DESIGN AND DEVELOPMENT OF SAVONIOUS HYDROTURBINE

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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. ProblemStatement:

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 rura lpopulation.
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:

Nowadays a trend is noticed to use the hydro technology not only for pico hydropower,but also for larger hydropower plants, aiming at the conversion of kinetic energy present in large rivers, tidal flowsand ocean streams. This paper describes the evolution of the hydrokinetic technology and the initiatives undertaken tomake it available for rural electrification in Brazil during the last two decades. It also proposes to discuss the trends of hydro conversion for on grid electricity generation and its integration into the electricity sector.But as mentioned before, the evolution is bounded to specific socio-political and intellectual contexts.The technology for implementing decentralized pico hydropower with hydrokinetic turbine has beenmatured over the last decades, but its wide use

within society depends now on socio-political conditions.As for larger hydro turbines, it can be expected that it will follow the same trends as in windenergy.

2.2 Literature Survey 2:

Roshni Deepika Hemrom, Shibayan Sarkar,done the work on, Performance Analysis Of Savonius Hydrokinetic Turbine In Array Based At Same Input Velocity At Different Speed, according to his work,River current generation uses a generator to produce energy, changing the kinetic energy of current into a turning force by setting a water turbine in the river current. Savonius hydrokinetic turbine is designed in software CATIA V5R19 and CFD used in ANSYS 15.0 for analysis. Analysis is done by the method Fluid Flow (Fluent) in SIMPLEC method. In this velocity is constant at 1 m/s and speed is varying in rad/s as k and epsilon method used in turbulence keeping it constant in non-uniform flow. Power generated by the turbine is maximum when four turbines are used, coefficient of power is maximum when one turbine is used and turbulent intensity is almost same in array.A detailed study of computational study of the Savonius Hydrokinetic Turbine in array is done. It is very useful in small scale for power generating. Its design is simple and low cost. Maximum power is generated by the rotor on the four turbines which gives 995.6184 W at a speed of 7 rad/s. Maximum coefficient of power is on one turbine which value is 0.682623 at a speed of 7 rad/s. And the turbulent intensity is almost equal in all turbines which are maximum at one turbine whose value is 4.121123 at a speed of 7 rad/s. As we concluded that the further we can analysis on more turbines on changing its arrangement and distance and making any parameters is constant or varying. We can check it maximum efficiency.

2.3 Literature Survey 3:

L. C. Emea, J. A. Ulasib, A. I. Alade Tundec and A. C. Odunze, done the work on, Hydrokinetic turbines for power generation in Nigerian river basins, according to his work,This work presents a design for Hydrokinetic Renewable Energy (HRE), for off grid power generation for remoteriverine regions in developing nations. The uniqueness of this technique for power generation using streams and other marine currents to generate electric energy is detailed. The problem of the impact of greenhouse gas emissionson the environment, rapid increase in human population, industries, modernization and our lifestyle putimmense pressure on most power generation plants and infrastructures. The results show that for a hydro turbine the level of power output I sdirectly proportional to the flow velocity. Therefore the cost of its installation is reduced drastically from about$7,900 per installed kW to about $2,500 per kW, is easily assessable, less technical and a familiar motor technologyfor most of these communities. It is also a predictable form of energy in comparison to other emergingrenewable energy fields like wind, solar and wave

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

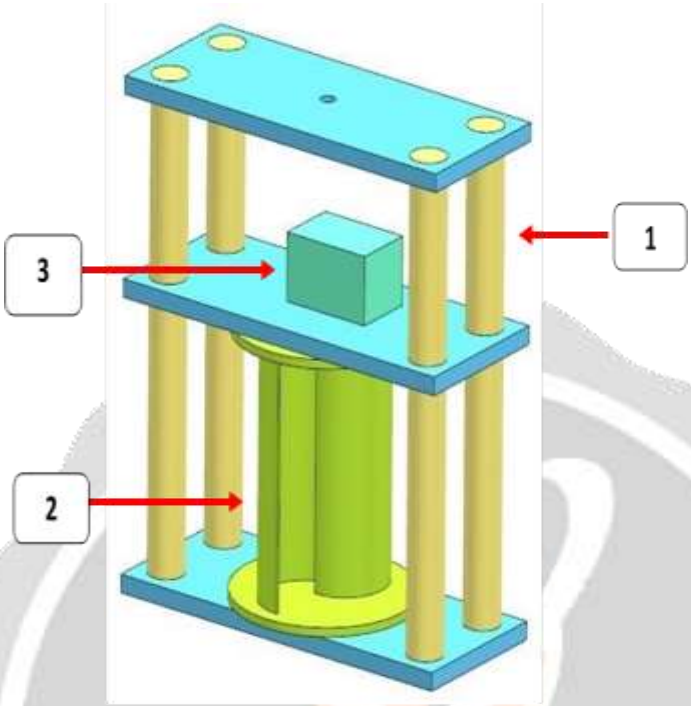
7. DC Motors

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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