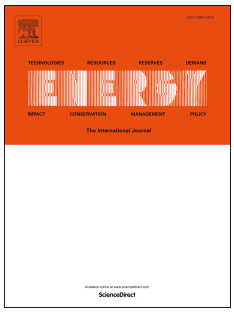
Accepted Manuscript



Optimized fuzzy rule-based energy management for a battery-less PV/wind-BWRO desalination system

I. Ben Ali, M. Turki, J. Belhadj, X. Roboam

PII: S0360-5442(18)31175-7

DOI: 10.1016/j.energy.2018.06.110

Reference: EGY 13152

To appear in: *Energy*

Received Date: 10 November 2017

Revised Date: 8 May 2018

Accepted Date: 17 June 2018

Please cite this article as: Ben Ali I, Turki M, Belhadj J, Roboam X, Optimized fuzzy rule-based energy management for a battery-less PV/wind-BWRO desalination system, *Energy* (2018), doi: 10.1016/j.energy.2018.06.110.

Optimized Fuzzy Rule-based Energy Management for a battery-less PV/Wind-BWRO Desalination System

I. Ben Ali [a], M. Turki [a, b], J. Belhadj [a, c], X. Roboam [d]

[a] Université de Tunis El Manar, LR 11 ES 15, Laboratoire des Systèmes Électriques, École Nationale d'Ingénieurs de Tunis, BP 37 – 1002, Tunis le Belvédère, Tunis, Tunisia.
e-mail: ines.benali.lse@gmail.com

[b] Université de Jendouba, École Supérieure des Ingénieurs de Medjez El Bab, P5, 9070, Tunisia.
e-mail: mehdi_turki1@yahoo.fr

[c] Université de Tunis, École Nationale Supérieure d'Ingénieurs de Tunis, BP 56 – 1008, Montfleury, Tunisia.
e-mail: Jamel.Belhadj@esstt.rnu.tn

[d] Université de Toulouse, LAPLACE (Laboratoire Plasma et Conversion d'Énergie), UMR CNRS-INP-UPS, ENSEEIHT, 2 Rue Camichel 31071 Toulouse, France.
e-mail: Xavier.Roboam@laplace.univ-tlse.fr

Abstract

Coupling water desalination processes with Renewable Energy Sources (RESs) can be a sustainable and ecological approach to the global water/energy supply crisis. In this regard, small-scale standalone battery-less Brackish Water Reverse Osmosis (BWRO) desalination system powered by a hybrid PV/Wind RES is expected to meet freshwater demand of a small isolated community. One particularity of the proposed architecture deals with the absence of electrochemical storage; only taking benefit of hydraulic storage in water tanks when RE is available. This study puts forward the prime importance of Water/Power flows management optimization. For this purpose, an *online* Fuzzy Logic-based Energy Management Strategy (FLEMS) is proposed. Firstly, a Hand-Made Fuzzy Inference System (HMFIS) was designed to identify the *instantaneous* power sharing between the system hydro-mechanical processes (well pumping, water storage and desalination processes). Secondly, an *offline* genetic algorithm optimization was applied on the HMFIS design in order to optimize the power sharing factor and maximize freshwater production. Then, when applying unknown power profile, the optimized FLEMS demonstrated its performance to improve the system energy efficiency and enhance the brackish water (from 16.7% in autumn to 63 % in summer) and freshwater production (to 3.3% during autumn for instance) compared with the HMFIS-based EMS.

***Keywords*:** Water/Energy production; renewable energy sources; energy management; fuzzy logic; genetic algorithm optimization.