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Power Production in Water Pipes with Build-in Turbo Generator

Vandita Thantharate Shahu[a], Shahrukh Naseem[b], Sachin Kawalkar[b], Ratnesh Madavi[b], Rohit Meshram[b], Sandeep Bundele[b]
[a]Assistant Professor, Mechanical Engineering Department
[b]Students, Mechanical Engineering Department,
Jhulelal Institute of Technology, Nagpur, Maharashtra

Abstract*: The use of hydropower for generating electricity has gained increasing attention in recent years due to its renewable and sustainable nature. One promising approach is to develop electricity through the flow of water in a pipe using an inbuilt turbo generator . This review paper aims to provide a comprehensive overview of the development of this technology, including the working principle, system design, and performance characteristics. The review also highlights the potential applications of this technology and discusses the challenges and opportunities for future research.*

Keywords: turbo generator, hydropower, power generation, water pipe

I. INTRODUCTION

The flow of water in a pipe can be harnessed to generate electricity using an inbuilt turbo generator. This technology offers several advantages over conventional hydropower systems, such as smaller size, lower cost, and higher efficiency. The working principle of this technology involves the use of a turbine to convert the kinetic energy of the water flow into mechanical energy, which is then used to drive a generator to produce electricity. The system design can vary depending on the specific application, but typically consists of a turbine, a generator, and associated control and monitoring systems. The question of energy recovery from water stream transmitted within water supply systems has become an increasingly popular topic. Apart from large turbines with relatively large diameters installed in transit pipes, there have started to appear solutions to be used in the case of smaller distribution pipes. Electricity obtained with their assistance may be used to power the monitoring devices

II. SYSTEM DESIGN

The system design of a water turbine generator involves several key components. The turbine is the primary component responsible for converting the kinetic energy of the water flow into mechanical energy. The turbine design can vary depending on the specific application, but typically consists of blades or vanes that are shaped to optimize the energy conversion process. The generator is responsible for converting the mechanical energy of the turbine into electrical energy. The generator design can vary depending on the specific application, but typically consists of a rotor and stator that generate a magnetic field to induce electrical current in the stator windings. The control and monitoring systems are responsible for regulating the speed and output of the generator, as well as monitoring the performance of the system.

III. PERFORMANCE CHARACTERISTICS

Several The performance characteristics of a water turbine generator are dependent on several factors, including the flow rate, pressure, and quality of the water. The efficiency of the system can vary depending on the specific design, but typically ranges from 70% to 90%. The power output of the system is directly proportional to the flow rate and pressure of the water, and can be increased by optimizing the design of the turbine and generator.

IV. APPLICATIONS

The development of electricity through the flow of water in a pipe using an inbuilt turbo generator has several potential applications, including small-scale hydropower, renewable energy generation, and water distribution networks. Small-scale hydropower systems can be used to generate electricity in remote areas where grid connection is not feasible, or as a supplement to grid electricity. Renewable energy generation can be used to reduce dependence on fossil fuels and mitigate the impacts of climate change. Water distribution networks can be used to generate electricity from the pressure of the water in the pipes, providing a source of revenue for water utilities.

V. LITERATURE REVIEW

Kowalska et.al presented the Solutions only that have still not been put into practice. The authors are looking for partners interested in construction of device prototypes, who after verification in laboratory and semi-industrial conditions would be willing to try to implement them in real-life network systems.

Kulkarni and Ambekar performed Modeling of micro hydropower plants using MATLAB / Simulink . They mentioned that the introduction of a micro hydro power plant will reduce the huge burden without any adverse impact on the environment when meeting the localized electricity requirement. The simulation result shows that the optimal load sharing, constant voltage output and variation of load values for the micro hydro power plant is the optimal choice of the governing system constant speed. This leads to the economic activity of the system.

VI. CHALLENGES AND OPPORTUNITIES

The development of electricity through the flow of water in a pipe using an inbuilt turbo generator faces several challenges, including the need for optimal system design, the selection of appropriate materials, and the maintenance of the system. Opportunities for future research include the development of new turbine and generator designs, the optimization of system performance, and the integration of the system with other renewable energy technologies.

VII. CONCLUSION

The development of electricity through the flow of water in a pipe using an inbuilt turbo generator offers a promising approach for hydropower generation. The technology has several advantages over conventional hydropower systems, including smaller size, lower cost, and higher efficiency. The performance characteristics of the system are dependent on several factors, including the flow rate, pressure, and quality of the water. The technology has several potential applications, including small-scale hydropower, renewable energy generation, and water distribution networks. The challenges facing the development of this technology can be addressed through ongoing research and development efforts aimed at optimizing system performance, improving material selection, and reducing maintenance costs. Overall, the development of electricity through the flow of water in a pipe using an inbuilt turbo generator has the potential to play a key role in the transition to a more sustainable and renewable energy future. The scope of future work would include the design optimization of the turbine and generator components, the selection of appropriate materials, the development of control and monitoring systems, and the testing and validation of the system performance. Specific research questions that would need to be addressed include the following: 1. What is the optimal design of the turbine and generator components to maximize energy conversion efficiency 2. What materials are most suitable for the turbine and generator components in terms of durability, cost, and performance? 3. How can the control and monitoring systems be optimized to regulate the speed and output of the generator and ensure system safety? 4. How can the system be integrated with other renewable energy technologies to provide a reliable and sustainable source of electricity? Answering these research questions would require a multidisciplinary approach, drawing on knowledge from mechanical engineering, materials science, electrical engineering, and control systems engineering. The development of a functional and efficient water turbine generator system could have significant practical applications in areas such as small-scale hydropower, renewable energy generation, and water distribution networks. Additionally, the development of this technology could contribute to the overall goal of reducing dependence on fossil fuels and mitigating the impacts of climate change.

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