International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Power Generation from Water Pipeline in Hydro Power Generator

Prof. S.M.Pimpalgaokar[1], Vaishnav N. Nandagawal[2] , Harshal S. Tayde[3] , Abhinav N. Turkar[4], Darshan G. Raut[5], Mayur S. Khot[6]

[1]Project Guide , Department of Mechanical Engineering, Priyadarshini Bhagwati College of Engineering, Nagpur
[23456]Students, Department of Mechanical Engineering, Priyadarshini Bhagwati College of Engineering, Nagpur

Abstract-
Picohydroelectricity is a dependable and effective type of clean, renewable energy. In this work, the design and development of a pico-hydro generation system that draws water from residential buildings' water tanks are discussed. The kinetic energy of the water flowing through household pipes has the potential to produce electricity for energy storage. For better operation and energy production, three novel mechanical arrangements are included: an air bladder for maintaining water pressure, U-tube piping, and a large nozzle pipe end. It uses no fuel and requires little maintenance to produce power. We could create a mechanical system that would use the potential energy that a water storage tank has from a water head to generate power. Therefore, the goal of this project is to create a small-scale hydro production system that uses water from a water tank to generate electricity for domestic usage.
Key words: Renewable energy, Hydroelectricity, turbine , diaphragm pump, portable etc.

1. Introduction

In essence, hydro-electricity combines vertical drop (often called) and water flow. Pressure is created by a vertical drop, and a hydroelectric system's continual water flow provides a reliable source of pressurised liquid energy. Because the resource is trapped in the pipes or the flame, pressed, flowing water is a particularly dense resource that hydroelectric systems convert into power at a high rate. For ages, people have used the energy of flowing water to create the first mechanical power, and for the past 100 years, electricity. Early uses included driving machines, pumping, and milling. Correct water supplies, in contrast to wind and sun, may be made available every day of the year, 365 days a year. Due to this, early settlers could power irrigation pumps and grain mills, and today individuals can produce clean, renewable energy at a fair price. In this technique, domestic water is held in a tank and then flows via a conduit (a penstock) that slopes downward. It is possible to generate electricity without incurring increased water bill costs. This system's primary purpose is to store power produced during battery charging for later use, particularly during an electrical blackout. Compared to existing Pico micro hydro systems, the suggested system provides much less electricity (8W), yet it is still affordable, simple to use, and environmentally friendly and easy to install anywhere.

2. Problem Identification

One of the most fundamental components of our universe is energy. Promoting education, health, transportation, and infrastructure in order to achieve a livable standard of living is essential for survival and important for development activities. It is also a crucial element for economic growth and employment. The previous ten years have seen an increase in global issues relating to the energy crisis, including the oil crisis, climate change, electricity demand, and limits on whole sale marketplaces. Since these problems keep getting worse, technological solutions are needed to guarantee their resolution.

One of these technological options is producing electricity as close as possible to the point of consumption utilising renewable energy sources, such as wind, solar, tidal, and hydroelectric power plants, which do not pollute the environment. A renewable energy source that derives from moving water is hydroelectric electricity. Water needs to be moving in order to generate power. The potential energy of the water transforms into kinetic energy as it falls due to gravity. In hydraulic turbines, the kinetic energy of the moving water is converted to mechanical energy by turning blades or vanes. The generator's rotor is turned by the turbine, and this mechanical energy is subsequently transformed into electrical energy.

Many different uses, including the milling of grains, the sawing of wood, and the pumping of water for irrigation, have made use of the power that falling water generates. The water wheels that turned slowly were employed to capture the mechanical energy of moving water. These early water wheels' design and efficiency advancements paved the way for the development of hydroelectric turbines. In the 1880s, the first hydroelectric power systems were created. The international energy agency (IEA) estimates that 16% of the world's electricity is currently produced by large-scale hydroelectric dams. However, these kind of projects necessitate massive amounts of land impoundment, dams, and flood control, and they frequently have an adverse influence on the environment.

3. Block Diagram

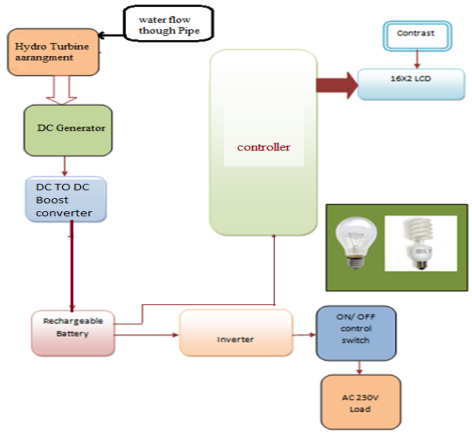


Figure 1 Block Diagram

4. Experimental working

Water storage tanks are positioned at specific heights to simulate residential buildings. First, we need take into account residential structures like apartments and villas, which are densely occupied with many people in a little space. The water tank that is initially built in the residential structure will have a large capacity. The maximum flow rate is then attained when the volume rises.

The morning hours from five in the morning to ten in the morning are when residential buildings like apartments will use the most water. For the duration of this time, practically everyone will be using one or more water sources for cooking, bathing, or washing purposes.

Since water is being continuously consumed, we reach our maximum flow rate at this time. Every day before the start of consumption time, the water tank needs to be filled so that water pressure and head are both maintained.

Following are the working of total system;

• Three hydro turbine generators are installed in the pipe, and they operate when water flows from the pipe at a specified height. At output, whole water is discharged is fall on big hydro turbine generator, forcing water flow in one direction, causing turbine generator to start rotating, and producing energy. A generator begins to run and generate power when water is used to rotate a turbine.

• through increase the dc voltage, the entire electric energy is sent through a DC to DC boost converter. Additionally, it goes via a unidirectional current controller before being stored in a battery.A control board with an LCD display uses a controller. The output voltage is measured using this control board.

• A further inverter board is utilised to change the voltage from DC to AC. Finally, an AC load is connected at the output.

• By doing so, the pipeline work will use a prototype hydro power generation model.

5. Components Specification

- **DC Generator**

A powerful magnet The mechanical energy generated by a pico-hydro system is best used to power a DC generator. High currents could be provided by a DC generator even at the lowest voltage needed for battery replacement and the operation of direct current loads. They are also significantly less expensive and smaller in size. Since no power is lost creating the magnetic field, this sort of generator is said to be more efficient.

- **Hydro Turbine Module**

A water turbine is a rotating device that uses the potential and kinetic energy of water to produce mechanical work. A force is exerted on a turbine runner's blades as a result of flowing water being directed onto the runner's blades. In this manner, power from the water flow is transferred to the turbine.

- **Battery**

In order to store the electricity generated by solar and wind energy, batteries are employed. The size of the solar or wind power plant may have an impact on the battery's capacity. Low charge leakage and low maintenance should be characteristics of the battery. The optimum option is the free discharge kind when all these factors are taken into account. Depending on the output from the hybrid systems, multiple batteries can be linked in both series and parallel to enhance or decrease the battery's capacity.

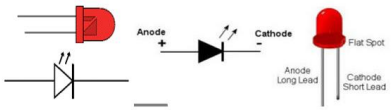
- **DC to DC Boost Converter**

A boost converter, also known as a step-up converter, is a DC-to-DC power converter that increases voltage from its input (supply) to its output (load) while reducing current.

This type of switched-mode power supply (SMPS) has at least two semiconductors (a diode and a transistor) and at least one energy storage component, such as a capacitor, inductor, or both. Filters built of capacitors are typically added to such a converter's input (supply-side filter) and output (load-side filter) in order to eliminate voltage ripple.

- **Light-Emitting Diode (Led)**

The anode (+) is the longer lead, and the cathode (&minus) is the shorter lead. The anode is on the left and the cathode is on the right in the schematic symbol for an LED (bottom). LEDs are components used in electronics for light signalization.



6. Calculation

Power Generation

In a micro hydro system, the head and the flow of the water in a river or stream define its power potential. One can calculate the potential power as follows:

$$P = Flow\ rate(Q) \times Head(H) \times Gravity(g) \quad (2.1)$$

Where

$P = Power\ (W)$

$H = Head\ (m)$

$Q = Water\ flow\ (m3/sec)$

$g = gravity\ constant\ (9.81\ Newton)$

When the water pours out of the pipeline and falls over the head, this potential energy will be converted into kinetic energy. This kinetic energy is a form of pressure that causes the hydraulic turbine's shaft to rotate. The synchronous generator will then be powered by the mechanical energy from the turbine to generate alternating current (AC) electricity. The distribution of the electricity to homes will follow. For the AC power source to reliably power any electrical equipment using it, it must be kept at a steady 50 or 60 cycles per second. The speed of the turbine, which needs to be extremely precisely managed, determines this frequency. The ideal geographic regions for using micro-hydro power are those with steep rivers that flow all year round, such the hilly regions, the hill areas of countries with high year-round rainfall, or the great mountain ranges and their foothills.

Experimental Results

In this part, Table 3 summarises the empirical findings for the suggested turbines, where the power varied depending on the model design employed. The following formula can be used to estimate the output power in a gravity-fed in-pipe hydropower plant. [8], [11]:

$$P = \eta \times \rho \times H \times Q \times g \quad (1)$$

where,

P ≡ The output power [W]

η ≡ Turbine efficiency

ρ = Water density $\left(1000 kg/m^3\right)$

H = Net head (m)

Q = Water flow rate $\left(m^3/s\right)$

g = Gravity acceleration constant $\left(9.8 m/s^2\right)$

The speed in rpm was measured using a tachometer, and the pressure was measured using a Differential Pressure (DP) transmitter. The speed in (rad/s) was calculated using the following Equation,

$$\omega = \frac{2\pi N}{60} \quad (3)$$

where,

$N = revolution\ per\ minute\ (rpm)$.

The flow metre with the Arduino was used to calculate the flow rate. Due to their poor performance, the spherical turbines with three and four blades have been removed from the study.

7. Main Benefits from This Technology

- It generates neat and clean energy (it has no negative environmental effects).
- It does not rely on the weather in the same way that the solar system and the wind system do.
- It has no impact on the water's quality for drinking.
- It is one of the least expensive ways to generate electricity (as opposed to solar and wind, which cost three or four times as much to generate the same amount of energy). • It can also be put in wastewater, agricultural, and industrial pipelines.
- Water flow can be used to continuously generate electricity.
- Simple installation
- Recovers energy from processes.

8. Advantages

•It generates neat and clean energy (it has no negative environmental effects).
- It does not rely on the weather in the same way that the solar system and the wind system do.
- It has no impact on the water's quality for drinking.
- It is one of the least expensive ways to generate electricity (as opposed to solar and wind, which cost three or four times as much to generate the same amount of energy). • It can also be put in wastewater, agricultural, and industrial pipelines.
- The constant flow of water can generate electricity.

Installation is quick.
- Recovers energy from processes.

9. Future Scope

• There are no carbon emissions when producing electricity.
• Electricity is produced without the usage of coal or oil. Natural resources have a longer lifespan.
• It will lower the per-unit consumption rates, allowing for the provision of power to all areas.
• When compared to nuclear power and fossil fuels, it is safer. These techniques make use of chemicals that, when regularly ingested, can cause a number of health issues.

10. Conclusion

A pico-hydro production system that uses water from residential buildings' water tanks is to be developed as an alternative energy source. This might be a dependable and environmentally acceptable source of energy that can be produced to expand small-scale hydro generating. This is an incredibly adaptable power source that can be utilised to provide AC electricity even in remote areas of the world.

References

1 B.Chitti Babu and K.B.Mohanty, Doubly-Fed Induction Generator for Variable Speed Wind Energy Conversion Systems- Modeling & Simulation, International Journal of Computer and Electrical Engineering, Vol. 2, No. 1, February, 2010 , 1793-8163
2 Ankit gupta,S.N.Singh and Dheeraj k.Khatod, Modeling and Simulation of Doubly Fed Induction Generator Coupled With Wind Turbine-An Overview, Journal of Engineering, Computers & Applied Sciences (JEC&AS) ISSN No: 2319-5606 Volume 2, No.8, August 2013
3 Harsh bhatt and soham jani, Energy Generation in Water Pipe Lines Savonius Water Turbine Power, International Journal of Research in Advent Technology, Vol.2, No.12, December2014 E-ISSN: 2321-9637.
4 Brian Davis,1 Chris Dorchester,2 Ted Geldmacher, 3 Tim William,4 Salah Badjou, PhD,Inpipe water generator,2012 ASEE Northeast Section Conference University of Massachuse
5 Chih-Yuan, Chang,Yen-Huai Ma,Yin-Song Hsu, Sy-Ren Huang,Yao-Hua Liu,The Feasibility of Applying Micro-hydroelectric Power Technology in Building Water Supply Pipes, International Scientific Journal Environmental Sciencehttp://environment.scientific-journal.com
6. Dipen N. Sinha;Power Generation in Pipeline; Los Alamos National Laboratory August 12, 2005.
7. H. Zainuddin, M. S. Yahaya, J. M. Lazi, M. F. M. Basar and Z. Ibrahim, Design and Development of Pico-hydro Generation System for Energy Storage Using Consuming Water Distributed to Houses
8.Tejaswini Gharge, Supriya Shintre, Shruti Bhagwat, Rasikh Solkar, Dhanashree Killedar,Mahesh Kulkarni Design, development of micro hydroturbine and performance evaluation of energy generation for domestic application , IJRSET Volume 2.