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Food Waste Curtail by Kitchen Waste Biogas Plant (K.W.B.P)

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ABSTRACT:A mission is commenced by students to reduce the food waste, design and develop a kitchen waste biogas production and storage system suitable for cooking in hostel mess. It maximise the reduction of food waste to the ground. This bio gas plant will provide biogas for cooking purpose and also manure for vegetation purpose. The biogas is produced in a PVC floating drum type gas holder by the anaerobic digestion in digester tank of kitchen waste biogas plant. It is connected via pipeline to burner for cooking purpose. The final prototype can offered kitchen waste up to 6kg and the output biogas obtained is about 0.65 $m^{3,}$ which have operating time of 90 minutes. It is very effective idea in which students are credited with knowledge and management yield turnover out of it.

KEYWORDS: KWBP, Anaerobic Digestion, Digester, Gas holder, Biogas

I.INTRODUCTION

Presently, demand on fossil fuel is certainly on peak. Energy produced from Kitchen waste will certainly reduce the demand of fossil fuel. This system will provide no net increase in carbon emission in to the atmosphere for climatic change. Basically, tropical region will have very much biomass productivity because of the consent temperature and climate. As a result, it will be a sustainable energy production system. It is an Eco-friendly and less time consuming system. In every home cooking accounts 85% of energy consumption in urban areas.

Anaerobic digestion is an appropriate technique to treat waste water and solid waste in to energy production. The anaerobic digestion is a biological process which generates CH_4 (methane), CO_2 (Carbon dioxide) and H_2S (Hydrogen Sulphide). The anaerobic process gives net output energy but less biological sludge than aerobic treatment process. A well maintained biogas plant will generate the maximum methane out of it than other gases. Through kitchen waste the efficiency of methane production can be increased as the waste have high calorific and nutritive value.

KWBP is a system which renovates the food waste to biogas for cooking and liquid slurry for gardening. It involves a principle of Anaerobic digestion system which breaksdown the complex organic material into simple elements to produce biogas.

At Saveetha School of Engineering we projected the biogas plant of 6kgs at back side of boy's hostel. This is done as per the food waste audited from the campus mess and canteen. In order to reduce the food waste this idea is implemented and through this project food waste reduction, little slurry which is used as manure for the plants and even the management is obtaining the turnover out of it. The plant is eructed in a 2m * 2m RCC slab platform for strong basement. Digester is 1000ltr tank and floating drum is 700ltr tank followed by gas pipeline, moisture trap system and burner.

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II.BLOCK DIAGRAM

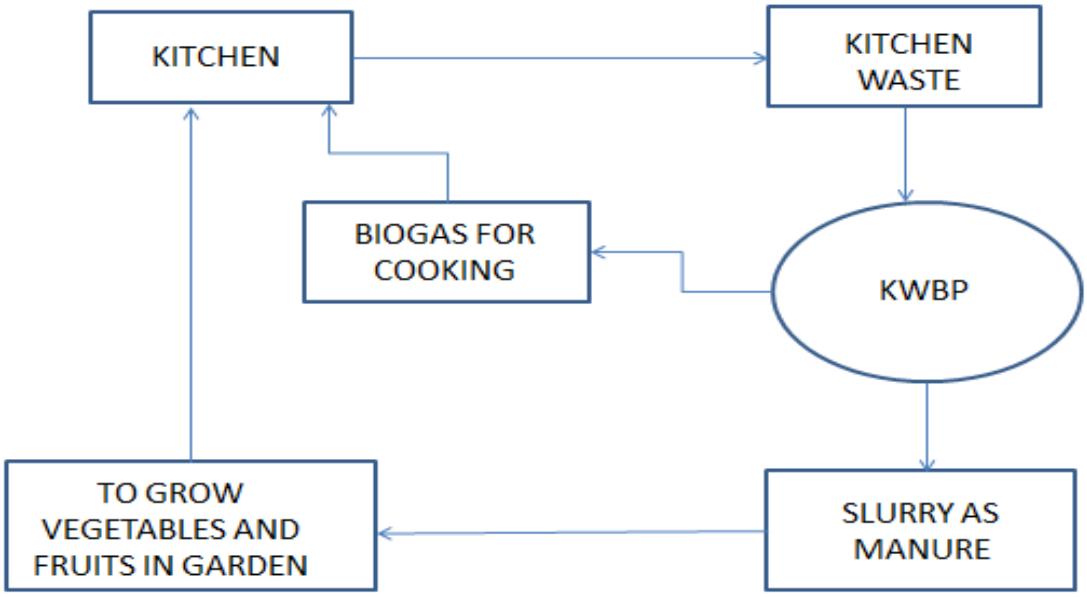

Fig.1 Block Diagram of Biogas Plant

It is the block diagram for Kitchen Waste Biogas plant (Fig.1) where it depicts that from kitchen the kitchen waste is generated and it is made to put in to the biogas plant, through which biogas is obtained which is used for the cooking purpose and the waste slurry produced from it is used as very good manure to the plants and trees. So on erupting this biogas plant we have many advantages in it.

III.SURVEY AT SSE

Survey is done at several places in SSE (Saveetha School of Engineering) such as college canteens, mess etc. We found the maximum waste generation was at SSE Boys Hostel mess about 150kg of food waste generated per day. Food waste generated in SSE boy's hostel by students after their meal are collected in separate bin. Thrown wastes (Fig.2) are like Rice, Chappathi, Dosa, Idly, Sambhar, vada, puri, pongal etc.

Timing	No. of bins in Working Days *	No. of bins in Non-Working Days **
Morning	1.5	1
Afternoon	1.5	1
Night	1.5	1

Table 1. Amount of waste produced

*Working days- Monday to Friday
**Not working days- Saturday and Sunday, Special Holidays
The bin which collects the food waste is approximately about 40kgs. Approximately the waste generated is about 150kg/ day as depicted in Table 1.

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Fig. 2 Collection of food waste at SSE boys hostel mess.

IV.CONSTRUCTION OF PLATFORM

Kitchen Waste biogas plant requires a flat platform for placing of digester and floating drum in a still position (Fig.3). Therefore we built a RCC concrete slab of 2m*2m area and with 0.15 m height. A thick Rubble soling, thick plain cement concrete and down size granite metal coarse aggregates with flooring 12mm is done.

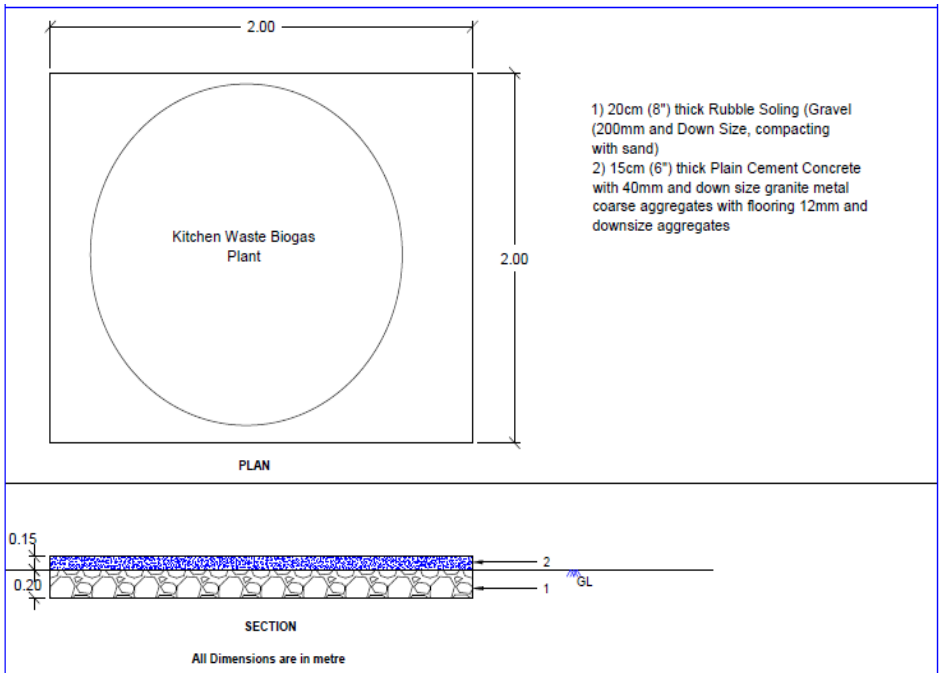

Fig.3 Platform Layout

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V.MATERIAL PROCUREMENT

As per the design for 6kgs Biogas plant we procured the materials (Table.2) accordingly and it was purchased two days back of implementing biogas plant from nearby shop in Chennai at Poonamalle.

It is important to feed the biogas digester with cow dung as an initial feeding. Cow dung is also procured from Poonamalle and made to place in the sunlight free zone for easy production of anaerobic bacteria when it is dropped in to the digester.

S.No	Particulars	Quantity	Unit
1	3 Layered PVC Tank of Capacity 1000L	1	No.
2	3 Layered PVC Tank of Capacity 700L	1	No.
3	90mm PVC pipe(6kg/cm2)	10	Feet
4	90mm PVC Male Threaded Adaptor(MTA)	3	No.
5	90mm PVC Female Threaded Adaptor(FTA)	2	No.
6	90mm PVC- Tee(heavy)	1	No.
7	90mm PVC- Elbow(heavy)	1	No.
8	90mm X 180mm PVC Reducer Collar(heavy)	1	No.
9	3/4 " GI Collar	1	No.
10	3/4 " GI 'Tank' nipple	1	No.
11	200ml solvent	1	No.
12	Teflon Tape	5	No.
13	Hacksaw Blade	3	No.
14	M-Seal	5	No.
15	Hose pipe 16mm mesh graded	15	m
16	3/4 " Brass Ball Valve	1	No.
17	3/4 " X 1/2 " brass hose nipple	1	No.
18	Washer (Flange Washer 80mm)	5	No.
19	Single Burner Stove	1	No.
20	Drip Tee 16mm	3	No.
21	Drip valve 16mm	3	No.
22	3/4 " Stainless steel Hose Clamp	12	No.
23	Shellock	1	Bottle
24	Waste Atta	100	kg
25	Fresh Cow Dung	250	kg

Table. 2 Lists of Materials Procured

VI.DESIGNING AND FEEDING

A. Designing of Digester and Gas Holder

We procured 1000 Litres tank (Fig.4) as a digester tank and 700 litres tank (Fig.5) as Gas holder. Gas holder is invertedly positioned on the digester tank. The digester tank is made to cut on the upper part for insertion of gas holder in to it. The gas holder also made to put small holes using drillers and cutters for making the biogas to penetrate through these holes. In digester tank the inlet feed pipeline, emergency pipeline and slurry collection outlet pipeline is made to fix. In gas holder the gas valve is placed in its bottom through which the gas is made to flow to the burner through controlling valve.

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Fig 4. Digester tank of 1000 litres

Fig.5. Gas Holder tank of 700 litres

B. Initial feeding for biogas plant

It is must to initially feed the biogas digester with cow dung for production of anaerobic bacteria within it. The cow dung and water should be added proportionately about 1:1. The intention time period for production of first biogas is minimum 20 days and maximum 30 days. After which regular production of biogas will take place as we feed kitchen waste to it. After the kitchen waste feed is given, it takes about 24hrs to generate the next biogas within it and can be utilised for coking purpose.

C. Positioning Gas Holder

After the intial feed i.e. cow dung is fed at proportional ratio, the gas holder is made to fix(Fig. 6(a), (b)) on it gently and it is immersed in the cow dung. Such that it gets fixed properly and it also checked for easy rotation of drum. If it is tight add water along the sides of gas holder.

Fig.6 (a), (b) Positioning of Gas holder on Digester tank.

VII. ACCESSORIES INSTALLATION

A. Gas pipeline and Burner installation

On bottom of the gas holder gas piping valve is fixed and it helps to move the gas from bottom of digester tank to top gas holder (Fig.7). The biogas produced will be stored in the gas holder until the gas pipeline valve is opened. When the gas pipeline valve is opened the gas is flowed through the gas pipeline to the burner and hence we obtain the flame and used for cooking.

Burner is the material which gives out flame through it. It also have valve that we can control the flow of gas through it (Fig.8). Even though the gas valve is in open condition on the gas holder the burner can keep it in close/ off

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condition by controlling through the valve fixed with burner. Through burner the cooking is done up to 90mins per day for 6kgs of food waste.

Fig.7 Gas pipeline fixing

Fig.8 Burner

B. Emergency pipeline installation

During Emergency period like overflowing of drum due to food blockage or no gas production will make us to use this emergency pipeline to get rid of the problem very easily (Fig.9). A ball valve is fixed with closure such that if we open the closure all the blocked items will come out of it and it can be controlled through the valve kept in the emergency pipeline.

Fig 9. Emergency pipeline Installation

Fig.10 Moisture trap system

C. Moisture Trap System

It is a system by which the moisture is trapped out (Fig.10). Basically the biogas plant will produce CH_4,CO_2 &H_2O. H_2O will get settled in the bends of the pipe, it leads to extinguishing of fire. So during flaming, moisture is trapped out through the moisture trap. It is must to trap the moisture out of the biogas pipeline for continuous flaming.

VIII. MAINTENANCE OF KWBP

- Observe for gas generation.
- If the drum floats, check for the flame.
- Do not feed the plant with citric/ acidic items, lemon and onion peels.
- Feed the plant with kitchen waste such as rice, sambar, waste oil, rice washed water, tea and coffee powders and other cooked waste from kitchen.
- Rotate the drum regularly for half a circle. If it is tight add water along the sides of gas holder.
- Feed the plant daily. Maximum 6kg of kitchen waste + 6kg of water and minimum 2kg of kitchen waste + 2 kg of water.
- The slurry obtained from outlet is very good manure and used for gardening purpose.

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A. Interrogations

It is observed that there is gap between the digester tank and gas holder, why not the gas could escape through it? The gas unable to escape through the gap between the gas holder and digester tank because the water present around the gap will act as a membrane and do not allow gas to escape through the gap. So the only possible way to gas is to enter the gas holder and float on the digester.
How much gas is produced when 6 kg kitchen waste is fed?It is analysed that 6kg kitchen waste in 24 hours it produce about 0.65m^3 of biogas within it and it is LPG equivalent to 0.26 kg, which flames about 90 minutes continuously.

IX. KWBP AT SSE BOYS HOSTEL MESS

Kitchen Waste Biogas Plant (K.W.B.P) is uprooted at Saveetha School of Engineering Boys Hostel Mess (Fig.11).Due to which the students gained knowledge, food wastes are utilised to produce biogas for cooking purpose, Slurry coming out of it used as manure for gardens and also it yields profit to the management. Over all it could give root to apply the proposal of 500kpd food/vegetable/kitchen waste based 40m^3/day biogas power plant for producing Electricity and Bio-diesel.

Fig.11 Biogas Plant at SSE Boy's Hostel Mess

X.CONCLUSION

The increasing amount of waste, dependence on fossil fuel as main source and global warming stimulated various research on anaerobic digestion. In few decades bioenergy will be the most significant energy source as it offers the economical alternative to fossil fuels. This small level project gave good exposure to students on fabrication and implementation technique, provided biogas for the SSE boys hostel mess, provided manure to the garden and overall it gains profit to the management. It gave a feasibility study on waste-to-biogas from organic waste. It endorses the recycling since our raw material is waste or unwanted. The success of this project is started from small level i.e. 6kg KWBP and in future the broad variety of usable forms of biogas for the production of electricity and Bio-fuel will be implemented. It is an effective waste management System.

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