Abstract

There are many sparsely populated and isolated zones in Algeria. The lack of water for consumption and irrigation is one of the major problems. Photovoltaic water pumping systems of low power are the answer for this problem.

The main objective of the thesis is to optimize the use of these systems taking into account the scarce economical resources available and to provide maximum performance and adapting the system to the specific conditions of each climatic zone of Algeria.

Four characteristic climatic zones have been defined in Algeria. A series of hourly solar radiation data has been generated for several different locations where measured data was not available.

Three different I-V curve models for PV generators and two methods for extrapolating the I-V curve data to desired conditions have been compared.

Based on the experimental results obtained in the laboratory for typical photovoltaic pumps, two general new theoretical models are proposed for the motor-pump unit (current and voltage as the input and the flow-rate and pumping head as the output) and are valid for centrifugal and positive displacement pumps. A simplified experimental method is proposed to obtain the parameters for the models.

With the aid of a simulation program developed, different parameters of the pumping system are analysed, mainly the consumption profile, the tank capacity, the threshold irradiance, the series/parallel configuration of the PV generator, the geographic location and the loss of load probability.