DESIGN AND DEVELOPMENT OFSAVONIOUS HYDRO-KINETIC TURBINE

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ABSTRACT

The contribution of renewable energy in the global electricity production is 26.2% of which 15.8% is the share of hydropower (REN21, 2019). Hydropower is the largest contributor in renewable energy but has various negative impacts on biodiversity and now-a-days, society aims to produce energy in an efficient and sustainable manner. This is the reason that growth rate of large hydropower is reduced. But unlike solar and wind, hydro is 24X7 available, reliable and predictable source of energy and therefore instead of out-looking this source, it is better to utilize the water energy more effectively.Small hydropower has been evolved as a solution to the adverse impact of large hydropower on the environment. In small hydropower, energy can be harnessed by static and kinetic method. Energy is harnessed by creating water head in static method and using flow velocity in kinetic method. Now-a-days hydrokinetic technology is growing extensively and emerging as a promising technique which utilizes the flow velocity for the energy generation. In the present study, an attempt has been made to savonius hydrokinetic turbines with the aim to develop hydropower as low head turbines.The methodology of the study comprises of five steps involving data collection from the study area, turbine designing, numerical simulation followed by post processing and analysis of the results.

Keywords: low head, hydrokinetic, savoniusturbines, hydropower.

INTRODUCTION

Almost throughout the year, consistent water currents are observed in rivers or canals in most of the parts of India. However, development towards the use of kinetic energy from river currents is not explored substantially in India. Development of electricity from the water current of river may become one of the best renewable sources as it is predictable compared to wind or solar energy.Hence,there is a need for a simple hydro turbine which can take advantage of these naturally available sources. This type of run of the river hydroelectricity systems utilizes kinetic energy from rivers or canal water-flow, which does not require huge dams. Strong candidate for the utilization of these hydropower sources is Savonius turbine because of its simplicity in construction and better starting torque. It is made of two or more semicircular vanes (or blades) attached to a vertical shaft. It can be used as standalone plant at remote locations away from the power greed and nearer to the water currentsource.

Savonius hydrokinetic turbine has the following advantages over wind turbines: It is simple in design and easy to manufacture. So, it is very easy to install in river or canal waters, because of which it is best suited for remote areas in developing countries like India. Unlike the wind turbine which needs to be installed at high elevation.Water current has a well-defined flow direction. This eliminates use of yaw control and reduces complexity. This improves reliability and reduces maintenance. Because of high power density of water, it has greater potential to extract power compared to wind turbine from a given size of the turbine and velocity of the fluid. Because of the above mentioned advantages, Savonius turbine is suitable for the following applications: small- scale standalone hydraulic turbine that can be used to generate electrical power for household applications, and for operating water pumps, charging batteries, powering telecommunications and several other low powerapplications.

1.1. Problem Statement:

Energy needs of today are incessant and their thirst cannot be quenched only through fossil fuel based non-renewable energy resources. India's capacity for renewable energy in the hydro power sector has been pegged at about 84,440 MW but we have only been able to access about 1/4th of this capacity. Hydro power on the other hand also has a lot of tenacious environmental impacts, discuss and design a different way to access and harness the enormous renewable capacity in the rivers of India with minimal environmental impact. Comprehend this design on the parameters of economical, efficiency, and sustainability. India has a lot of small rivers and canals which have low heads and thus are inefficient to be used in high head power generation and thus the possible ways to harness this renewable energy.

1.2. Objectives of present study:

1) To use the low head of minor tributaries and canals to generate electricity for supporting the rural population.
2) Design and development of compact hydroturbine.
3) Study the properties of this design and compare it on the bases of cost, efficiency and environmental impact.
4) To record and analysis the characteristics of this turbine with respect to power and efficiency.
5) To analyze the cost pro-efficiency and the payback period for the demonstrated piece and use that analysis to support the commercial viability claim for th etechnology.

1.3. Methodology:

1) Literature survey on Savonius hydrokinetic turbine and river system in India.
2) Identify the different ways to harness the flow potential of small water bodies in India.
3) Design development and fabrication of Savonius hydrokinetic turbine.
4) Testing of hydrokinetic turbine in flowing water conditions.
5) Analysis of performance of the turbine with regards to power, efficiency and cost.Discussion and conclusion about results obtained.

1.4. Scope:

1) The scope of this project is to utilize the energy of flowing water for effective power generation
2) To study the properties of the resultsobtained.
3) To calculate the cost of power generation per watt and discuss maximizing returns on investment.
4) To maximize the efficiency of Savonius hydro-kinetic turbine for low headconditions.

2 – Literature review

2.1 Literature Survey 1:

Vimal Patel ,T.I.Eldho et al. “ Velocity and performance correction methodology for hydrokinetic turbines experimented with different geometry of the channel” has studied “The aim of the present work is to study the influence of channel geometrical parameters on the performance of Savonius type hydrokinetic turbine and to present velocity correction methodology to determine the actual performance of the turbine. In the present experimental work, the effect of geometry of channel bottom and channel side wall distance on the performance of a Savonius turbine is investigated. Elevated channel bottom (hump) enhances the velocity of flow by reducing the depth of flow. Experimental results indicate that nearly an increase of 83% in power output is achieved by placing the turbine on the hump with reference to the turbine placed at the bottom of the channel. Similarly, the effect of channel sidewall location on the performance of turbine is studied for two separate cases, i. Constant flow rate -

water spilling not allowed from blocked region and ii. Variable flow rate -water spilling over the blocked region allowed. In both the cases, the obtained coefficient of power is achieved above 0.45, considering the inlet velocity of flow. The results suggest that the potential head difference between the turbine inlet and outlet has the predominant effect on the power output of the turbine when a rotor is placed between the two closely located side walls."

2.2 Literature Survey 2:

Mosbahi, Mabrouk; Ayadi, Ahmed; Chouaibi, Youssef; Driss, Zied; et al. "Performance study of a Helical Savonius hydrokinetic turbine with a new deflector system design " has studied "The use of renewable energy sources has becoming a necessity to generate electricity. Helical Savonius rotors have been preferred for small-scale hydropower generation. Numerous studies were carried out to improve the performance of the Helical Savonius rotor which has not been fully explored. In this paper, an experimental study was carried out to evaluate the performance of a Helical Savonius water rotor in an irrigation channel. In order to enhance the performance of the studied water rotor, a new deflector system design was proposed. Different configurations of the proposed deflector system were tested numerically using the commercial software ANSYS FLUENT 17.0. Without a deflector system, the maximum power coefficient is found to be equal to 0.125 at tip-speed ratio of 0.7. Using the optimal configuration of the new deflector system, the maximum power coefficient reaches 0.14. The utilization of this new design system is predicted to contribute towards a more efficient use of flows in rivers and channels for electricity production in rural areas.

2.3 Literature Survey 3:

3 Sebastian Hermann et al "Design of a Micro -Hydro Powered Battery Charging System for Rural Village Electrification" has studied " Many remote villages or farms in developing countries are not yet connected to the grid due to the high costs and the complex technology of village electrification. Rechargeable batteries are commonly used to cover the basic demands for lighting and radio / TV operation. Often, villagers carry their batteries a long way to the next town to recharge them. Solar battery charging would be one comfortable but also very expensive possibility to charge batteries directly in the house of the consumer; but using available hydropower potential to charge batteries seems to be a better solution to supply energy at low costs into remote areas. This thesis investigates and explores the possibilities of battery charging using small hydropower resources in rural areas with respect to its economical and technical feasibility. In Part 1 of the study different management options are introduced and basic economic calculations are performed. It will be shown that battery- or pre-electrification schemes can be economical, especially when compared to other conventional sources of energy like candles, LPG or non-rechargeable batteries. Part 2 deals with the technical aspects of a battery charging system and shows simple and cost effective solutions for the implementation. All different parts of a MHP scheme are evaluated with respect to their possible application in battery charging systems. Furthermore, options for battery charging and discharging procedures are explained and evaluated."

3. Constructions

Component of Savonius Hydro Turbine use for power generation system is given below,

Sr.No	Components	Quantity
1	Storage Battery	1
2	DC Motors	1
3	PVC Blades	2
4	Ball bearings	2
5	Shaft	1
6	Spur gears	2
7	Fasteners	20
8	Supporting frame	1

Parts:

1. Ball bearing

2. Shaft

3. Washer

4. Nut and Bolt

5. Spur Gear

6. Turbine blade

7. DC Motors

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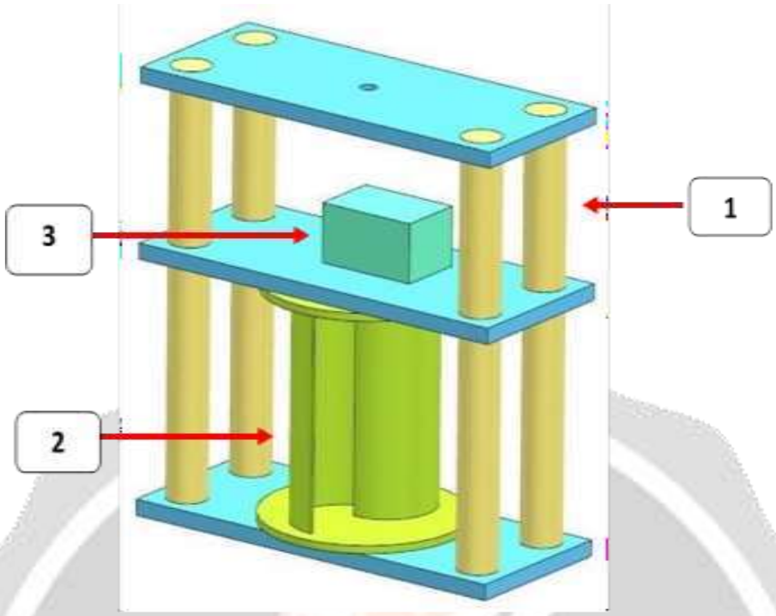
4. WORKING

Hydro power is energy from the water flow. It is renewable, inexhaustible and environmental pollution free. Hydro power is a natural phenomenon related to the movement of water masses caused. The Hydro power turbine captures the water kinetic energy in a rotor consisting of two blades mechanically coupled to an electrical generator. The turbine is mounted on a top of the frame to enhance the energy capture.
In the proposed Savonius Hydro Turbine model, a charge controller is used to regulate the power generated by water turbine. It also simultaneously charges battery and gives power to the load. The controller has reverse current protection and short-circuits protection. A specifically chosen battery is used to store the generated power. In this

present project we will make two blade type savonius turbine to test the performance of the Savonius Hydro Turbine.



Diag.**Proposed model**
1.Support Structure
2.Savonius Turbine
3.Generator Casing

5. SPECIFICATIONS

5.1. PART NAME: SUPPORTING FRAME
Part weight –8 kg
Part material – M.S.
Part quantity – 1
Part size – 450mm x 450mm x 450mm.

5.2. PART NAME: CENTRAL SHAFT
Part weight – 1.5 kg
Part material – M.S.
Part quantity – 1
Part size – Ø10 X 600 mm

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5.3. PART NAME: BLADE FRAME
Part weight – 2kg
Part material – M.S.
Part quantity –1
Part size – 200mm x 300mm x 5mm.

6. ADVANTAGES

The advantages covered by the propose system are listed as,

1) Producing much more efficiency as renewable energy generation system.
2) System maintains is remarkably reduced and becomes easy.
3) Wind as a renewable energy sources are utilized so, no waste production.
4) Producing clean, friendly to environment, renewable energy.
5) Within certain time period the installation cost gets covered.
6) Once the system is designed and developed or manufactured, the installation of system is easy.
7) Within certain time period the installation cost gets covered.

7. APPLICATION

Some of the applications for the purpose system are listed follow,

1) The system is used for domestic purpose.
2) Street lighting, Traffic signals.
3) Various monitoring systems.
4) Powering up for communication system.
5) Pump irrigation Systems..
6) As per requirement of electrical energy the system can be either designed or updated for higher energy requirement.
7) So, it can be used for almost every electronic, mechanic, viz. system needing/ require electric energy to work on.

8. CONCLUSION

While concluding this report, we feel quite fulfill in having completed the project assignment well on time, we had enormous practical experience on fulfillment of the manufacturing schedules of the working project model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of balancing problem. Needless to emphasis here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction. Here the project model will capable to produce power 3-6watt per sec.The model develops by us fulfill the required objectives & hence we are satisfied with our project work.

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