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Food Waste Based Kitchen Gas Plant – A Sustainable Solution Forfood Waste Management

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Abstract:

The world's fuel supply is under jeopardy due to the approaching scarcity of petroleum. With the help of biogenous methane, humanity may successfully combat this menace; but, the world has yet to completely use this technology because its practitioners have so far ignored a basic premise of science, namely that the output of work is dependent on the energy available to do that task.

Bio Gas obtained from organic and solid waste is sometimes also known as swamp or landfill gas. It has a pungent stench and may easily be identified as a component in the air near regions where naturally occurring organic degradation is occurring. Biogas is created when organic matter decomposes in an environment with little or no oxygen. This naturally occurring bacterial decomposition usually occurs underground or in regions where gas displacement limits access to oxygen.

The good thing about Biogas is that it is a natural process that can be used with almost any organic waste (Crop waste, lawn clippings, septic tank waste and even your household trash). Although energy is not free, the conversion process may be regulated and improved to boost efficiency, which in turn lowers the cost of the process.

Appropriate Rural Technology Institute (Pune) has created a small biogas plant that uses discarded food as a feedstock rather than dung or manure to provide biogas for cooking. The plant is compact enough to be utilized by urban homesand many household in urban and rural areas have been installed these plants.

This is demonstrated by the existing practice of employing low-calorie inputs in biogas plants, such as cow dung, distillery sewage, municipal solid waste, or sewerage, which condenses methane generation inefficient. Dr. Anand Karve (Trustee of ARTI) formed a portable biogas system that employs starchy or sweet feedstock in 2003 to correct this biased approach. Only 2 kg of such feedstock yields around 1/2 kg of methane, and the process takes around a day to complete.

Traditional biogas systems, which employ bovine dung, sewerage, and other waste, require roughly 35-40 kg of feedstock to produce the same amount of methane and take about 5-6weeks to complete. Thus, the system created by is around 20 times more efficient compared to conventional system in terms of converting feedstock into methane, and it is 40 times as efficient in terms of reaction time. As a result, the new system is highly efficient than the conventional biogas system.

Key Words: Food Waste, Bio Gas, Methane, Digester, Anaerobic Digester

Introduction:

In a process known as anaerobic digestion, microorganisms decompose organic material in the absence of oxygen, producing biogas. Biogas is a renewable fuel derived from waste treatment because it is a blend of methane (also known as marsh gas or natural gas, CH4) and carbon dioxide.

Methane and carbon dioxide make up the majority of biogas. Biogas typically comprises 65 percent methane, making it a promising alternative fuel source because methane is flammable and can be converted to other kinds of energy. The conversion of waste and dangerous germs into potential fuel sources and raw material for various applications is made possible by the controlled decomposition of organic matter.

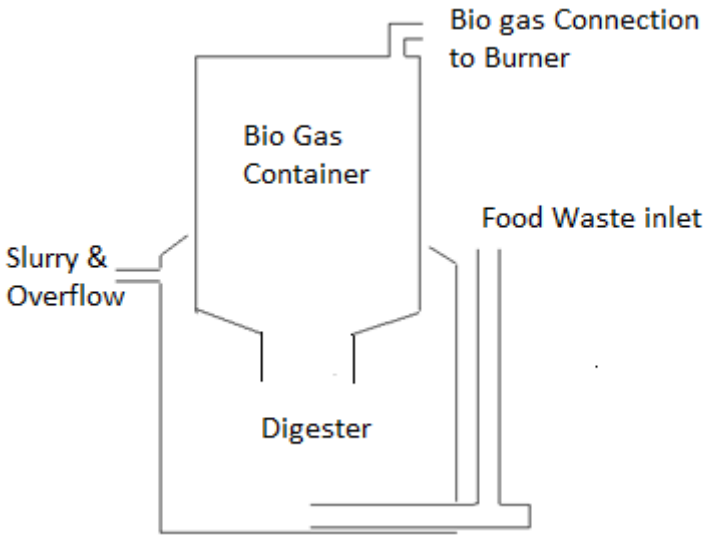
Appropriate Rural Technology Institute:

Appropriate Rural Technology Institute (ARTI) is a Maharashtra-based non-profit organization created in 1996 by a group of scientists and social workers. The organization's purpose is to act as a tool for long-term rural development through the use of scientific and technological expertise.

The Scientists from ARTI havecreated a small biogas plant that uses discarded food as a feedstock in place of cow dung or solid waste to provide biogas for cooking/combustion. The plant is so compact enough that it can be used by even urban homes (in small place) and many households have been installed such plants in their houses, both in urban and rural areas. In the modified version of same, ARTI has advanced to the final round of the Ashden Award 2006.This time for its series of technologies for converting agricultural waste into charcoal briskets and using it as a clean domestic fuel. These charcoal briskets were having high energy density, thus compact in size, and were less pollutant compared to Woodstock or cow dung etc.

Biogas system with Water Tanks:

Cut-down high-density polythene (HDPE) water tanks are converted with a heat treatment and conventional HDPE pipes to create the compact plants. The usual plant has two tanks, each with a volume of 0.80 m^3 and 1.1 m^3. The gasholder is inverted container over the larger lower tank, which contains the mixture of decaying feedstock as food waste etc and water (slurry)& some amount of starch as catalyst to improve the processing time and efficiency.



A feedstock inlet is provided, along with an overflow outlet so that the digested residue can exit so that the reaction rate will increase. Because there is significantly, less solid matter in this than in a manure-based plant, it is recommends blending the liquid with the feedstock so that it can be recycled it back into the plant.

The biogas pipe line can be extended into the kitchen and used using a biogas based gas burners. In India, where manure-based biogas facilities have a long history, such stoves are widely accessible.

As the digestion process is contentious, the release of gas is a continuous process. As the gas collected in inverted tank, over a period the amount of gas increased and that result in to increased pressure. The gasholder progressively increases in height.

Installation:

The plant comes as a kit that only takes 2 to 3 hours to put together. It requires an area of roughly 2 m^2 and a height of 2.5 m, though it can be adjusted if put under a roof. Though the plant can be installed under roof, however for better and faster reaction, it is recommended to install under direct sunlight. Basic foundation and pipeline connections to be properly done. Any leakage in pipeline should be avoided.

Initialization of plant and reaction:

The lower tank plant is added with some bio waste as cattle dung, food waste etc and it is blended with hot water preferably and waste flour or sewagepreferably from an existing biogas plant. To catalyze the process some kind of starch is added. Over the course of a few days, the plant is fed until it produces a continuous supply of gas, typically ¼ kg per day from 1 kilo gram (dry matter) of feed that is food waste etc.

The supply of food waste/ stock to the plant:

Waste flour, vegetable residues, waste food, fruit peelings, and rotten fruits and vegetables can all be used as feed stock. A food blender can be used to break up feedstock with huge lumps (more than 20 mm). Food blenders driven by hand and pedal are being developed.

If a biogas plant is over-fed, it can become acidic and fail. This typically challenging with highly digestible organic feedstock. To avoid this, the plant can be protected by stopping feeding and gradually increasing the feed rate.

The earlier, smaller systems (0.5 or 0.75 m^3) were more prone to this issue than the later, larger ones.

Advantages and benefits:

The majority of biogas plants currently developed across the country and globally are designed to utilizecow dung, animal dung etc as their primary feedstock and are hence employed in rural regions. In cities, however, the majority of people cook on LPG or electricity like induction cookers. When compared to the usage of electricity or LPG for cooking, the obvious benefit of owning a tiny biogas system is the cost savings, flexibility in use, ease of availability etc.

If waste flour is utilized as feedstock, the operating cost for the plant is just about Rs 1-2 per day, and it can be almost negligible if the facility only uses food wastes like vegetable residues, rotten fruits, etc. Even taking in to account of subsidy, the kitchen gas generated from these plants is substantially less expensive than LPG. The presently available LPG cylinders, cost up to Rs. 30-40 per day for a family if 4-5 people. The produced kitchen gas can readily replace half of a family's LPG consumption. Some families that cook with efficient cooking utensils like pressure cooer etc and also gather food scraps from theneighborsor society have completely eliminated their use of LPG.

Methane is a gas that burns with a blue flame and produces no smoke or soot. As a result, it is a cooking technique that is beneficial to the environment. Cooking using biogas reduces indoor air pollution when

compared to wood or kerosene (Kerosene is still one of cheap and popular alternative to wood in villages). This has a significant favorable impact on the health of those working in the kitchen (mostly women).

The elimination of the need to transport LPG cylinders to be refilled results in even more pollution and energy savings. The biogas plant's modest amount of solid waste makes an excellent fertilizer.
On a global basis, it is commonly understood that replacing fossil fuels reduces greenhouse gas emissions.

As per data, biogas can save up to 100 kg of LPG or up to 250 liters of kerosene annually for a typical urban home, equating between450 to 550 kg CO_2 per year. In comparison, a rural family may save approximately 2.5 to 3 tons of wood annually. 3 Tons of wood has a potential of producing approximately 5 tons of COz if burned in open air.

Comparison of Food Waste based Bio Gas Plant with cow dung (conventional) Bio Gas Plant:
Biogas systems take organic material (feedstock) and place it in an airtight tank, where bacteria break it down and create biogas, which is primarily methane with a small amount of carbon dioxide.

The solid waste residue can be utilized as organic compost.The biogas can be used as a fuel for cooking or other applications.

Methane generation in typical biogas facilities is currently inefficient due to the use of low-calorie inputs such as cow dung, distillery effluent/waste, municipal solid waste or sewerage. The efficiency of methane generation can be enhanced by several orders of magnitude by using catalyst feedstock with high calorific and nutritional value to bacteria, as illustrated by this compact system.

Operating the system based on this fundamental tenet also provides a number of additional benefits over traditional systems: The new system's size and cost are also reduced as a result of its increased efficiency. The tiny biogas system is around the size of a domestic refrigerator.While the conventional cow dung based biogas system may require up about 4 m^3 of space.

It is a very user-friendly system, as it only requires a few kilograms of feedstock per day and just 5 liters of effluent slurry each day. However, the proportionate of feedstock and water may vary depending on the type of feed atmospheric temperature.

Biogas in cities is becoming a new trend.

Waste food is frequently dumped in cities, and the resulting heap attracts flies and rodents, posing a public health issue.The ARTI compact biogas plant technology accepts highly digestible organic resources such as kitchen trash as feedstock and blends in seamlessly with urban life. A single plant produces enough biogas to cut LPG or kerosene use in a family in half, as well as a small quantity of solid residue that can be utilized as fertilizer.

This method can be used to turn starchy waste into clean, usable energy in city residential and business settings.

Between 2003 and mid-2006, 700 tiny biogas units were erected in Maharashtra, serving both rural and urban residents. At least 100 additional plants have been installed in India.

Conclusion:

The ARTI compact biogas plant is the most efficient method for producing biogas from kitchen garbage.

Typically, a 500 bed hostel produces around 150 kgs of food waste every day. According to this technology, 500g of methane can be created from 2 kg of kitchen trash, while 37.5 kg of methane may be produced from 130 kg of kitchen waste. With the same quality and quantity of feed stock, the biogas produced in a traditional biogas system is around 3.5 kilogramme.

The entire process may be completed in significantly less time with the conventional Biogas Plant. As a result, Biogas may easily replace half of a family's LPG consumption. Industries are attempting to commercialize this small biogas technology.As part of a current study financed by the US Environmental Protection Agency. The construction of this biogas plant is taught to rural residents, who are encouraged to create and sell the plants only for financial benefit.

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