Electricity Generation through Gravity Fed Water Pipes

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ABSTRACT

In a time of rising climate change crises there is a more pressure than ever to find effective energy harvesting method in order to secure our future. In today's word automobile sectors are introducing new technologies to run vehicles with the help of electricity. Objective of this project is to create self-sustainable system to generate electricity. Converting kinetic and pressure energy of flow of water which runs the turbine assembly couple to generator sequentially located in the channel of water. Water flow in the domestic pipes as kinetic energy has that potential to generate electricity for use and storage purpose in addition to perform routine activities such as a laundry, cook, bath etc. In this project, The high water pressure and flow inside the pipe from utility main tank that use for those usual routine activities is also using to rotate small scale hydro-turbine which is attached to pipeline at calculated required height to drive generator for electrical power generation. This project is one step towards generating clean and renewable hydro energy. Paper describes development of Pico hydro generation system and efficient utilization of water energy. Hence, this project is conducted to develops a hydro-generation system using consumed water distributed to houses has an alternative energy source for residential use. The generated power will be stored in the battery sources for the future use which will also satisfies the domestic needs. This project is implemented under the sort of environmental condition where the velocity of water flow is higher.

Keywords- Hydraulic Turbine, Losses in Pipes

1. INTRODUCTION

In today's world energy is the basic necessity for the economic development of a country. By the limited sources of non renewable energy world are focusing more on innovative, environment friendly, cost effective energy generation techniques. With the growing concern of cleaner living environment, renewable energy has generate large interest and market with high potential energy stored in water tank through the cause by the gravity, there is a potential to capture that energy using an inline turbine generator.

By focusing on residential building water tank at available on certain height which can generate the sufficient amount of energy to charge mobile battery, 12V radio, small LED light, etc.

As the water coming higher location, the potential energy and discharge increase thus increasing the amount of electricity made. We are planning to capture this untapped energy by converting this potential energy of water into electrical energy that could take the strain off power plant and other power sources. The major essential component required for this project is proper turbine economical generator. The generator will be coupled to the turbine, use to convert mechanical energy from the water into electrical energy. There are several types of turbine and each is design for special parameter, so picking the proper class of turbine is the challenging task. Currently this is an untouched renewable energy sources, but with the generator installed in inline water pipe and generating the clean energy thus reduces or cut down the pollution and energy cost by generating revenues. The main objective of this project to generating the small scale hydro energy with the help of Pico-hydro turbine generation system.

There is a huge amount of water required for a daily household application. The water in a building travels from the tanks located at the top through the pipe lines. In the dally basics tape water is use for the work at different intervals of times for applications like clinging utensils, bath, washroom, etc. We have created the prototypes in which calculation of the dally use of tape water in hours basis which will give us the exact time for which water travels from tank to tape at different pressures heads. The heads created in the pipe is applicable to run the hydro turbine generation system to generate electricity. There are many Pico-hydro turbine generation system are available in the market. We have specially chosen (12volt, 10watt) DC Pico-hydro turbine generation system.

The power generated in the turbine with the help of generator circuit assembly which is merged with the turbines carry output supply lines through which we can use and store DC electric supply.
The system carries a specific model of about 7 feet height consist of water tank at the top which is connected to the water pipe lines. The turbines are connected to the inline at the predetermined height which are use to generate electricity from the flow of water gradually.

2. DOMESTIC WATER-TANK POWER GENERATION PLANNING

Due to increasing demand of electrical energy and high billing for electricity,it's time to produce electricity for our own use. Generation of electricity in micro amount is feasible for villages,home and big residential buildings. Under the technology home water tanks are used as a small hydro power generation systemfor clean and green source of energy. Pico hydro generation system under 5kw power is used for home appliances like fluorescent light bulb,mobile charging, battery storage etc.The water is topically used for all home applications such as cooking,washing, bathing etc.between the water tank and the water tap there is a natural head created which is here used for the electricity generation. The pipeline is rearranged with the mini hydro power turbine connected to the generator which helps to convert mechanical energy into electrical energy which can be stored in batteries or directly supplied to the home appliances. Like other hydro electric and renewable source power generation systems the pollution by consumption of fossil fuels is reduced in this system and made it environment friendly. It is applicable in rural areas as the consumption is about 1kw of energy, it can be used as a domestic supply for powering temporary lamp or public facilities in urban and remote areas.
This system runs around 14-17 meters, even though the site with lower drop such as 9-10 meters is also feasible. The higher the head the definitely more power will be generated. It is a form of renewable resources, therefore it is expected to reduce the carbon emission from fossil fuel used.
Pico hydro power generation system has many advantages comparing to other energy generation system and it is much cheaper than wind and solar power generation systems. Batteries and inverters can be used to store energy and conveying to further use.
This research paper gives new idea for generation of clean and cheaper energy from home water tank. The energy from wind and solar power system is available in abundance in nature. Hybrid combination of two or more renewable sources gives high operating characteristics and improves performance and efficiency of the system.

SELECTION OF TURBINE AND GENERATOR SYSTEM

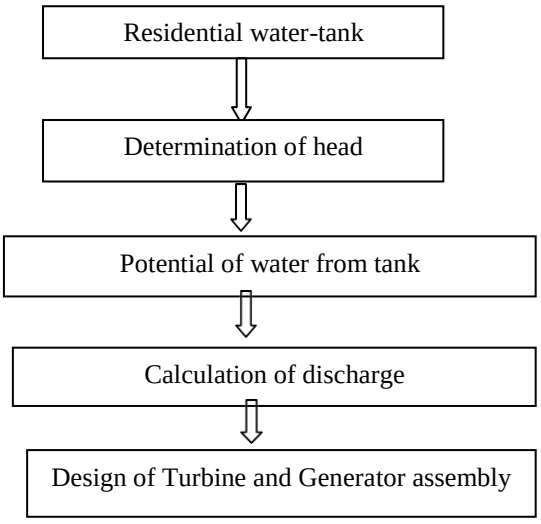

Fig.1. Selection of Turbine –Generator System

Fig 1. Shows the procedure behind the selection of turbine -genrator system. For effective utilization of water pressure selection of proper turbine and generator is most important to generate electrical energy.

DESIGN, ANALYSIS AND HARDWARE DISCRIPTION

The Pico hydro power generation system is designed and developed for the purpose of electricity generation for micro power device which can be implemented in the rural areas, buildings and other high head rating structure.

For the demonstrative purpose we have developed the model which is able to discuss the water head about 7feet height from the ground and electricity generation. From this demonstrative model we are able to calculate the amount of head generated for the various heights and amount of power for the same.

WATER TANK

For the proper head generation there should be the high pressure of water in the tank. We have used the 300 liters water tank which provides the the enough pressure inside the tank when it is full field with water.

2.1. STAND

For the demonstrative purpose we assumed the hight of a water tank from the ground about 7feet for the same we fabricated the iron stand of 7feet height on which the water tank can be installed. Ability of stand to sustain water tank weight, flexibility of stand to move, flexibility of stand to dismantle and arrange, guiding bars such parameters has been considered in the fabrication for proper and defect free model.

PIPELINE

The high head condition is created as the flow of water is straight line flow. The flow from the pipe has a ability to develop a high head condition. The pipes of about 30mm and 20mm diameter are installed in the system. The taps are installed on the pipeline as the flow of water has to be regulated for low head and high head conditions.

The mechanical arrangement makes the available hydro power to get utilized all along the pipeline. We are able to install a turbine at 2feet distance from the ground since this much water head is enough for the generation of electricity.

TURBINE-GENRATOR SYSTEM

The Pico hydro power turbine is adopted to generate electricity at Pico level. The major benefit of this turbine is that it carries an inbuilt generator system. The mechanical power produced by the turbine is converted into the electric current with the help of generator system.The Pico hydro power turbine having a power of about 12 volts and 10watt. The run time of a turbine is about 3000 hours.

The LED bulb is used for showing the result obtained from the system as it is actually generating the electricity which is glowing the bulb. Instate of LED bulb we can use energy storing battery to store electricity in the battery and use it in the future.

Fig.01 Pico hydro turbine generator system

3. WORKING

The demonstrative model design is shown in the figure. The tank full of water is placed at the top of the stand to which the pipeline is connected for the flow of water. The pipe is been connected to the water tank from the bottom most center position for generating the excess head.

As the tap of pipeline is opened the water from the tank travels to the turbine connected at the bottom of the pipe. It helps to generate electricity when the high head water goes through the turbine, blades inside the turbine converts the kinetic energy of water into the mechanical energy. The inbuilt generator inside the Pico turbine provides electric current from the mechanical energy. This electrical energy can be used for lighting the LED bulb, charging mobile batteries or can be stored for the future use.

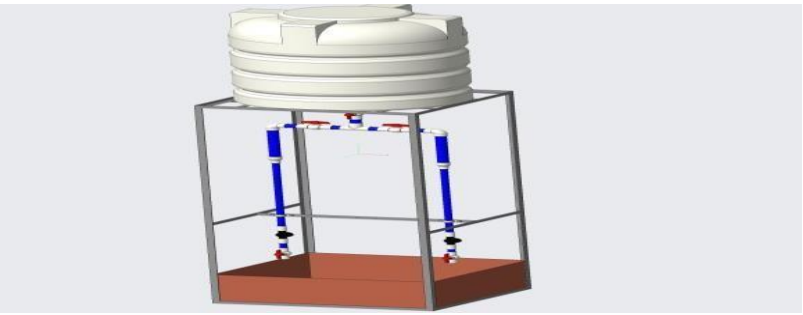

Fig. 2. Demonstrative Model

4. RESULT AND CALCULATIONS

As per our research paper, concerns with electricity generation the parameters such as discharge velocity voltage and current as to be calculated for the demonstrative model of predetermined head. We have to calculate output power required with reference to different flow rates available at a different head of residential buildings and domestic houses.

The below table shows the experimental calculation of parameters for the constant head(7 feet).

	Parameters					
Sr. No.	Tab Openings	Discharge (m^3 /s)	Velocity (m/s)	Voltage (volt)	Current (mA)	Power Output (Kw)
1.	Semi-open	0.00028	2.21	7.56	15.25	4.68
2.	Fully-open	0.00045	3.55	10.05	19.78	7.52

Table no.01 calculation of parameters at constant head

For achievable higher power there is need of calculating parameters at various head possible for the fully opened tab conditions specified in the table no. 02.

	Parameters (For fully open tab)			
Ser. No.	Head (m)	Discharge (m3/s)	Speed (m/s)	Power Output (Kw)
1.	5.48	0.0014	9.07	60.20
2.	8.53	0.0018	14.21	120.49
3.	10.66	0.0023	18.15	192.41
4.	14.93	0.0031	24.47	363.23

Table no. 02 Calculation of parameters at different heads

For the achievable discharge calculation at various heads has been calculated in lit/min and further it is converted in m3/s, velocity for various discharge is calculated as follows,

Q = A* V

Where,

Q - Discharge in m3/s
A - Area of pipe in m2
V - Velocity of water in m/s

For calculation of Hydro power potential (P) the formula use as follows,

$$P = \rho * Q * g * h * \eta$$

Where,

ρ – Density Of Water
Q - Flow rate in m3/s
g - Gravity constant (9.81 m2/s)
h - Height (Gross head)
η - Efficiency coefficient

Above calculation, the density of water is assumed constant at 1000 kg/m3, the efficiency coefficient is set to 0.8,the various heads are measured in feet and further converted into meter for formulative calculations, while the hydro head is defined as the height difference between the intake and the generating station. Thus, with these assumption, only two remaining parameters, Q and h, are needed to determine the hydropower potential for any site in a given paper.

5. CONCLUSION

As per our project electricity generation through gravity fed water pipes we develop clean and renewable energy sources. The objective behind our research paper is to design a pico hydro turbine generation system with the capacity of charging batteries, radio, small Led lights etc. The major aim of this technology is made to electrify and support electrical network to urban and rural areas at reasonable cost. It can generate up to 5 kw with power electronics and controllers. In this connection, the paper should act as evolutionary step in rural electrification. This system is to generate a specific amount of energy which can be applicable to reduce the electricity bills to the certain amount in urban and remote areas. In addition to that it can acknowledge reduction in line losses to overcome prevailing power storage, improve the reliability of power supply, power quality improvement and its management.

6. FUTURE SCOPE

As per the vision of our Hon. Prime Minister Shri Narendra Modi, Government is focusing to develop clean and renewable energy sources so, this system is one step towards his vision. This system has vast scope for implementation at domestic and commercial level. In future, there is much scope for design and development of such turbine and generator assembly that can be accommodated in systems having high heads. This system can be further used in the areas such agricultural field and lake areas.

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