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Simulation of Site choice in application of photovoltaic system

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***Abstract*— Global environmental concerns and the escalating demand for energy, coupled with steady progress in renewable energy technologies, are opening up new opportunities for utilization of renewable energy resources. Solar energy is the most abundant, inexhaustible and clean of all the renewable energy resources till date. Photovoltaic technology is one of the finest ways to harness the solar power.**

For photovoltaic applications, the knowledge about system behavior in real operating conditions is desirable. Presented paper describes the dependence of site in irradiation density. The results obtained for photovoltaic array in different sites.

***Keywords*— solar, photovoltaic, irradiance, SITE**

I. Introduction

Solar power is at the forefront of clean, renewable energy, and it is gaining momentum due to advances in solar panel manufacturing and efficiency as well as increasingly volatile fuel costs. Photovoltaic (PV) solar cells are the most readily available solar technology, and they operate best on bright days with little or no obstruction to incident sunlight [1].

The recourse to the use of renewable energies would be beneficial in Algeria which is exposed to the sun the major part of the year and must benefit from this energy which has the advantage of being an inexhaustible resource [2].

More especially that apart from the solar photovoltaic energy field, several other sectors' users could benefit from it in particular "purification from wastewater"[2].

The objective of this work was to create a tool for designing new photo-voltaic power plants based on optimization of different factors of system in Algeria, which can also be used to improve production in existing power plants.

The two main types of biological treatment to treat solids generated at station wastewater treatment plants are anaerobic digestion and aerobic digestion [3].

II. Photovoltaic system

A. PV Generality

Photovoltaic conversion is the direct conversion of sunlight into electricity without any heat engine to interfere. Photovoltaic devices are rugged and simple in design requiring very little maintenance and their biggest advantage being their construction as stand-alone systems to give outputs from microwatts to megawatts. Hence they are used for power source, water pumping, remote buildings, solar home systems, communications, satellites and space vehicles, reverse osmosis plants, and for even megawatt scale power plants. With such a vast array of applications, the demand for photovoltaics is increasing every year [4].

A photovoltaic power generation system consists of multiple components like cells, mechanical and electrical connections and mountings and means of regulating and/or modifying the electrical output. These systems are rated in peak kilowatts (kWp) which is an amount of electrical power that a system is expected to deliver when the sun is directly overhead on a clear day [4].

B. Mathematical Model Of PV Generator

The current-voltage characteristics of the electric circuit of solar cell can be described by the following simplified equation [5]:

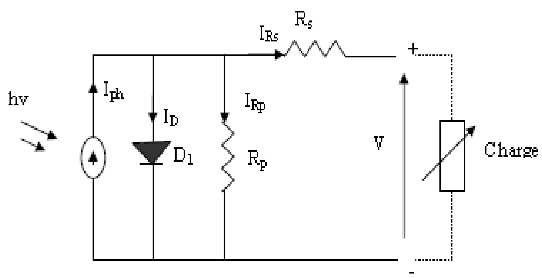

Fig 1. Equivalent electrical circuit of PV module, showing the diode and ground leakage currents [5].

$$I = I_{ph} - I_O \exp [q (V - I R_s) / (A K T)] \quad (1)$$

q : the electro charge ($1.602*10^{-19}$ C)
K: Boltzmann's constant ($1.38*10^{-23}$ j/K)
T: temperature, K.
A : the surface area part of the cell exposed to solar radiation, m^2.
I_o: the saturation current density, amp.
I: the current flowing in the circuit, amp.
V : voltage of the circuit, v.

The electric power output of PV is:

$$P_{el} = I V \quad (2)$$

Moreover, the maximum output power is given by:

$$P_{max} = (I V)_{max} = V_{OC} I_{SC} FF \quad (3)$$

V_{OC}: the open circuit voltage
I_{SC}: the short circuit current
FF : the fill factor

$P_{max} = V_{mp} * I_{mp}$, corresponding to the maximum power point, MPP.

The energy conversion efficiency, η , is given by:

$$\eta = V_{mp} I_{mp} / P_{in} = V_{oc} I_{sc} FF / P_{in} \quad (4)$$

III. The Factors of PV Evolution in Wastewater Treatment Station

In Our study, we use three Parameters:

1. The choice of site
2. The technology of cells
3. The position of PV array

Before present the effect of this parameters in the PV system, it is important inform that the day selected is: 18/07/2105

A. *The choice of site*

The geographic data of the three site is presented in the under table, the type of PV panel is polycrystalline

TABLE 1
GEOGRAPHIC DATA OF SITES

Geographic coordinates	Algers	Batna	Ouagrla
Latitude	36.75	35.55	31.94
Longitude	3.04	6.17	5.32
Maximal Temperature	30	33	43
Minimal temperature	18	17	26

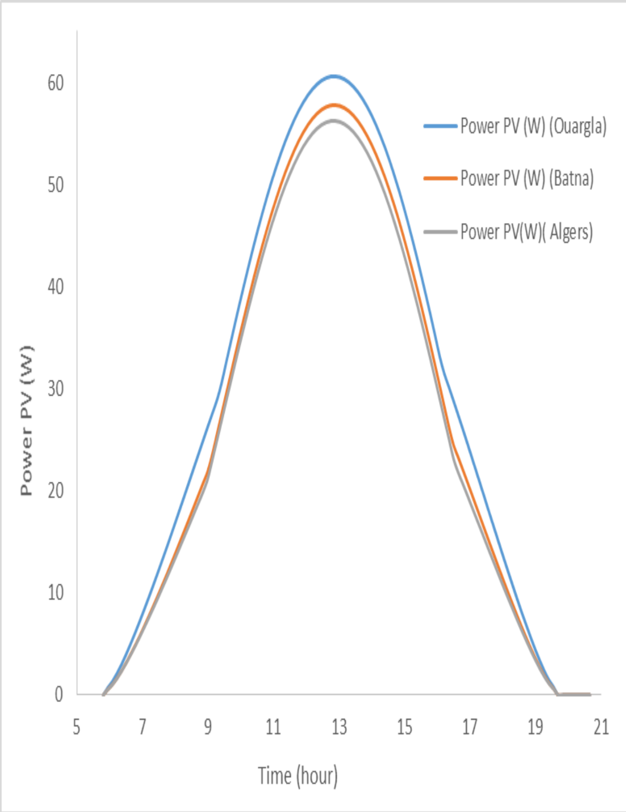

Fig 2. The evolution of Power PV at different site of est Algeria: Algers, Batna and Ouargla

The fig 2 presented the power PV evolution at different sites in Est of Algeria. We note her, that Ouargla site presented the very important power PV between the three site. This result signified by the sec climate of this area and the high temperature which give a values higher of radiation, and by consequence give an important Power PV

B. *Technology of cells*

We simulate two type of technology cells: polycrystalline and monocrystalline

TABLE 2
CHARACTERISTICS OF PANEL TECHNOLOGY

Characteristics	Polycrystalline	Monocrystalline
Peak power Pc(W)	50	95
Peak current (A)	2.87	5.14
Peak Tension (V)	17.39	18.50
Short circuit current (A)	3.15	5.44
Open circuit Tension (V)	21.35	22.30
NOCT (°C)	45.3	45
Temperature coefficient A/°C	1.48	-0.32
Temperature coefficient V/°C	-2.3	0.06
Cells Number	36	36
Module area ($mm^{é}$)	418X1075	535X1200

The results obtained for: 800 W/m^2 of radiation and 30°C of temperature

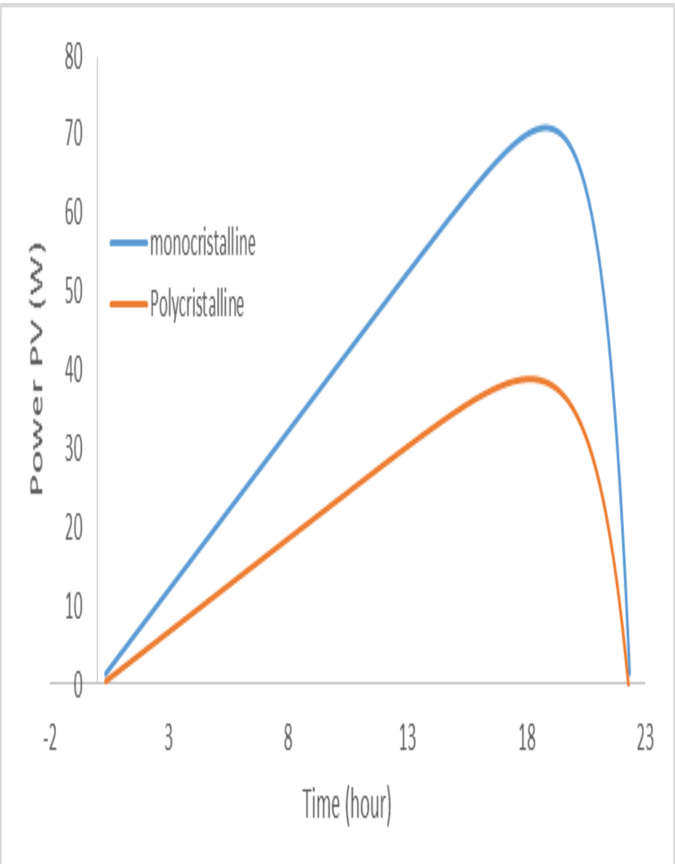

Fig 3. The evolution of Power PV in two type of technology: mono and poly crystalline

The Fig 3 presented The evolution of Power PV in two type of technology: mono and poly crystalline. The technology monocrystalline have a big power than the polycrystalline technology, that's presented the role of purity of cell composition in efficiently photovoltaic

C. The position of PV array

In this part, the type of PV panel is polycrystalline, where we simulated the tow optimal angle:

- Tilt angle
- Orientation angle

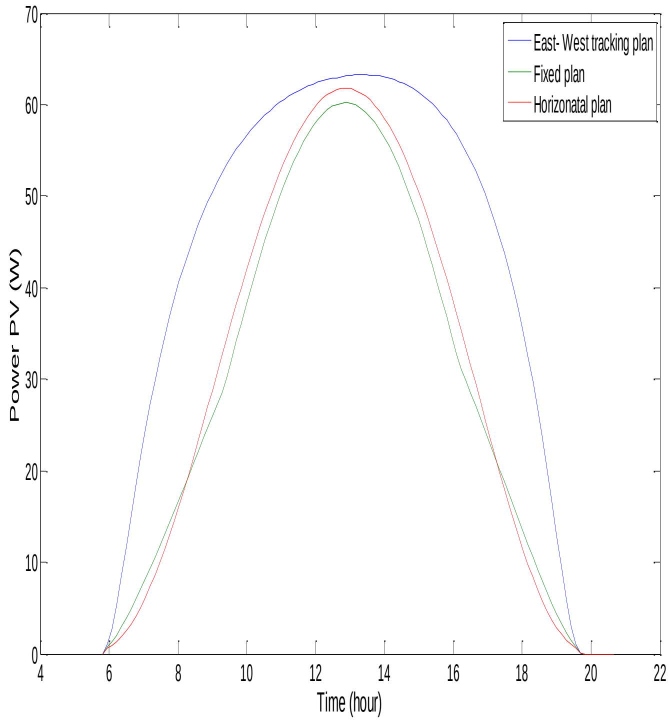

Fig 4. The evolution of Power PV in three position of PV array: tracking, fixed at tilt of 30° and horizontal at site of Ouargla

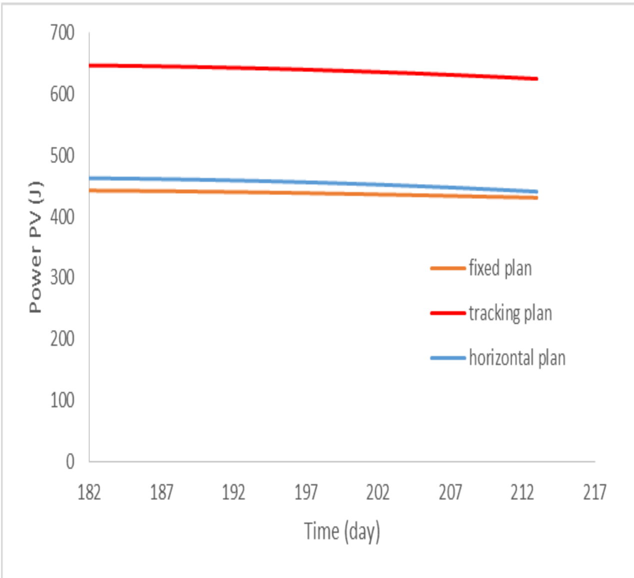

Fig 5. The monthly evolution of Power PV in three position of PV array: tracking, fixed at tilt of 30° and horizontal at site of Ouargla (July)

Looking at figures 4 and 5, it is easy to see how the movements of the tilt and orientation angles are related to the improvement of production.

These figures show the gains in power production given in the tracking positions;

IV. Conclusions

Wastewater treatment is a process to convert wastewater - which is water no longer needed or suitable for its most recent use - into an effluent that can be either returned to the water cycle with minimal environmental issues or reused.

This process need the energy source for produce a power electric. The coupled of photovoltaic system with the station of wastewater treatment conditioned by the optimised of different factors photovoltaic to obtained a good results.

The three factors photovoltaic: site, technology and tracking system present the important parameters of Radiation and Power PV evolution as shows in the results.

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