion. But it also provides stirring effect.