SOLAR POWERED IRRIGATION MANAGEMENT FOR SMALL SCALE LANDSCAPE

By

MANAR ESSAM ABD EL-HAKEEM
B.Sc. Agric. Eng., Fac. Agric., Cairo University, 2013

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ABSTRACT

Manar Essam Abd El-Hakeem: Solar Powered Irrigation Management for Small Scale Landscape. Unpublished M.E. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2019.

The main aim of this project is small-scale irrigation management using photovoltaic to power a pumping system in landscape in Egypt. Field test had been carried out in (2017– 2018).The first experiment were carried out at Ain Shams University, Faculty of agriculture, Egypt from January till March 2017 then the second experiment were carried out at the experimental farm of soil and water Research Department, Nuclear Research Center, located at Inshas city, Sharkia Governorate, Atomic Energy Authority, Egypt from April 2017 till January 2018. Design of irrigation system in the first location consisted of four sprinkler with flow rate about .53 m^3/h with radius of 3 m under operating pressure 1.5 bar and flow meter were fixed at the outlet of the solar water pump followed by pressure gauge with operating range from (0-10 bar). While in the second location consisted of six sprinkler with flow rate about 0.93 m^3/h with radius of 5 m under operating pressure 1.5 bar and flow meter were fixed at the outlet of the solar water pump followed by pressure gauge with operating range from (0-6 bar).

All the measurements of solar radiation and electric power pump discharge pressure head, hydraulic hp operated for 15 minutes along the day from 8:00 a.m. to 16:00 p.m. The study of system operating based on the solar radiation and its impact on electric power and hydraulic power.

The main result showed that both of the electric power and the hydraulic power increased with increasing of the solar radiation. For the first experiment the maximum hydraulic output power was 48 W was not enough to irrigate the required space, where the electrical power consumption was 191 W although the solar radiation intensity were 946

W/m² and the efficiency of the solar generator is 16 %. The maximum overall efficiency, pumping system efficiency were 4% and 25 % respectively. The second experiment data illustrated that the maximum hydraulic output power was 362 W enough this amount was enough to irrigate the required space, where the electrical power consumption was 669 W and at solar radiation, intensity of 761W/m², the efficiency of the solar generator is 13 %. The maximum overall efficiency, pumping system efficiency were 7.9 % and 54% respectively.

The detailed measurements accurately portray the spatial variations existing in the spray and recommended that importance of using photovoltaic pumping system as technique to operate sprinkler irrigation system in small-scale landscape.

Keywords: Solar water pump, Sprinkler irrigation, Photovoltaic, landscape, solar radiation, hydraulic power, conversion efficiency.

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LIST OF ABBRAVIATIONS

DC	Direct Current
AC	Alternating current
Eto	Reference Evapotranspiration
KW	1000 Watt
W	Watt
kWh	kilowatt hour
PV	Photovoltaic
PVPS	Photovoltaic Pumping System
SOC	Standard Operation Condition
STC	Standard Test Condition
SPV	Solar photovoltaic
SPVWP	Solar photovoltaic water pumping
SPVWPS	Solar photovoltaic water pumping system
ASM	Asynchronous motor
NREA	New and Renewable Energy Authority
DC-PVPS	directly coupled photovoltaic Pumping system
BBPVPS	battery-buffered photovoltaic pumping system
MPPT	maximum power point tracker
IRN	irrigation networks