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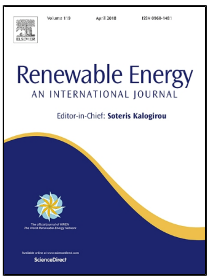

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PII:	S0960-1481(18)30178-2
DOI:	10.1016/j.renene.2018.02.038
Reference:	RENE 9769
To appear in:	*Renewable Energy*
Received Date:	04 February 2017
Revised Date:	29 January 2018
Accepted Date:	06 February 2018

Please cite this article as: Heungsu Jeon, Joo Hoon Park, Youhwan Shin, Minsuk Choi, Friction Loss and Energy Recovery of a Pelton Turbine for Different Spear Positions, *Renewable Energy* (2018), doi: 10.1016/j.renene.2018.02.038

Friction Loss and Energy Recovery of a Pelton Turbine for Different Spear Positions

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Abstract

This study is dedicated to find a cause of a critical flow rate in a Pelton turbine operating with a constant runner speed, below which the efficiency of the turbine decreases significantly. A critical flow rate was initially found in the performance test of the Pelton turbine for extracting energy from a PRO (pressure retarded osmosis) pilot plant. For higher flow rates than a critical value, the efficiency of the Pelton turbine was nearly constant independent of flow rates. For lower flow rates than a critical value, however, the efficiency drops with decreasing flow rates. 3D flow simulations were conducted at three different flow rates to investigate effects of flow rates on the performance of the Pelton turbine. It was found in the numerical results that a large friction loss is generated in an injector if the spear is closed too tightly for a low flow rate below a critical value. Head loss coefficients of the injector for three different spear positions were calculated and it was found that the loss is doubled below a critical flow rate. This implies that it is important to include the geometry of an injector and spear in the numerical simulations for Pelton turbines.

Keywords: Pelton turbine, Injector, Friction loss, Head loss coefficient, PRO

1. Introduction

For a country with energy shortages, it is very important to generate power from renewable energy resources such as solar, hydro, marine and wind energies without any pollution. PRO is a power generation technique based on osmotic energy, with which fresh water passes through a semipermeable membrane to sea water and