



Development of a Simplified Francis Turbine for Pico-Hydropower Generation

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Abstract

The world's hydropower potential from rivers and reservoirs amounts to no less than 15 billion MWh per year and only about 20 percent of this has been developed. Hydropower is not only environmentally friendly but also cost-effective. Hydropower plants have the highest operating efficiency of all known generation systems.

-Nowadays alternative energy becomes an important factor in industrial and developing countries. The environment pollution is so serious that all possibilities of a "clean" power supply should be developed and used. Using the power of small sites is one option to make a step in the right direction.

Large potential of energy still remains untapped in Low-Head, High-Flow sites such as irrigation canals in several parts of the country. This energy can be utilized to augment the gap between demand and supply. The advantages of Low-Head, High-Flow small hydropower schemes are that being in a plain area, easily accessible and having assured water availability as canals are running for quite a long time.

Small scale Francis Turbines that could be used at Low-Head, High-Flow sites are not popular because of the high cost of the turbine itself. During this study, the flow analysis within the turbine runner under similar operating conditions of the actual turbine was carried out. Graphical and numerical simulation was done to determine and display the velocity profile and pressure distribution within the turbine runner. The information was used to design a simplified Francis Turbine that could be fabricated without using sophisticated manufacturing processes.

The developed turbine was tested in a water stream situated at Hiyare village in Galle District. The aim was to produce a simplified Francis turbine that could be installed in a stream with a head of 10m and a flow rate of 15l/s. However, all the tests were carried out at a low flow rate of 9l/s and the head of 7 m. The turbine produced over 60 W of shaft power at 12% efficiency under some more technical drawbacks such as water leakages from the runner that can be easily rectified in a re-design.

Keywords: *Francis Turbine, PicoHydro, Low head – High Flow, Flow Analysis.*

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