International Journal of Scientific & Engineering Research, Volume 8, Issue 4, April-2017
ISSN 2229-5518

In-pipe Water Power Generation from Spherical Turbine

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Abstract— An environmental protective electrical power generating system is the need of this generation. This project relates to an innovative approach for generating electrical power utilizing the flow of sewer waste liquid, 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 waste 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 purposes.

1.2 OBJECTIVES

- Harnessing the energy which does not harm the ecosystem.
- Energy security and to generate consistent, predictable energy 24/7
- Generate clean, reliable, low cost electricity.
- Eliminate dependency over fossil fuel.
- Turn kinetic energy into a revenue stream through power purchase agreements.

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 turbines 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.

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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.

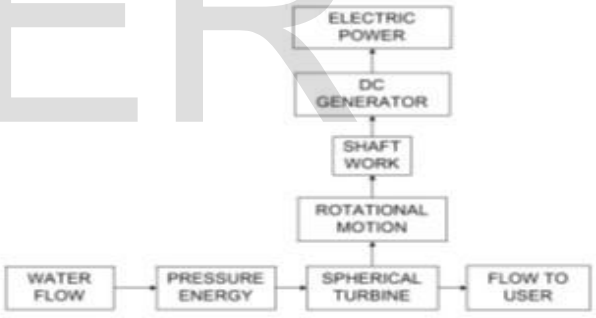

Fig 1 Basic flow chart

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 as-

sembly of generator. A gearbox is provided in between to increase the RPM of the generator. The electricity generated is stored in a storage battery for the lighting application when needed.

Fig 2 Proposed turbine model

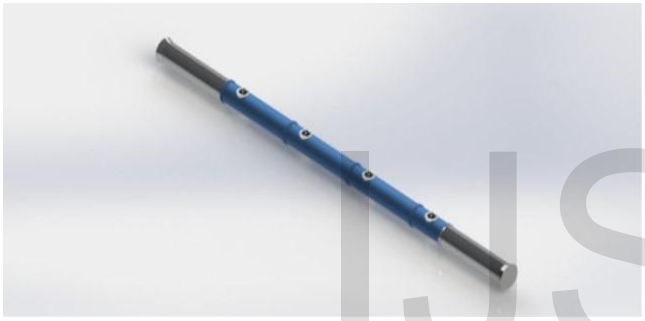

Fig 3 Turbine installation in pipe

4 DESIGN CALCULATIONS

Assumptions:

1. Each household consists of four persons.
2. Each household generates a constant volume of sewage water.
3. Each household consumes a constant amount of electricity.
4. The inlet volume remains same throughout and after treatment (recycling)

Average generation of sewage water per household per day = 7500 litre approx.

Therefore, generation of sewage water of 10 households = 75000 litre = 75 m^3 per day approx.

Average discharge capacity of Sequence batch reactor = 65 m^3 per day approx.

Average consumption of electricity per household per year = 131 kwh approx.

Average consumption per capita consumption = 31 kwh approx.

Therefore, One month consumption = 11 kwh
One day consumption = 0.36 kwh
One minute consumption = 0.00025kwh

Estimated power production by a single unit of in-pipe water power generator consisting of 4 turbines is 18 kw per day.

Similarly one minute production can be = 0.00125 kw

Soon after the final stage of treatment or recycling process, the water needs to pump from the collector chamber to the subsequent channel (pipe) of water consisting turbines.

5 RESULT

Therefore, for producing 0.00125kw of power, a turbine is to be hit with flow rate of 306 m^3 per hour working at 1440 rpm. The working pressure of fluid will be 2.5 kg per m^2.

6 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 Darrius design
5. Cost effective.

7 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. Rudraduttsinh Parmar"** 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 provide us a good study environment and access of workshop facilities.

8 CONCLUSION

Selection of in-pipe turbine to generate power form the flowing water is an innovative approach towards renewable energy. This new scheme has provided us with a low-cost electricity generation which is big assistance in helping the world. Unlike other renewable energy source, it can be utilized in both day and night time with the applicant of flowing water's energy.

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