ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 7, July 2017

Hybrid Model of Solar and Effluent Water Based Power Generation

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ABSTRACT: India stands in second position in terms of population. So it one among the most densely populated countries. Especially in cosmopolitan cities, buildings can be found elbow to elbow. As a consequence of denser population, power crisis and sewage management are challenging issues faced by India [9].

[1]This paper mainly focuses on hybrid power generation by utilising renewable resources such as treated sewage water and solar energy Which could meet the needs(agricultural activities, household activities ,etc [3-4]) of people in cities to an extent. Not only urban areas even rural areas have ample amount of natural water flow and solar energy [2] but not the power grid connection. An experimental setup in which sewage water treated in sewage plant and sunlight are passed on to turbines and solar panels, then into the alternator and dc to dc convertor respectively. Further charge controllers are used for better performance, battery and inverter to store the energy. The plant used here includes renewable energy and local generation in order to reach future growth needs. It also ensures in reducing cost and improving efficiency [6].

KEYWORDS: Efficient Power Generation,

I.INTRODUCTION

An outline of Hybrid power generation system using the renewable resources such as treated waste water (Sewage) i.e. effluent and the solar energy, is described here. Firstly the sewage water treated in Sewage Treatment plant. And it includes physical, chemical and biological contaminants. It's motive to generate electricity environmentally. Here the treated sludge suitable for disposal of recycle (usually for agriculture) and effluent water used for generating electricity by the small Hydro power plant. Effluent water of sewage plant at a more pressure or flowing with high velocity that can be used to run the turbine or impeller of turbine coupled to Generator and therefore the electrical energy is becoming more and more popular as it is reliable and requires least maintenance and care. Solar Panels attached with this hydro model also generated certain amount of energy. The output of these two hydro model and solar panel are connected to a charge controller and from there the total generation of power can be estimated by this hybrid model. Output power has been calculated for available different head and flow rate of the waste water as well as the availability of sunlight. Various types of the turbine-generator sets for different available head have also suggested for reliable operation of the developed in this plant. It is not dependent on the season because the availability of waste water is always maintained. And usage of the solar panels makes sure that the power generation is consistent during summers when there is more sunlight. During other seasons of the year, the water flow will compensate the less availability of sunlight. Power generation through this method is expensive in initial stages but cheapest in maintaining and the production cost. This hybrid plant is focused on reducing fuels and utilizing the renewable resources. This type of plant has used a range of innovative solution, including renewable energy and local generation to reach future growth needs while improving efficiency and reducing cost.[6]

This hybrid model is renewable, non-polluting and environmentally benign source of energy. Hydropower is based on simple concepts of moving water turns a impeller of turbine, the turbine impeller spins a Generator generate electricity is produced. The waste water falling from a height has been utilized as to the source of the turbine since long time; the oldest renewable energy technique is known to the mankind of mechanical energy conversion as well as electricity generation.

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PROJECT DESIGN

Flowing water has a lot of kinetic energy which can be harnessed to generate power, in metropolitan cities a lot of effluent water is left in canals this water in the canals can be used to generate electricity, also to prevent evaporation of water the top of the proposed design solar panels are placed on top, hence more power can be generated if we go for hybrid models.

The above structure shows the project design. It has three impellers which contained 12 numbers blades [11]. Three impellers are connected on the same shaft. Which has a pulley mechanism that connected to the generator with belt mechanism? The output of the generator is given to the charge controller. Which maintain the voltage level. Supporting structure made for the impeller as shown in the above. On top of that structure, placing solar panels to get maximum power extraction. Combining both solar and hydro. Charging battery and output of that connected to the load.

Block Diagram

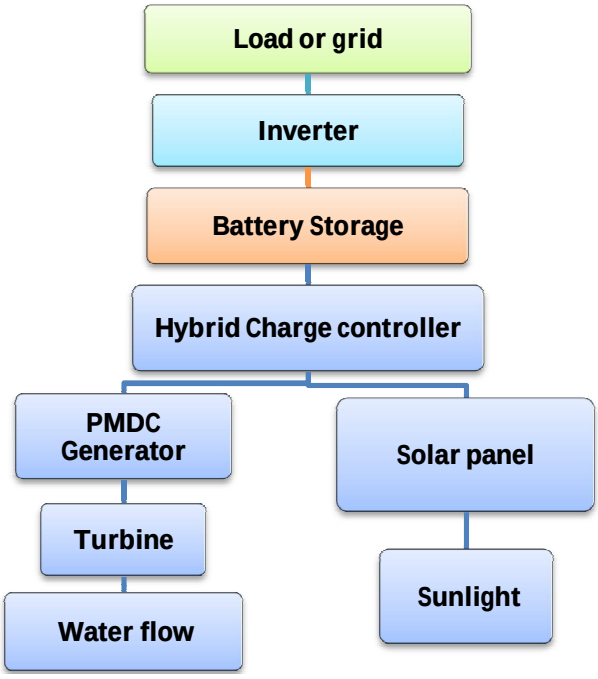

Fig 4.1: Block Diagram of Hybrid Model of Solar and Effluent Water Based Power Generation

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In the above shown block diagram of the hybrid model, it can be seen that the combination of effluent water from the sewage treatment plant and the sunlight is used for the power generation. Flow of water is used to run the impeller of the turbine and turbine coupled with a generator using pulley mechanism. Thus the Generator produces the electricity. The generated electricity is fed to the battery through the charge controller. In solar system, sunlight falls on the photovoltaic panel produces the electricity. This is fed to the battery through the charge controller. Energy stored in the battery can be used for household purposes or can be fed to the grid by using Inverter.

SITE SELECTION

A site which consists of existing hydel energy which can utilize to produce electrical energy, using a hydel power is suitable for this project. In this type of site search for the power generation selected "27 MGD Primary sewage treatment plant, Vrishabhavathi valley, Mysore road, Bangalore for project model testing. The site consists of a Sewage water plant which cleans the water partially. Most of the bigger Cities have STP. If we utilize these STPs to generate power an ample of power crisis could be met with by this method. The project carried out in an STP plant area spread over 40acres of land. The land consists of renewable sources in a larger amount. [15]

Theory and Assumption

Normally, Micro-hydro and Pico-Hydro power system are found in rural or hilly area but now with this project, it can be introduced in urban city too having the drainage system. The drainage water cleaned by STP (Sewage water treatment plant) as well as partially cleaned water by these STPs that is Effluent water, such water force is used for generating the power. This is an example of typical Micro-hydro system application used in urban areas. This system can also be made operated in upper water and river water reservoir with some modifications in the existing model. From the reservoir, water flows to down-hill through a piping system. This type downhill mechanism is called "head" and this type of water flow produce kinetic energy for rotating a Hydro turbine system. Thus, the turbine will be rotating the alternator, generates the electricity. This generated electricity can be directly supplied to the users, or can be stored in battery or other storing devices. [15]

Solar Photovoltaic working principle.

A photovoltaic cell involves P-type and N-type semiconductors with various electrical properties, combined. The joint between these two semiconductors is known as the "P-N intersection."

Daylight striking the photovoltaic cell is consumed by the cell. The vitality of the assimilated light creates particles with positive or negative charge (gaps and electrons), which move about or move openly every which way inside the cell.

The electrons (-) tend to gather in the N-sort semiconductor and the gaps (+) in the P-sort semiconductor. In this manner, when an outside load, for example, an electric globule or an electric engine, is associated with the front and back cathodes, power streams in the cell.

V. RESULT AND DISCUSSION

In urban cities, usual output of effluent by STPs is 100 Million Litres per day.
Calculation goes with this assumption of water outflow.
For, 100 Million Liter water per Day & 1 meter height head and 1MLD water can be converts to Liter/ second. [11]
The equation to calculate the flow is:
Q =Aavg×Vsurface × correction factor (4) where
Q= Flow rate (litres per second)
A= Average cross-sectional area (m 2)
V surface = Surface velocity (meter per second))

100X1000000Litre=100000000Litre/day
=1157Litre/sec
=1.157m^3/sec
Height = 1 meter
Head loss (30%) = 0.7mtr

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Gravity = 9.81meter/second²
Power input = Height X Flow Rate X Gravitational Force = 1m X1.15m X9.8m/s ²
=11.27KW
The electrical power that can be generated is given by [13]
Power out = Q* Hg *G* E
P = Power developed in Kilo watts
Q = Discharge or flow rate in m³/sec
Hg = Effective head of water in meters
G = 9.80 m/s²
E = Efficiency of the water wheel and generator (between 0.5 -0.8)
Pout = (1157) X (0.7M) X (9.81) X (0.5)
= 3.944Kw
≈ 4Kw
Table: Three different Levels of height calculations
Calculation for different height level of water and corresponding power generation is as mentioned. Different heights used for the experiment are 1 meter, 2 meter & 3 meter. [16]

MLD	P(out) in watts For 1mt height	P(out) in watts For 2mt height	P(out) in watts For 3mt height
10	396.99	793.98	1,190.97
20	793.98	1,587.96	2,381.94
30	1,190.97	2,381.94	3,572.92
40	1,587.96	3,175.93	4,763.89
50	1,984.95	3,969.91	5,954.86
60	2,381.94	4,763.89	7,145.83
70	2,778.94	5,557.87	8,336.81
80	3,175.93	6,351.85	9,527.78
90	3,572.92	7,145.83	10,718.75
100	3,969.91	7,939.81	11,909.72

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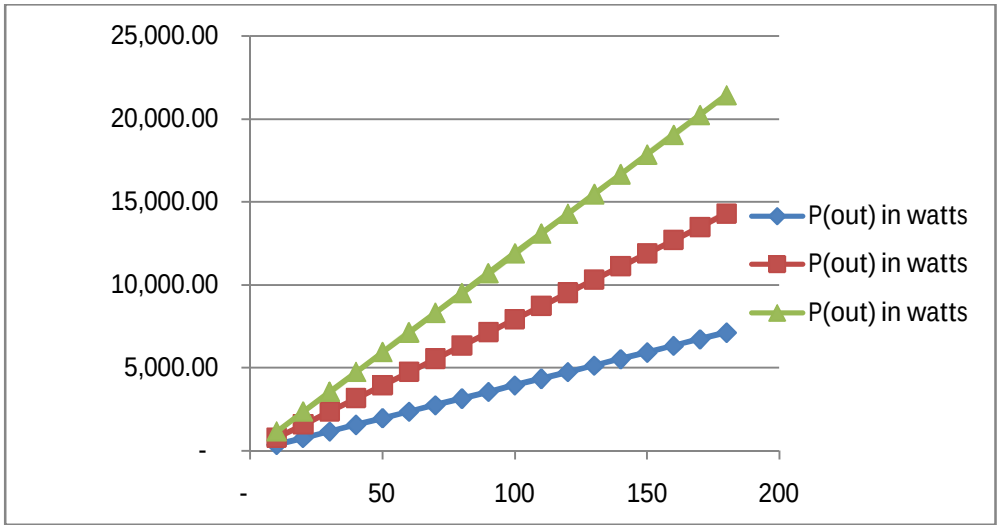

VI.CONCLUSION

Hydel assets as well as sun powered energy is utilized to make the model more proficient in power generation with the assistance of solar panel.

"Turbine-generator sets working for various heads of sewage water plant. Generator is utilized as a part of a small scale hydro control plant produced for dependable power generation. The sewage flow rate and heads are measured with summer/winter and day/night cycles. The normal power output is evaluated at various flow rates and head at the sewage water plant unit. Sewage based hydroelectric plant has prescribed to supply local agriculturists to water system purposes after water protection and power generation, this model is installed not only in urban area, it can be used for remote area where the natural water available.

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