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Energy Strategy for Poultry Gasification

S.Mathankumar[1], P.Loganathan[2]

Assistant Professor, Department of EEE, V.M.K.V Engineering College, Vinayaka Missions University, Salem, Tamilnadu, India[1]

Assistant Professor, Department of EEE, V.M.K.V Engineering College, Vinayaka Missions University, Salem, Tamilnadu, India[2]

ABSTRACT: Resource depletion is the consumption of a resource faster than it can be replenished. Resources are commonly divided between renewable resources and non-renewable resources. Use of either of these forms of resources beyond their rate of replacement is considered to be resource depletion. The need for alternate source of energy is increasing. This paper deals with the production of electricity from the wastes produced from the poultry farms, which can supply for the demands of the ever growing energy requirements. The term poultry is used to indicate chickens farmed for economic production. Energy generation from the poultry litter can be achieved by anaerobic digestion, direct combustion, co-firing, and gasification. Among them the method of direct combustion was considered most appropriate for the combustion of Biological matter to produce steam to generate electricity. Poultry litter – the mixture of cellulosic bedding material and manure generated in broiler production houses – can be converted into thermal and/or electrical energy or even into liquid fuel. Over the years it has found use in agriculture and has been highly valued as a nutrient-rich fertilizer. Power generation from animal biomass is considered one of the best alternatives to the growing issue of poultry litter management. Using it as a fuel may create a new continuous outlet for poultry litter, while improving the efficient utilization of poultry houses.

KEYWORDS: Poultry, Gasification, Digester, Keratin, Renewable, Power Generation.

I. INTRODUCTION

The analysis of the poultry business sector, manure importance and value, its growth, revenue and cost, economic and social contributions, employment generation, investment opportunities and other aspects is beneficial and is the main objective of this project. In addition, we have aimed:

- To analyze the current situation, problems, challenges and its solutions.
- Decentralization of power generation needs to be promoted, thus providing energy security and reducing transmission and distribution losses.
- Reduction of energy crisis.
- Reduction of greenhouse gases.
- Providing subsidies to poultry farm, industries and society for burning diesel in generators is counterproductive keeping in view of promoting low carbon power generation.
- Access to quality power for poor needs.

II. LITERATURE SURVEY

JOHN P. REARDON, ART LILLEY, KINGSBURY BROWNE AND KELLY BEARD, "DEMONSTRATION OF A SMALL MODULAR BIOPOWER SYSTEM USING POULTRY LITTER", COMMUNITY POWER CORPORATION-LITTLETON, FINAL REPORT, FEBRUARY 25, 2001.

The purpose of this project was to assess poultry grower residue, or litter (manure plus absorbent biomass), as a fuel source for Community Power Corporation's Small Modular Biopower System (SMB). A second objective was to assess the poultry industry to identify potential "onsite" applications of the SMB system using poultry litter residue as a

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fuel source, and to adapt CPC's existing SMB to generate electricity and heat from the poultry litter fuel biomass. Bench scale testing and pilot testing were used to gain design information for the SMB retrofit.

The poultry industry contributes $23 B USD to the gross domestic product, producing 7 billion birds and 36 million tons manure annually; and 17% of domestic production is exported. The largest sector of the poultry industry is broiler production with 93% of the head production and 73% of the manure production. Turkey production is second to broilers for both head production (4%) and manure production (22%). Egg layers are not a target market for gasification technology.

FATEN HOSNEY FAHMY, HANAA MOHAMED FARGHALLY, NINET MOHAMED AHMED, "PHOTOVOLTAIC-BIOMASS GASIFIER HYBRID ENERGY SYSTEM FOR A POULTRY HOUSE", INTERNATIONAL JOURNAL OF MODERN ENGINEERING RESEARCH (IJMER), VOL-4, ISSUE-8, PP. 51-62, 2014.

The authors present an Availability and sustainability of energy and food production are the biggest challenge facing the world. Find out how to integrate poultry and animal farms with renewable energy technologies will lead to a greater energy security and food production. The main objective of this paper is to obtain the optimal suited configuration of a hybrid renewable energy system from various combinations to meet the poultry house load requirement reliably, economically, continuously and sustainably. This paper presents an optimal design of hybrid solar PV-biomass gasifier system to fulfill the requirements of 250 kWh/day primary loads with 19 kW peak load for poultry house located at El-fayoum governorate, Egypt. Using HOMER simulations, the optimal sizing of solar photovoltaic (PV) and biogas generating system is obtained on the basis of the minimized cost of the obtained energy (COE) generation, HOMER results show that the solution is sustainable and techno economically viable. The simulation results show that PV (12 kW) - biomass gasifier (20 kW) - battery (270 kWh) hybrid system is most economically feasible with a least cost of energy about $0.224/Kwh. Also, this system is characterized by the minimum percentage of carbon dioxide and the other greenhouse gases emissions.

III. DEMAND FOR POULTRY LITTER

Despite growing environmental concerns and restrictions, land applications still the main use of poultry litter. Poultry litter contains significant amounts of nutrients essential for plant growth. The most important are the macronutrients, nitrogen, phosphorus, and potassium and other essential nutrients in lesser or trace amounts. With growing interest on green energy, the latest demand for poultry litter is coming from the renewable energy sector. New opportunities in renewable energy sector to use poultry litter as a feed stock for bio-fuel generation has created a growing interest among poultry farmers. Fluctuations in energy costs and growing attention to greenhouse gas emissions have made poultry litter a potentially stable green fuel source that can help displace the demand for fossil fuels and purchased electricity. Conversion of litter into energy is carbon dioxide neutral. Poultry litter has good burning qualities due to its composition, making it a potentially excellent source of fuel.

IV. FUEL CHARECTERISTICS

Heating or calorific values for broiler litter on an basis range from 10.7857 to 16.1658 MJ/Kg. Generally broiler chickens produce an average of just over 3.65kg/bird at 75% moisture (as excreted) in a typical 6½ -week growth cycle. For a 20,000-bird house with 5.5 to 6 annual growth cycles, 440 to 480 wet tons of manure is produced in a year. At 25% dry matter, there is 110 to 120 dry tons manure/year for each production house. Litter with the highest volatile matter content will have the highest heating value. The highest volatile matter content, 71.9% dry basis; the lowest moisture, 15.1% w.b.; and lowest ash content 10.9% d.b.

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	Poultry litter
Carbon, dry wt%	39.5
Hydrogen, dry wt%	4.3
Nitrogen, dry wt%	3.9
Sulfur, dry wt%	0.8
Ash, dry wt%	22.9
Chlorine, dry wt%	1.28
Oxygen, dry wt%	27.3
Moisture, %	20-35
Dry HHV*, Btu/lb	6572
LHV**, Btu/lb as fired	3600-4400

Table.1. Fuel Characteristics

V. METHODS OF GENERATION

There are four different types of methods to methods to generate electricity.

A. Direct Combustion

The simplest and most developed bio-power technology. Direct combustion involves the burning of fuel with excess air, generating hot flue gases that are used to produce steam in the heat exchange sections of boilers. Steam is then used to produce electricity in steam turbine generators. Various fuels could be used during combustion, having highest calorific value and lowest ash content in combustion. The direct combustion technique is currently used for electricity generation. First poultry litter is delivered to the plant. Second, the fuel is delivered to a fuel hall which has a capacity varies from 100 to 10,000 tons of fuel. Hourly, tons of litters are fed to the boiler house by spiral screw augers into combustion chamber at 850 ºC.

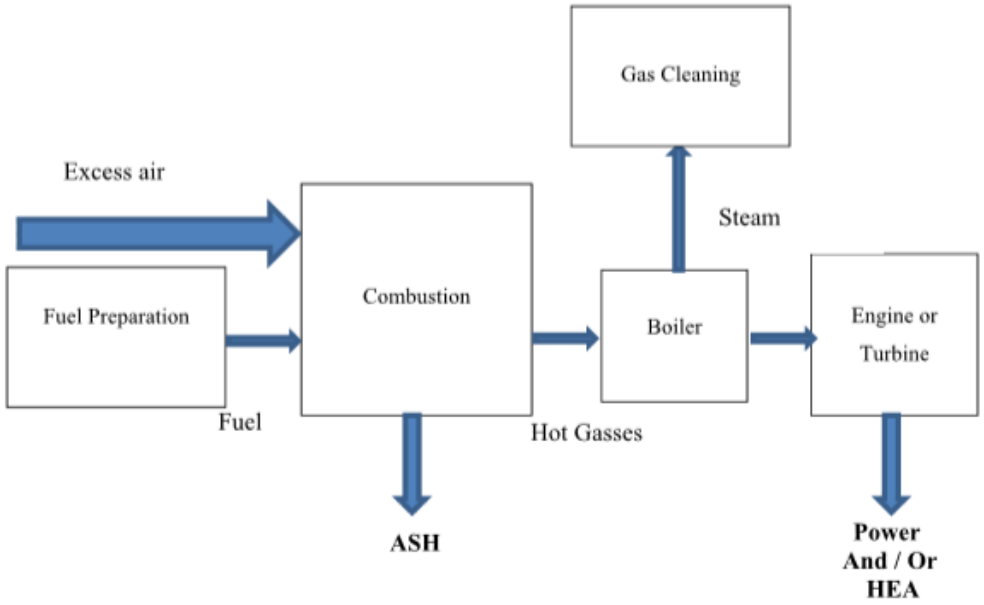

Fig. 1 Bio-power technology block diagram (Direct Combination)

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B. Anaerobic Digestion

This method is done using the digesters. These are large structures which are used to produce methane from the wastes especially poultry wastes. The maximum capacity of these digesters are about four tones, the poultry wastes are first dumped into the digesters, then its heated at the specified temperature and it undergoes the process of fermentation. The waste starts to mix with the bacteria and the methane is produced as the by product. These are used to produce the bio gases and these bio gases are supplied to the nearby villages to meet their demands. this is an very simple process to produce methane or biogas from the poultry wastes.

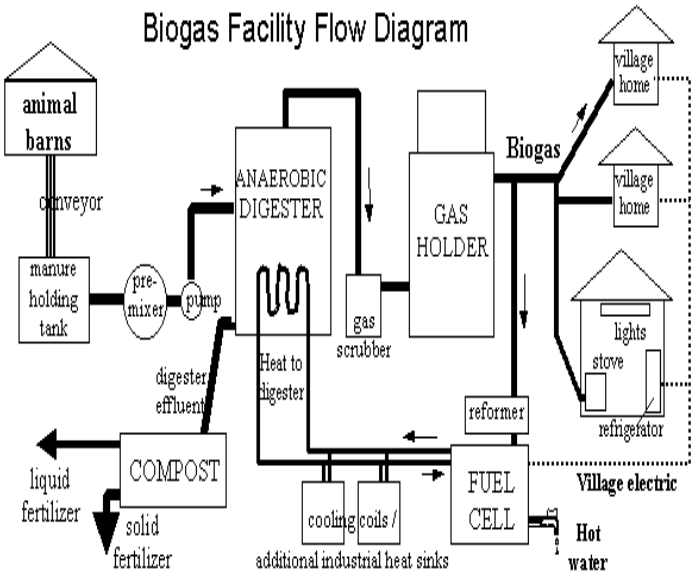

Fig.2Biogas Facility Flow Diagram

C. Gasification Method

This method is done using the power plants. The animal waste is dumped into the feeder and it then it's heated at the specified temperature and it undergoes the process of fermentation. The waste starts to mix with the bacteria and the methane is produced as the by product. This methane can be used to run the turbines of the power plant these in turn used to produce the electricity. These in turn can be connected to the state electricity grid and can be used to meet the demands of the country.

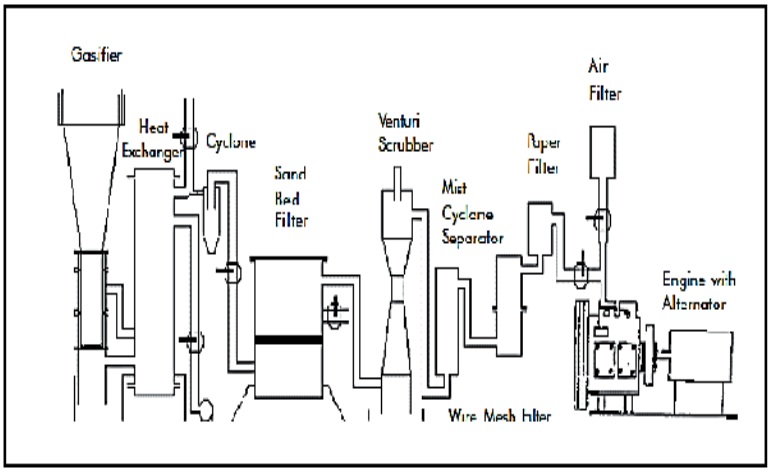

Fig.3 Gasification Method block diagram

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D. CO Firing System

This is also a type to produce energy from the poultry wastes. The main advantage is that it produces natural fertilizers as the by product. The wastes from the farms are dumped into the feeder and its then undergoes into the mixer and gasification process takes place. Then the output from the gasifier is then sent into the heater the gas which comes out is the fuel, it can be sent to the turbine to generate the electricity. In other words the CO firing method is a combination of gasification method and anaerobic digestion method.

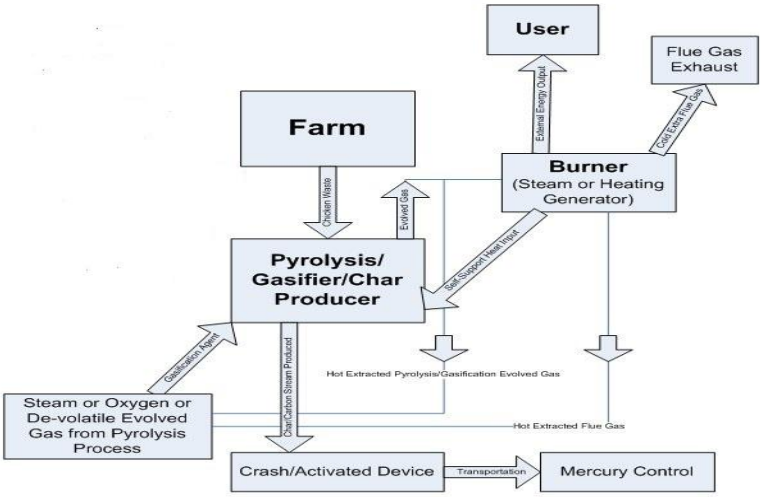

Fig.4 CO Firing System Block diagram

VI. HYDROGEN FUEL CELLS

Carbonized chicken feather fibers have the potential to dramatically improve upon existing methods of hydrogen storage and perhaps pave the way for the practical development of a truly hydrogen-based energy economy. Chicken feather fibers are mostly composed of keratin, a natural protein that forms strong, hollow tubes. When heated, this protein creates crosslink's, which strengthen its structure, and becomes more porous, increasing its surface area. The net result is carbonized chicken feather fibers, which can absorb as much or perhaps more hydrogen than carbon nanotubes or metal hydrides, and they are cheap. Hydrogen, the most common element in the universe, has long been touted as a clean and abundant energy alternative to fossil fuels. But its physical characteristics make it very difficult to store and transport — as a pressurized gas it takes up about 40 times as much space as gasoline, as a liquid it needs to be kept at extremely low temperatures. Stats estimates that it would take a 75-gallon tank to go 300 miles in a car using carbonized chicken feather fibers to store hydrogen. The problem with hydrogen as a gas or liquid is its density is too low. Using currently available technology, if you had a 20-gallon tank and filled it with hydrogen at typical room temperature and pressure, you could drive about a mile. In addition to hydrogen storage, there are ways to transform chicken feather fibers into a number of other products including hurricane-resistant roofing, lightweight car parts and bio-based computer circuit boards.

VII. LITTER INTO LIGHT

Stats say that few districts in Tamil Nadu produce around 6,000 tons of poultry litter. If the total poultry litter in the district is collected daily [6,000 tons] and processed, nearly 16 MW of power an hour can be generated, with 1,000 tons of manure and 10,000 liters of liquid biofertilizer as by-products The plant, built on 60 acres at Goundampalayam, Tiruchengode, is touted as the country's first power project that extracts energy from poultry excrement. It started with a capacity of 2.5 MW, later scaled up to 3.76 MW. The bird muck is collected daily from several places and brought to the factory, where it is fed into a processing unit. It emits methane gas that is converted into electricity with a patented technology. The slurry, generated as residue, is sold as manure and liquid bio-applications to farmers. So far around 54 lakh units (kW) of power, worth Rs.2 core, has been generated and sold to the government, with 10 percent reserved for the company.

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VIII. ADVANTAGES

A) Abundant: poultry is always available and can be produced as a renewable resource; it can be found anywhere and includes organic matter such as plants, animals or waste products from organic sources. These energy sources are known as biofuels and usually include rotted trees, wood chips, sewage, manure and tree components. As they come from living sources we will never run out, so long as there are living things on the earth and there is someone to turn these components and waste products into energy. No harmful carbon dioxide emissions: Less pollution is generated through the production of biomass energy due to the completely natural intake, meaning there are no carbon dioxide side effects in its use. Many other energy sources struggle to control the amount of carbon dioxide realised, resulting in harm to the ozone layer and increases in the effects of greenhouse gases, potentially warming the planet.

B) Restoration of wasteland: A huge advantage of poultry energy is its ability to take harmful waste and turn it into a useful energy resource.

C) Clean energy: As biomass is relatively clean, it can be used in such commercial businesses as airlines, meaning it is good for the environment and good for businesses.

D) Reduce Fossil Fuel dependency: With the majority of homes and businesses using oil to provide energy, oil will gradually run out if people do not switch to a renewable energy source such as biomass. Once oil is gone, it is gone forever. The use of poultry will therefore reduce the dependency on fossil fuels.

IX. ENERGY EQUIVANT

It is quite interesting to calculate the fuel cost equivalent of poultry litter using the energy content results from this present study.
(10785.7KJ/Kg)*(1000Kg/Ton)*(1Galdiesel/147340 KJ) * (0.75) = (55Gal/Ton)
It shows that one ton of dry litter equals to 55 Gallons of diesel. Where 55 Gal diesel cost Rs 17,709, but one ton of dry litter cost maximum Rs 2000.If we combust 2Kg of litter , we can get 1KWh electrical energy (2.106 tons/MWh) .

X. DISADVANTAGE

A) Handling: poultry wastes have microbes in it that may be dangerous. It should be incorporated into the soil when it is aged or composted.. If it is stored rather than incorporated into the soil, make sure there is no runoff into sources of drinking water or food production areas. Wheelbarrows, buckets and equipment that have touched fresh manure should not touch produce that will be eaten raw.

B)Nutrient Variablity: The amount of nitrogen in manure depends on the type of animal, how they are fed, the amount of bedding mixed with the manure and the storage and collection methods. Controlling application rates is difficult to impossible with manure, but in most cases, the nutrients are released slowly enough that it does not cause problems. If large amounts of fresh poultry manure are applied to already fertile soil, there may be enough nitrogen to damage the roots of young plants.

C)High Salt Level: Salt is necessary for animal health. Often animals are fed more salt than they need and it is excreted. This results in high salt levels in the manure. This is particularly true of cattle raised in feedlots. Salt makes them eat and drink more, so they gain weight faster. High levels of salt can damage or kill plants. The salt is leached out in areas with high rainfall, but may build up enough to become a problem in drier areas.
D) Odor Control: Incorporating manure into the soil will reduce the odor, but this is possible only where the soil can be tilled. For topdressing, compost the manure first. Proper carbon/nitrogen ratios are important to control odor. Horse manure has about the right ratio. Cow and chicken manure will need added carbon. Start by mixing equal amounts of manure and high-carbon material, like bedding, straw, leaves or sawdust. If there is still an odor, add more high-carbon material. If decomposition is slow, add more manure. Keep the pile damp but not soggy and turn it frequently to speed decomposition.

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IX. CONCLUSION

There are 18,000 poultry farms which have large amounts of poultry litter that could potentially be tapped for energy generation initiatives. Farms could utilize combined heating and power generating facilities, and have a vested interest in ensuring continued viability of poultry farms if land application of poultry litter is not allowed. Energy produced could helps in reducing the increasing demand of energy as well as GDP of country. Creates job for poor peoples. Thus government should enhance the poultry farming and conduct more and more research on Biomass Energy. Knowledge of commercial farming to the people as well as viable threats from it. Privatization can be done. To avoid the energy crisis, its necessary to find alternate sources of energy to meet the needs. The energy produced from the poultry farms has many advantages its by product like natural fertilizers doest harm the atmosphere in deed helps it. It's new scope for of energy source, which is generated from waste.

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