In-line Water Power Generation from Spherical Turbine

Dipali Tathe dipalitathe23@gmail.com

Abstract—This project relates to an innovative approach for generating electrical power utilizing the flow of sewer waste liquid, clean, as the energy source for operating turbines which in turn, drive electrical power generators. The objective is to create self-sustainable system to generate electricity with the help of the kinetic and pressure energy of the flow of water which runs the turbine assemblies including spherical turbines coupled to generator, sequentially located in the subsequent channel of water. In this project activity, we will be studying the required process parameters, design requirements, operational parameters, cost of implementation and power generating capacity of a spherical turbine in-pipe water power generator for ten households in a street.

Index Terms — Electrical power generating system, Sewer liquid, Clean liquid, Self-sustainable system, Spherical turbines

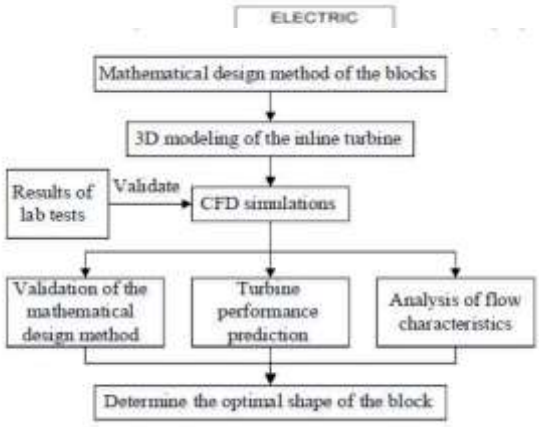
1 INTRODUCTION

1.1 AIM

To extract the pressure energy of the flowing water from the pipes with the application of in-pipe turbine for lighting purpose. [9]

1.2 OBJECTIVES

- Harnessing the energy which does not harm the eco- system.
- To generate consistent, predictable energy 24/7
- Generate clean, reliable, low cost electricity.
- Eliminate dependency over fossil fuel.
- To developing countries and remote area. [9]



2 IN-PIPE WATER POWER GENERATION

Water possess a lot of energy which is in the form of kinetic and pressure energy flowing vertically through pipe. The tur- bines working till date occupies a large amount of cross sectional area in pipe. When the area reduces, it converts pressure energy into kinetic energy which results in increase of velocity. This velocity of water is utilized in in-pipe turbine and used for generating electricity.

The in-pipe water generator is an electrical power generating pipeline which can produce renewable energy completely clean, reliable low cost electricity. The in-pipe turbine is setup in the pipe, the flowing water strikes the spherical blades of the turbine and leads to the rotation of it. The vertical shaft of the turbine is coupled to the generator which generates electricity and stores in batteries. [9]

Fig 1 Basic flow chart

3 COMPONENTS & ITS REQUIREMENT

PVC TEE JOINT

The tee joint of polyvinyl chloride provide housing for the in-pipe turbine. The pipe diameter and the tee joint's inner diameter is same for smooth accommodation of turbine.

The web of joint is covered with a PVC cap. A hole is drilled through the cap and bottom

portion of the PVC joint. The vertical shaft of the turbine is mounted in the bearings fixed in the hole, which reduces the friction.

IN-PIPE TURBINE

The turbine consists of a rotatable shaft which has its own axis of rotation and the set of the blades are fixedly attached to the rotating shaft. The turbine shaft is coupled with the assembly of generator. A gearbox is provided in between to in- crease the RPM of the generator. The electricity generated is stored in a storage battery for the lighting application when needed. [9]

Fig 2 Proposed turbine model

Fig 3 Turbine installation in pipe

4 DESIGN CALCULATIONS

Determination of power output

P = g * Q * H * So

Where

P = power developed

g = gravitational acceleration

Q = design flow rate

H = head

So = overall efficiency

In our case;

Turbine efficiency=0.85

P=9.8x00.0023x2x0.85=8.986w

Assumptions: (One Apartment)

Loss of pressure head (h) = 2 m_{water}

Pipe diameter (D) = 19.05 *mm* (3/4 *in*)

Velocity = 8.0 *m/s*

Calculations: (One Apartment)

(Q) = Velocity × Area

$= 8.0 \times (\pi D^2/4) = 0.0023\ m^3/s$

Pressure loss (Δp) = $\rho \times g \times h$

$= 1000 \times 9.81 \times 2 = 19{,}620\ Pa$

Power (P) = $0.8 \times 19{,}620 \times 0.0023 = 36\ W$

Total power of the building

$= 40 \times 36 = 1{,}440\ W$

$= 1.44\ Kw$

5 ACTUAL MODEL

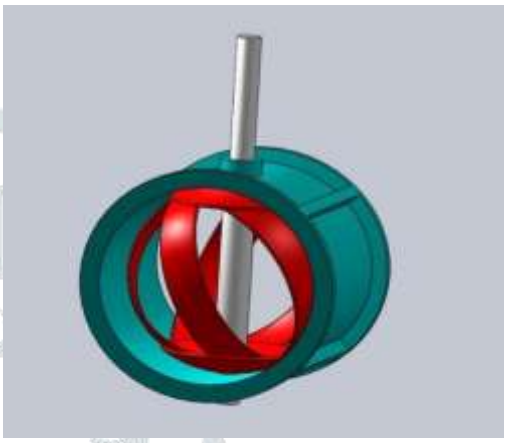


Fig 4 Proposed model

6 RESULT

Therefore, for producing 0.00135kw of power, a turbine is to be hit with flow rate of 406 m^3 per hour working at 1440 rpm. The working pressure of fluid will be 3.5 kg per m^2.

7 BENEFITS

1. Free energy generation from pipe water.
2. It does not require full pipe flow.
3. More customization could lead to small turbines to be fitted in house pipes.
4. Simple design.
5. Low cost.

ACKNOWLEDGMENTS

This paper shall be incomplete if we do not convey heartfelt gratitude to those people from whom we have got considerable support and encouragement during this project. Many people helped, provided direction technical information and advice at all stages of our project and it's our pleasure to say vote of thanks to all of them. However, with the help of

our project guide “Mr. Santosh Jadhav” it seems much more interesting to write this thesis then we expected. Also we are very much thankful to our college S.R.I.C.T., which pro-vide us a good study environment and access of workshop facilities.

CONCLUSION

In this study, the design can further be implemented on other flowing bodies of water such as rivers and canals by increasing and decreasing the size respectively of the turbine as this design can be applied over multiple flowing bodies of water. inline spherical turbine was newly developed for hydropower generation from urban water mains using limited water head. The proposed inline turbine can be used to supply continuous power to water monitoring sensors and meters, which are widely used in water supply systems worldwide. In particular, this study proposes a block design method for inline spherical turbines in water supply mains.

REFERENCES

[1] D Hoffmann, A Willmann, R Gopfert, P Becker, B Folkmer, “Energy Harvest-ing from Fluid Flow in Water Pipelines for Smart Metering Applications.”

[2] Brian Davis,Chris Dorchester,Ted Geldmacher, Tim William, Salah Badjou, PhD, “In-Pipe Water Generator”

[3] Marco Casini, “Harvesting energy from in-pipe hydro systems at urban and building scale”

[4] Jeffrey L. Cripps, “Waste Water Electrical Power Generating System”

[5] Seymour R. Levin,“Small Turbines In Water Reclamation Facilities For Gen-eration Of Electricity”

[6] Rakesh C, A H Akshay Krishna, Anwin T.V Joseph, Advaith M, “Theoretical study and the performance test of lucid spherical turbine” International Jour-nal for Innovative Research in Science & Technology, Volume 3, July 2016.

[7] Vyom Pathak, Priyanshu Parekh, Vishal Mistry, “In pipe spherical turbine for energy extraction” International Research Journal of Engineering and Tech-nology, Volume 3, May 2016.

[8] Mulunkuntla Vidya Sagar, Elumagadla Surendar, “Design and fabrication of spherical-s turbine, International Journal of Latest Trends in Engineering and Technology, Volume 7, June 2016.

[9] Vasu Dixit, Nirav Patel, Rhishabh Jadhav, "In-pipe Water Power Generation from Spherical Turbine"