*Environmental Engineering and Management Journal*

*April 2017, Vol.16, No. 4, 979-988*
*http://omicron.ch.tuiasi.ro/EEMJ/*

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# EXPERIMENTAL INVESTIGATION AND COMPUTATIONAL FLUID DYNAMICS (CFD) ANALYSIS OF AN ECO-FRIENDLY TURBINE

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## Abstract

The global renewable energy share should reach and exceed 30% by 2030. Mini-scale hydropower installations are environmentally-friendly technologies, unlike large hydroelectric power plants that have certain drawbacks from the environmental point of view. A safe and clean solution is the cross-flow turbine, but the commercial types require a minimum head, usually captured by additional hydro-technical works that can also damage the environment. In this context, a very good solution could be a low head turbine that has no adverse environmental impact, since no water storage is necessary. The objective of this paper is to investigate a cross flow pico-turbine prototype, in order to verify whether, when well designed, such a turbine can operate with good efficiencies at very low heads. The tests revealed good efficiencies of the turbine that are in the range of values calculated with the classical Hutton, Banki, and Sutton methods. However, unlike the classical methods, that predict an increase in efficiency as the head increases, the results presented in this paper suggest that, for cross-flow turbines designed for very low heads, the efficiency increases as the head decreases. This could be considered the most important result of this study. Numerical simulations were performed to get a better insight into the air-water two-phase flow inside the turbine operating at low heads. The results obtained suggest that air bubbles get entrapped into the blade channels during the first pass if the operating parameters are far from the rated ones. The results could be used as a recommendation for saving the hydraulic energy that is wasted in very low head hydraulic installations. By implementing the proposed cross-flow turbine in hybrid technologies or on irrigation open channels, the energy is produced using a sustainable solution that is able to protect the environment.

*Key words:* cross-flow turbine, efficiency, environmental impact, low head hydro application, renewable energy

*Received: December, 2016; Revised final: March, 2017; Accepted: April, 2017*

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