PERFORMACE EVALUATION OF SOLAR PHOTOVOLTAIC PUMP OPERATING LANDSCAPE SYSTEM

By

BELAL MOHAMED SWIDAN
B.Sc. Agric. Sc. (Agric. Engineering), Ain Shams Univ. (2008)

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This thesis for M.Sc. degree has been approved by:

Dr. El Said Mohamed Khalifa

Prof. of Agricultural Engineering, Faculty of Agriculture, Kafrelsheikh University.

Dr. Mosutafa Faheem Mohammed Abdel-Salam

Associate Prof. of Agricultural Engineering, Faculty of Agriculture, Ain Shams University.

Dr. Mubarak Mohammed Mostafa

Prof. Emeritus of Agricultural Engineering, Faculty of Agriculture, Ain Shams University.

Date of Examination: 9/10/2017

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B.Sc. Agric. Sc. (Agric. Engineering), Ain Shams Univ. (2008)

Under the supervision of:

Dr. Mubarak Mohammed Mostafa

Prof. Emeritus of Agricultural Engineering, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University (Principal supervisor)

Dr. Mahmoud Ahmed El-Nono (Late)

Prof. Emeritus of Agricultural Engineering, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University.

ABSTRACT

Belal Mohamed Swidan: Performance evaluation of solar photovoltaic pump operating landscape system. Unpublished M.Sc. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2017.

Field test had been carried out in 2016 – 2017 (August – February) at Menofia governorate, Egypt. The study carried out to evaluate the performance of a solar water pumping system for the purpose of operating landscape system. The system consists of a centrifugal water pump connected directly to DC electric motor that which connected directly to a solar photovoltaic generator. Measurements were taken every hour starting from 8:00 a.m. to 4:00 p.m. through randomly selected days during the period between August and February. Results show relation between the solar radiation and the output electrical power, hydraulic power, pumping rates and the efficiency of the system.

System evaluation was made by estimating the intensity of solar radiation, Photovoltaic output power and the hydraulic power generated. The results show that the maximum hydraulic output power was 14 W where the electrical power consumption was 140 W and the PV output power was 712 W at solar radiation intensity of 841 W/m^2. The maximum efficiency recorded for the overall system was 0.41% where the photovoltaic generator and pumping system efficiencies found to be 14.98% and 14.21% respectively.

Keywords: Solar water pumping; Pumping system; Photovoltaic water pumping; landscape; Performance evaluation.

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I will keep on trusting You for my future. Thank you, Lord.

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LIST OF ABBREVIATIONS

Abbreviation		Definition
A	:	Ampere
AC	:	Alternative current
DC	:	Direct current
Ea	:	Array efficiency
Es	:	Subsystem efficiency
Eo	:	Overall efficiency
H	:	Pumping head, (m)
Hr	:	Hour
I	:	Current, (A)
NOCT	:	Nominal operating cell temperature
Ph	:	Hydraulic power, (W)
Pi	:	Input Power, (W)
Pmax	:	Maximum rated power of PV module, (W)
Po	:	Output power of PV array, (W)
PV	:	Photovoltaic
PVP	:	Photovoltaic pumping system
PVWP	:	Photovoltaic water pumping system
Q	:	Pumping discharge, (m^3/hr)
Rs	:	Solar radiation intensity, (W/m^2)
STC	:	Standard test conditions
V	:	Volt
Vmp	:	Maximum point output voltage, (V)

INTRODUCTION

The world is witnessing in the current period, an increase in the steady population growth and a marked rise in the levels of culture, urbanization and luxury living. Thus, the horizontal expansion of the building industry becomes the element that fulfill the needs to accommodate the growing population, where they are in accordance with the standards and requirements of country laws in order to ensure a civilized urban planning that takes into account the achievement of the foundations of the integrated design for human use. These standards need to have green spaces and public spaces in size up to 80% of the total area of the project. Most landscapes depends on water essentially, whether used in the water features such as fountains, waterfalls and pools or to irrigate plants and even in the hydration and reducing air temperature. The presence of water in the landscape like plants is of the most important elements that brings life to the landscape.

The environmental problems are increasingly taking place in the daily lives of the population. Researchers, non-profit organizations and even companies are putting more attention to this subject that concerns everyone. A solution to these problems would be the use of alternative sources of energy, such as solar energy, which can be of great help in reducing the environmental impact of conventional sources. According to **Cometta (1978).**

For the favorable solar radiation conditions in the country (5 to 8 kW h/m^2/day with about 3500 sunshine hours per year), **Sorensen (2003),** solar water pumping may be a competitive application for remote areas and luxurious areas where power may costs a lot. Even for landscapes within the city if it was our aim to reduce the burden on national subsidization for energy sources. Also, the solar cells can be formed in beautiful shapes and incorporated as part of landscaping, that which will be aesthetic functional garden element that gives a feeling of friendship to the environment. One may argue that solar photovoltaic water pumping

systems not only comprises an environmentally friendly solution, but also contributes substantially to the satisfaction of remote communities' water consumption needs **Kaldellis *et al.* (2011).**

Even though, the solar photovoltaic water pumping systems has significant advantages a lot of challenges are associated with the solar photovoltaic water pumping, especially in operation and maintenance.

Contemporary water displays rely heavily on historic precedent, with elements usually abstracted to satisfy broader design and environmental constraints. Historical models range from ancient irrigation systems to ornate displays within fountains. Often, modern displays are modeled after free flowing streams and falls within natural settings **Charles *et al* (1997).**

The objectives of this research were using photovoltaic to operate water pumping system for landscape, studying the factors that affect the system and evaluate system efficiency.