Floating Drum Biogas Plants for Rural Energy

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Pakistan is facing severe energy crises from last decade which has adversely affected the agricultural, industrial and commercial sector in the country. Due to increasing prices of primary energy sources and its limited supply in future, the scientist community worldwide have already started work to explore alternate sources of energy. In this regard, many developments have been carried out in the field of renewable energy sources from last few decades. Renewable energy sources viz. biogas, solar energy, wind energy, biomass energy has huge potential for energy generation. Being an agricultural country, livestock is one of the biggest sector in Pakistan with a total population of 72 million animals (cows and buffalos) producing approximately 720 million dungs. Considering 50% collectability about 360 million dung can be used for biogas production. It is estimated that about 18 million m^3 of biogas can be produced (@ 0.05m^3 per kg) using this collectable dung. This biogas can be used to produce about 1243MW electricity in the country. Usage of biogas is also environment friendly as well as inexpensive source of energy generation. The most ideal utilization of biogas technology in rural areas of Pakistan could be for cooking, heating and tubewell operation. Keeping in view the above facts, two biogas plants have been installed at University of Agriculture, Faisalabad having total capacities of 25 and 40m^3. The feeding rates of 25 m^3 plant having 3.8m depth and 3.2 m diameter and 40m^3 plant having 4.1 m depth and 3.8m diameter are 400 and 650 kg, respectively which is collected from University Dairy Farms having total of 300 animals. The dung is mixed with water by 1:1 on mass basis and supplied in the inlet of biogas plant. The total biogas produced from 25 and 40 m^3 biogas plants is 20 and 32.5 m^3 per day respectively. Considering 70% plant efficiency, a total of 36.75 m^3 per day biogas can be produced from both plants. This biogas is used to run a 0.75 cusec tubewell for 6 hours a day. The biogas is purified using dehumidifier and scrubber to remove moisture contents and H_2S to prevent the engine from corrosion. Two storage tanks have been used to store biogas at a pressure of 5 bar to run a 20hp engine continuously for 6 hours daily with 70:30 biogas-diesel ratio as shown in Figure 1.

Description of solar distillation system

Figure 1. Floating Drum Biogas Plants (40 and 25m^3) installed at Dairy Farm, UAF

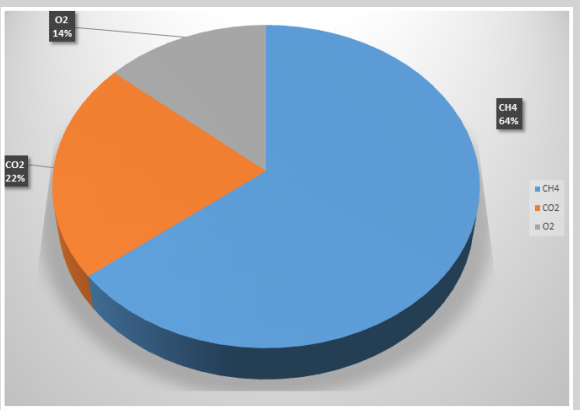

Figure 2. Composition analysis of biogas at laborary sale (cow dung)

A 15kW dynamo is also coupled with the engine with the help of a clutch mechanism for farm electrification by taking tubewell out of circuit. The slurry is mixed with water and applied to irrigate the agricultural crop of UAF farms. From this study successful results have been achieved in terms of biogas production and operation of plant. This study shows that biogas technology is suitable technology to be adopted especially in rural areas having plenty of animals. The biogas produced can be used for domestic cooking and heating applications, tubewell operation and farm electrification.

The experiments were also conducted for the UAF biogas plants. The composition of CH4, CO2, O2, CO, H2 and H2S of biogas before scrubber unit is shown in Table 1.

Table 1. Composition CH4, CO2, H2S, O2, CO and H2 of Biogas Plant installed at UAF

CH4	CO2	O2	PEAKCH4	PEAKCO2	MIN O2	NH3	CO	H2	H2S
%	%	%	%	%	%	ppm	ppm	LMH	ppm
55.3	45.5	0.2	55.5	45.5	0.2	>>>>	3	LOW	1958

These results helped to analyse the actual composition of methane production which can be affectively utilized for different applications. The study shows that biogas technology is viable solution for decentralized power generation using animal dung for rural energy solutions. The excellent utilization of biogas produce is for the farming community to run a tubewell for irrigation purpose and for farm electrification.

Technology Impact:

1. Utilization of dung energy for thermal and electricity applications
2. Production of high value organic fertilizer in the form of slurry
3. Recycling of biodegradable waste to energy
4. Sustainable income generation possibilities for rural community
5. Reduction in methane emission