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A STUDY OF SOLAR AND BIOGAS HYBRID POWER GENERATION SYSTEM WITH MAX POWER TRACKING BY SOLAR PANEL

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ABSTRACT

This paper proposes a idea on solar photovoltaic and biogas hybrid system for generation of electricity in order to increase efficiency of power generation system by using maximum power tracking. The electricity requirements of the world including India are increasing at alarming rate and the power demand has been running ahead of supply. We have solar photovoltaic and biogas for electricity generation are starting a coalition system. If the energy system in a high reliability, cost effective and can be used to improve the quality of the small town. This paper estimates the potential expansion of electricity generation in the state of India from the combustion of biogas produced from three alternative sources of waste biomass –manure from livestock farms, sewage from wastewater treatment plants, and municipal solid-waste from landfills.

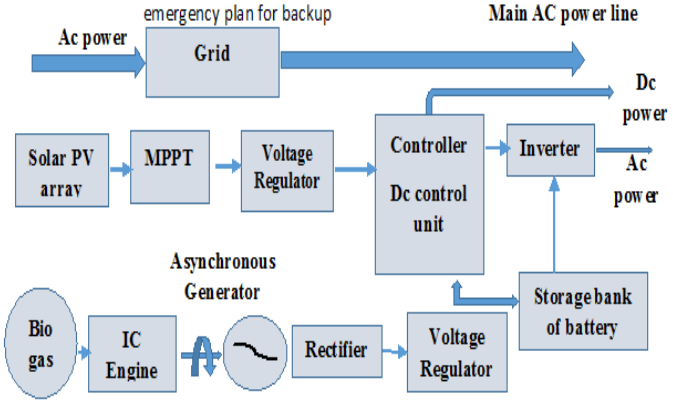
Keywords: PV System, Bio Gas, Methane, I.C. Engine, Combined System, Maximum Power Tracking Arrangement.

I. INTRODUCTION

Hybrid power system that aims to increase the system efficiency and increase use of renewable energy based hybrid power system. In order to meet sustained load demand during varying natural conditions, different renewable energy sources need to be integrated with each other like solar, wind, ocean, geothermal ,biomass /biogas , bio diesel , wave energy, fuel cell technologies , waste of energy municipal waste / liquid waste/industrial waste , small hydro. Thus we have seen that biogas is a promising tool for employment of generation energy, self-sufficiency and reduction greenhouse gases and recover global warming effect. Energy, Economy and Environment is the three inter-related areas having direct correlation for development of any nation. Per capita energy consumption is an index for development of any nation so we are tries to increase per capita energy consumption in India with use of renewable energy source.

Hybrid systems are usually a combination of photovoltaic with wind turbines and/or generators running on diesel or bio fuels/biogas is also used. Power generated by the PV array during the day is stored in the battery bank through an energy manager, which controls the complete system. Diesel generators are expensive to run, and may also require frequent maintenance support. A judicious mix of solar and other renewable technologies, coupled with a diesel generator/grid, can offer a techno-commercially viable solution that will

power the backbone of rural connectivity. The resultant hybrid system thus offers an optimal solution at a substantially lower cost. It is ideal for electrification of remote villages in India. Cutting edge technologies based on latest research to integrate dual power sources in the most ideal way. Features of hybrid power generation with biogas and solar panel which is very useful in upcoming time.



Hybrid solar and biogas power plant system with MPPT

Fig(1.1) Functional Block Diagram Of Hybrid System

the concept used for hybrid system by using biogas and solar panel is depicted in fig(1.1).the energy generated by both system is controlled by dc control unit where we are interested to integrate both power at same frequency level and depending upon requirement it may be converted into ac by using inverter for operation of various load.

II. LITERATURE REVIEW

Several works are going on solar photovoltaic systems and biogas for realizing the importance and significance of renewable technologies. There are some of the approach & ideas given by various researchers and scholars.

Li Wang, Ping-Yi Lin [1] Title of paper Analysis of a Commercial Biogas Generation System Using a Gas Engine–Induction Generator Set.

Vicente Salas and Emilio Olias [2] Hybrid Powering System for Stand-Alone Remote Telecom Applications.

Janani Chakravarthi [3] presented a paper of biogas and energy production biogas.

Zhanping You1, Shijun You1, [4] Biogas Power Plants Waste Heat Utilization.

Jiang Yao-Hua, Xiong Shu-sheng, [5] in this paper Research of Biogas as Fuel for Internal Combustion Engine.

P. Nagalaxmi1, M. Veda Chary,[6] in this paper he gives idea about Efficient Energy Management System with Solar Energy, working as Associate Professor Dept of ECE, CMR College of Engineering and Technology, Hyderabad, AP-India

Jozef Fiala, Ph.D.[7], Anna Michalíková, Ph.D. - Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology, Institute of Safety and Environmental Engineering.

III. BIO GAS

Biogas is gaseous mixture of methane, carbon dioxide, hydrogen Sulphids and several other gases, produced by anaerobic fermentation of organic material such as animal and human manure, leaves, twigs grasses, industrial

waste, etc. This energy release and allows biogas to be used as a fuel. It used in a gas engine to convert the energy in the gas into electricity and heat.

3.1 Working of Bio Gas Plant

Slurry (a mixture of equal amounts of biomass and water) is prepared in the mixing tank. Preparation of slurry inlet pipe through the digester is fed into the chamber. The plant is left unused for about two months and the introduction of slurry is stopped. During this period, anaerobic fermentation of biomass takes place in the presence of water and produces biogas digester. Biogas being lighter rises up and starts collecting in the gas holder. The gas holder is now starts moving. Gas holder cannot rise beyond a certain level. Starts collecting more and more gas, more pressure to be exerted on the slurry begins. Spent slurry is forced into the chamber now shop from the top of the chamber. The chamber is filled with slurry store expenses, additional overflow tank is forced out through the outlet pipe. The later is used as fertilizer for plants. Biogas supply store to get gas from the gas valve is opened. Begins to produce biogas, gas cost a steady supply of fresh slurry and the introduction of slurry can be ensured by regular removal.

3.2 Biogas Plant Output

The output biogas from biogas plant used as a fuel in order to convert mechanical energy into electrical energy by using IC(internal combustion) engine. For multiple rural application into biogas engines a conversion kits evolved by Dr. G.P. Govil with collaboration of lit Delhi can also be used.

IV. PHOTOVOLTAIC AND THEIR WORKING

Photovoltaic are the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons. When these free electrons are captured electric current results that can be used as electricity.

Photovoltaics were initially solely used as a source of electricity for small and medium-sized applications, from the calculator powered by a single solar cell to remote homes powered by an off-grid roof top PV system. As the cost of solar electricity has fallen, the number of grid-connected solar PV systems has grown into the millions and utility-scale solar power stations with hundreds of megawatts are being built. Solar PV is rapidly becoming an inexpensive, low-carbon technology to harness renewable energy from the Sun.

The International Energy Agency projected in 2014 that under its "high renewables" scenario, by 2050, solar photovoltaics and concentrated solar power would contribute about 16 and 11 percent, respectively, of the worldwide electricity consumption, and solar would be the world's largest source of electricity. Most solar installations would be in China and India.

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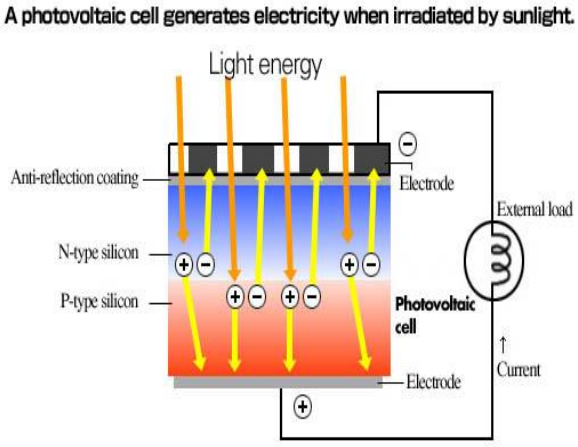


Fig. (4.1)Working principle of a PV cell

Internal working of photovoltaic cell are based on concept of modern physics as depicted in Fig. (4.1).

Working principle of a PV cell Light energy strikes the solar cell, electrons are knocked loose from the atoms in the semiconductor material. Electrical conductor to an electrical circuit, are attached to the positive and negative sides that an electric current of electrons, can be taken as electricity. This electricity can then be used to power a load. A PV system consists of many components. These include solar cells, mechanical and electrical connections and mountings and means of regulating or modifying the electrical output.

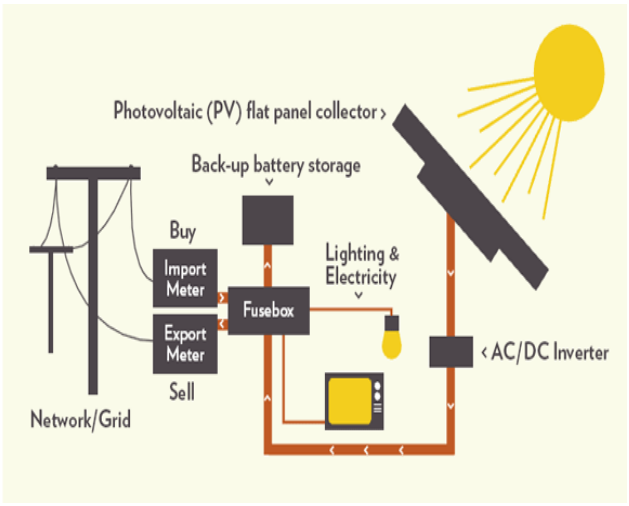


Fig. (4.2) A simple PV system

Due to the low voltage of an individual solar cell, multiple cells are then linked together into a photovoltaic array photovoltaic modules (solar panels usually called), are combined. Electricity generated, stored or used directly can be fed into a large electricity grid. Create a joint system for a PV system can be combined with domestic power generators. Solar power generation from solar radiation is taken into account. According to current scenario PV module efficiency 14.3% is considered. Due to this in order to increase efficiency of system the concept of hybrid system are used. The combined power system is completely used up for energy resources and healthy environment which gives a system

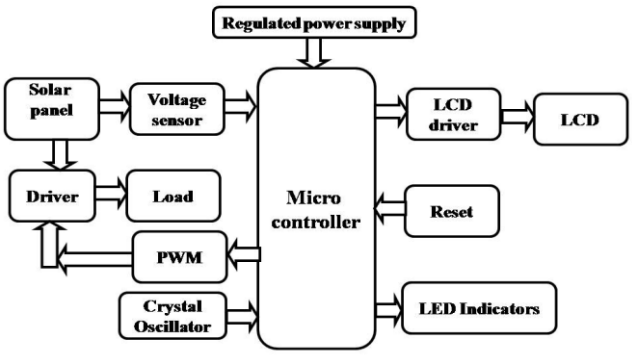
4.1. Maximum Power Tracking for Photovoltaic Power Systems

PV modules still have relatively low conversion efficiency; therefore, controlling maximum power point tracking (MPPT) for the solar array is essential in a PV system. The amount of power generated by a PV depends on the operating voltage of the array. A PV's maximum power point (MPP) varies with solar insulation and temperature. It's V-I and V-P characteristic curves specify a unique operating point at which maximum possible power is delivered. At the MPP, the PV operates at its highest efficiency.

This idea aims at designing an optimal power point tracking system for solar. The system is capable of maximum energy from solar panel with a mechanical tracking towards sun. MPPT is also a fully electronic system that varies the electrical operating point of the modules so that the modules are able to deliver maximum available power.

The main controlling device of the whole system is a Microcontroller. Solar panel, voltage sensor, LCD, and load are interfaced to Microcontroller. The Microcontroller initially measures the voltage from solar panel without load connected. Also, the Microcontroller measures the voltage from solar panel under load conditions. The microcontroller takes the decision of operating the load through PWM (Pulse Width Modulation) until the maximum voltage is obtained from solar panel without degrading the load performance. To perform this intelligent task, Microcontroller is loaded with an intelligent program written using embedded 'C' language.

Maximum power point tracking



V. PROJECT MODEL FOR GENERATION OF ELECTRICITY

Biogas based Electricity Generation Composting by NADEP method this method basically involves placing select layers of different types of compostable materials in a simple, mud-sealed structure designed with brick and mud water. We have taken following data for our calculations based on biogas plant working in Thapar University.

These data are case study of Study of Combined Renewable Power System for Electricity Generation published in International Journal of Research in Advent Technology, Vol.2, No.9, September 2014

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It can be installed and commissioned based on about 150–200cattle, 3000 human waste [9].

Project model-1 Salient features of the project are as follows: Power generation from human waste.

SR.NO. ITEM DETAILS

1. Plant Capacity for Captive Power Generation 85 M^3 /day

2. Plant Model 40 days HRT, Vertical KVIC

3. Daily human waste requirement for the plants 3000 human waste.

4. Human waste of 200 person produce

5 m^3 [10]

Producing of biogas by per person

5÷200 =0.025 m^3

3000 human waste is produce

3000×0.025=75 m^3

5. 5m3 biogas generate 12 kwhr [10]

Generation of per m^3

12÷5 =2.4 kwhr 75m^3

Biogas generate 75x2.4 =180kwhr

6. Total cost of the project

Rs. 20, 00,000.00

7. Recurring expenditure /annum (A)

Rs. 1, 20,000

8. SAVINGS: As electricity bill

Per year @ Rs. 4.50/unit

(

B) 65,000 units XRs.4.50 =Rs.2, 92,500

Manure sale/use per year @

Rs. 530/ ton (C) 450 x Rs. 530

=Rs.2, 38,500

Net savings /year =[(B+C)-A]

Rs.4, 11,000

Pay back 55Months or 4 year 8 months Approximate

Project model-2 Salient features of the project are as follows: Power generation from cattle waste.

SR.NO. ITEM DETAILS

1. Plant Capacity for Captive Power Generation - 85 M^3 /day

2. Plant Model - 40 days HRT,

Vertical KVIC

3. Daily cattle waste requirement for the plants

150-200 cattle waste

4. Cattle waste of 200 cattle produce

7.2 m3 7.2÷200 =0.036 m^3

Producing of biogas by per cattle is produce

2100 kg x 0.036=75 m^3

5. 5m3 biogas generate 12 kwhr [10]

12 ÷ 5 =2.4 kwhr

Generation of per m3- 75m3

Biogas generate 75 x 2.4 =180 kwhr

6. Total cost of the project

Rs. 20, 00,000.00

7. Recurring expenditure /annum (A)

Rs. 1, 20,000.00

8. SAVINGS: As electricity bill per year @

Rs. 4.50/unit

(B) 65,000units x Rs.4.50 =Rs.2, 92,500

Manure sale/use per year @ Rs. 530/ ton(C)

850 x Rs. 530=Rs.4, 50,500

Net savings /year = [(B+C)-A] Rs.5, 65,000.00

Pay Back 48Months or 4year8months Approximate

Let the Approximate demand of one day 1336 Kwh/day of connected consumers.

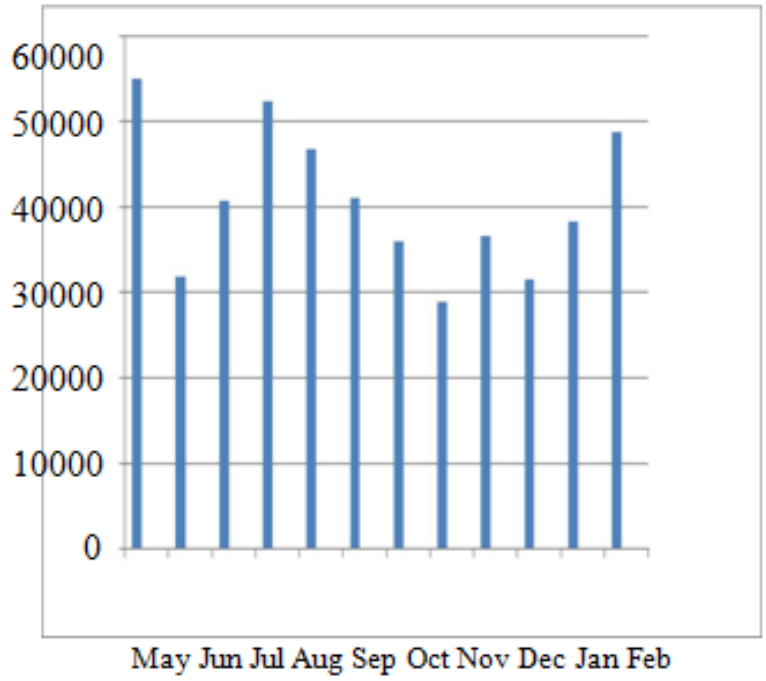

Fig (1.4) the bar chart electricity Consumption in Thapar university May 2009 - Apr2010.

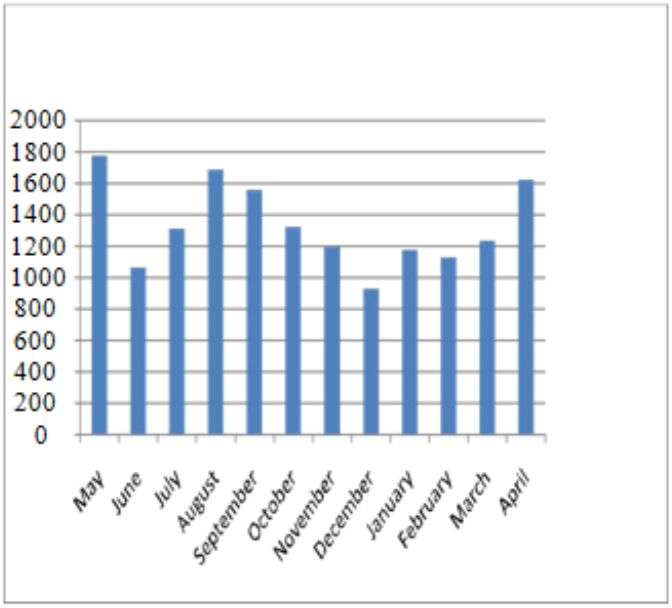

Fig 4.2 Average electricity consumption of the month

VI. SOLAR-BIOGAS COMBINED POWER GENERATION

The output of hybrid Combination system with biogas generation and solar generation with max power tracking stored in the battery bank. This DC power converted by inverter into AC power in order to operate various electrical load. The inverter has in-built protection against short-circuit, overheating, low battery voltage and overload. The battery bank is designed to feed the loads up to a certain number of days with no sun or wind/biogas, depending upon the system requirement.

Prime mover system is running by I.C. Engines use of biogas in diesel engines. Existing diesel engines can be modified to run on dual fuel while still retaining the ability to use diesel fuel only, Petrol engines: These engines can run on 100% biogas.

Biogas is a type of gas that is formed by the biological breakdown of organic matter in an oxygen deficient environment. It is counted as an eco-friendly bio-fuel. Biogas contains 60% methane and carbon dioxide. It can be employed for generating electricity and also as automotive fuel. Biogas can be used as a substitute for compressed natural gas (CNG) or liquid petroleum gas (LPG).

There are various benefits of biogas. There are four basic factors that determine the total performance of a biogas power plant.

1-AGRONOMIC: Optimal cultivation and harvest, perfect silage, silage drawing.

2-BIOLOGICAL: Pre-treatment of biomass (BIO accelerator), ideal dose, and the mixing time - with our program META N max reach really high levels.

3-ELECTRIC: Biogas with high methane content and choosing the right co-Generator, we can achieve significant increases in electrical efficiency.

4-THERMAL: Also the thermal energy produced by generators must be exploited.

VII. CONCLUSIONS

In this paper we proposed a hybrid system to distribute the power generated from renewable sources efficiently. Hybrid system is a system which is fully used of over energy resource and gives healthy environment by increasing the capacity of biogas plant system with hybrid solar panel. It is possible to construct a solar grid parallel to the commercial grid which solves the problems of electricity in future and it can be distributed effectively to the rural and urban areas which solves the problems of electricity. But the problem with this system is that to require huge inverter to store the largely variable solar energy and its maintenance. This can be overcome by constructing solar grids parallel to the existed grids by the government.

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