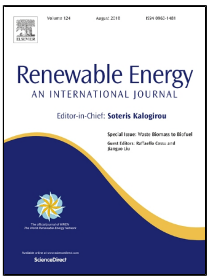
Accepted Manuscript



Experimental Study of Viscosity Effects on a Pump as Turbine Performance

Sina Abazariyan, Roohollah Rafee, Shahram Derakhshan

PII:	S0960-1481(18)30509-3
DOI:	10.1016/j.renene.2018.04.084
Reference:	RENE 10042
To appear in:	*Renewable Energy*
Received Date:	27 October 2017
Revised Date:	14 April 2018
Accepted Date:	28 April 2018

Please cite this article as: Sina Abazariyan, Roohollah Rafee, Shahram Derakhshan, Experimental Study of Viscosity Effects on a Pump as Turbine Performance, *Renewable Energy* (2018), doi: 10.1016/j.renene.2018.04.084

Experimental Study of Viscosity Effects on a Pump as Turbine Performance

Sina Abazariyan[a], Roohollah Rafee [a,1], Shahram Derakhshan[b]

[a] Faculty of Mechanical Engineering, Semnan University, Semnan, P.O. Box: 35131-19111, Iran.

[b] School of Mechanical Engineering, Iran University of Science & Technology, Narmak 16846, Tehran, Iran.

Abstract

An experimental study is carried out to find the effects of viscosity on the performance of a pump as turbine (PAT) system. A pump is tested in an established test rig for five kinds of fluids with different viscosities by the solution of Water-Glycerin with various volume fractions. By analyzing the results of performance tests, two opposite effects are observed. In the part-load region, increasing the viscosity leads to an increase in hydraulic friction losses in the impeller, which decreases the PAT efficiency. On the other hand, at the best efficiency point (BEP) and overload region, by increasing the viscosity, the lubrication effects cause a reduction in the mechanical losses. This effect improves the machine's efficiency. However, at the higher rotational speeds, the hydraulic losses are dominated. Dimensionless correlations for the pure water are compared with other available data in the literature. Three viscosity correction factors for the head, efficiency, and power are obtained, which can be beneficial for selection of a PAT system with the tested viscosity values. Finally, based on the obtained results, a correlation is proposed for calculation of the efficiency as a function of flow coefficient and Reynolds number.

Keywords: Pump as Turbine; Viscosity; Experimental test; Characteristic Curves

1. Introduction

Nowadays, demand for electricity is continuously increasing. The end of fossil fuels era is predicted shortly while the most portion of generated electricity still relies on fuel based power plants. Due to the limited amount of fossil fuels and their non-renewable characteristics, many countries around the world are expanding their renewable energy strategies, considering future energy safety policies [1].

Hydraulic energy is probably the oldest resource which humankind used to generate power. This clean, renewable energy generates 16% of total world electricity and consists of 85% of using renewable energies around the world which is about 20053 TW-h. Hydraulic energy is the main

[1] Corresponding author
E-mail address: rafee@semnan.ac.ir
Tel: +98 (23) 31 53 33 51; Fax: +98 (23) 33 65 41 22