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Photovoltaic Test Set Design

Lec. Abdil Karakan
Afyon Kocatepe Universty
Dazkırı Vocation Schooll,
Electrical Departman
Afyonkarahisar, Turkey
abdilkarkan@hotmail.com

Lec. Bahtiyar Uslu
Mehmet Akif Ersoy Universty
Gölhisar Vocation Schooll,
Electrical Departman
Burdur, Turkey
bahtiyaruslu@hotmail.com

Asist. Prof. Riyad Şihab
Afyon Kocatepe Universty
Dazkırı Vocation Schooll,
Building Inspection Departman
Afyonkarahisar, Turkey
rishihab@gmail.com

***Abstract*— The aim of this study, to provide the students in Electrical Department of Afyon Kocatepe University Dazkırı Vocational High School with practical knowledge about solar energy. The solar energy system consists of the energy production unit, the control system and the heaters. Energy production consists of monocrystalline and polycrystalline solar panels. The unit of control system is PIC18F4550 microcontroller. Consumers use 20 Waat lamps. Consumers use 20 Waat lamps. In the control system, all the data (voltage, current and power) which generated by the system is transferred to the computer With the USB connection. In the interface with respect to C # program on the computer, all data are displayed instantly and the data is recorded in the access database with intervals of 10 seconds.**

Keywords—component; Mono crystalline solar panel, polycrystalline solar panel, PIC18F4550, control system, C # interface

I. INTRODUCTION (*Heading 1*)

Although the photovoltaic effect was discovered in 1839, the first practical work was carried out in the 1950s. Photovoltaic energy was first developed for remote solar cells. Since conventional batteries, fuel cells and nuclear energy were not suitable for the conditions at the time, the stored energy soon began to be used, and with the development of high-efficiency silicon solar batteries, photovoltaic energy was the best solution.

The energy source (sun)is infinite. The operation of photovoltaic devices is based on the principle of converting the solar radiation energy of the semiconductor materials into electrical energy (by special applications) without the need for mechanical moving parts. Today it is used almost exclusively as a silicon semiconductor material.

A basic component of a photovoltaic plant is photovoltaic cell, which can generate power between 156 W x 156 mm mono cell at 3-5 W under standard conditions (25 ° C temperature, 1000 W / m2 radiation power). The power output of a photovoltaic device operating under standard conditions is called peak power (Wp). Photovoltaic modules are obtained by mounting the cells together. The main material of photovoltaic cells is silicon. Silicon is the most common element on the earth after oxygen.

Silicon is not found pure in nature, it is present as compounds with other elements. However, for the production of a photovoltaic cell, silicium in pure form is needed; obtaining the pure silicon is a very difficult and expensive process. One of the alternative methods; Silicon can be obtained from extra pure silicon rods by cutting very thin discs that have been polished and treated with acid.

Photovoltaic technology is a technology that offers long-term, large-scale, renewable energy production in the future with plenty of sunlight, with a solar energy potential of 380 billion kWh / year, especially in Turkey. The main purpose of this study to get strength of photovoltaic energy of solar energy, adding to or alternating with conventional production methods that are connected to a "continuous" production cycle and have difficulty in carrying out the requirements of daily peaks.

A lot of researches have been done on solar panels [1-22]. These studies are sometimes based on a single solar panel, sometimes using two or more solar panel types. The most used monocrystalline and polycrystalline solar panels were also selected in the realized solar energy experiment set.

II. MATERIALS AND METHODS

The set of Solar energy experiment set in AFyon Kocatepe University -Dazkırı Vocational School is aimed to provide the students in Electric Department with practical knowledge and show some applications about solar panels.

The solar energy experiment set consists of 4 (four) sections. The first part is solar panels where solar energy turns into electricity. In the system, two different solar panels are used which are mostly found in the market. The second part is the consumer part of the energy generated. The consumers have used 20 watt lamps. Thus the produce electricity which have been produced have consumed all the power by the consumer. The third part is where the control card is located. On the control card, the data (voltage, current and power values) produced by the system are measured by the sensors and processed on the control

card. The USB port of the control card is used to send the data instantly, digitally to the computer. Figure 1.1 shows the solar energy experiment set.

Figure 2.1. Solar energy experiment set

The last part consists of the interface written in the C # language programmed code to be displayed on the digital supplied computer. With the interface, the data that the system has produced are read and the data is recorded at the access level with 10 sec.

A. Solar Panel

Two types of solar panels, monocrystalline and polycrystalline, are used in the solar energy experiment set system. Since the production methods of solar panels are different, reactions to solar rays are different. Thus, it has been determined which solar panel is more efficient in Afyonkarahisar Province. Figure 1.2 shows the solar panels used in the system.

The technical information of the solar panels used in the system is shown in table 1.

	Monocrystalline	Polycrystalline
Power	20 Watt	20 Watt
Maximum Volt	18,5 Volt	18,68 Volt
Maximum Current	1,08 Amps	1,12 Amps
Open Circuit Voltage	22,14 Volt	22,51 Volt
Short Circuit Current	1,16 Amps	1,12 Amps
Weight	2,3 kg	2,1 kg

B. Consumers

20 Watt receivers are used to utilize all of the electricity generated in the solar panels.

C. Control Card

There are two independent photovoltaic systems in the solar energy experiment set. The materials and sensors used in the two systems are identical, but only the solar panels are different. In this way, it was possible to determine which solar panel is efficient in Afyonkarahisar Province. Figure 1.3 shows the control card used in the system.

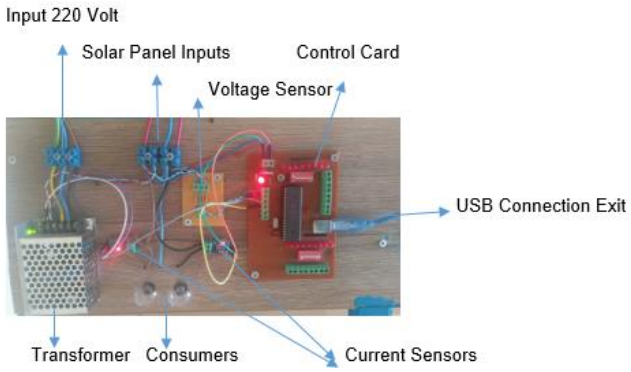

Figure 2.2. Solar panels used in the system

The control board has two voltage and current sensors. The analog data from the current and voltage converters are processed on the control card and converted into digital data. Digital data is sent to the computer via USB connection.

The control card needs to be connected to an external power source so it can measure up to 24 hours. There's a 220 volt input for this purpose. By adding power plant to the 220 volt input, the electricity which is needed for the sensors and control card used in the system is met. In order to increase the sensitivity of the voltage sensors, the solar panels have been designed with the maximum voltage values has been taken into consideration. The maximum voltage at which the

voltage sensor is measured is 30 volts. The sensitivity of the current sensors is also increased by selecting max. 5 Amps in the same way.

D. Interface

An interface has been designed through the written C # program , so all the data produced by the solar energy experiment set can be displayed on computer.

The designed voltage, current and power values of the monocrystalline and polycrystalline solar panels are shown.

In addition, all data generated in the system are recorded at the access base at intervals of 10 seconds in order to make a comparison. Figure 1.4 shows the interface used in the system.

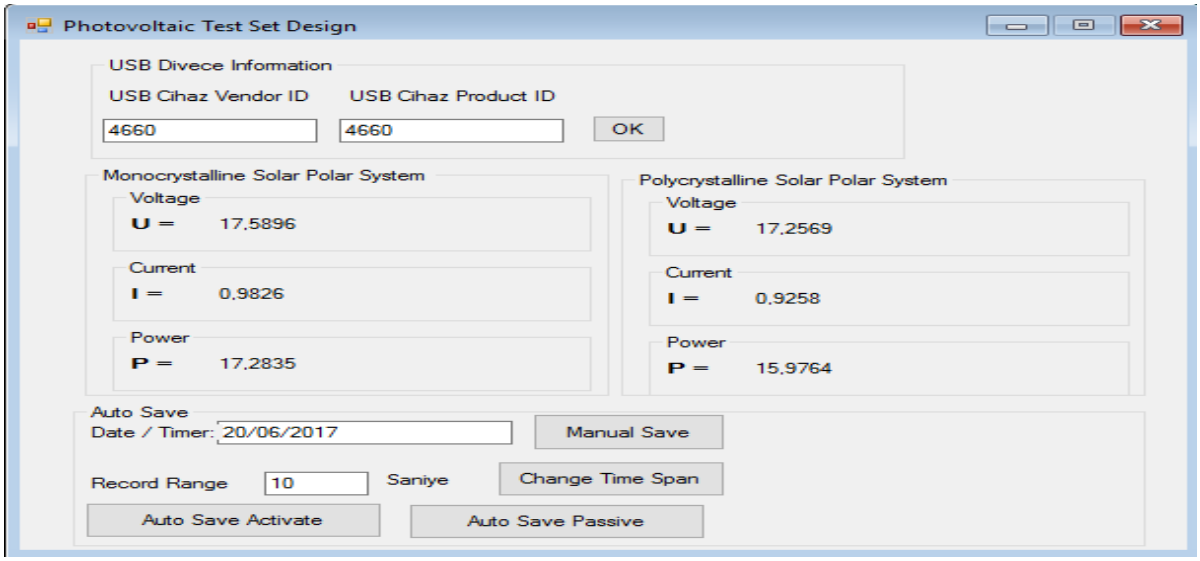

Figure 2.4. Interface used in the system.

III. RESULT

As a result of examining the current, voltage and power values produced by the solar energy experiment set, the following data were obtained. Figure 3.1 shows a daily voltage graph of 20/06/2017.

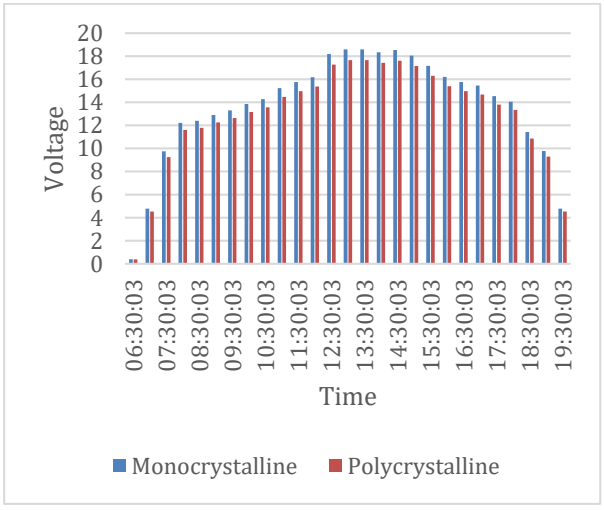

Figure 3.1. Voltage-time graph.

According to the voltage graph that produced monocrystalline and polycrystalline solar panel between 20.06.2017 and 06: 00-20: 00, electric energy production is lowest in early morning and late afternoon.

In the noon hours, when the sun's rays are at their steepest, electric energy production has reached the highest level. Since there is no production of electricity in the hours when there is no sun, those hours are not added to the graph. The chart covers the sunrise from 06:00 to sunrise at 20:00. A daily flow-time curve is shown in Figure 3.2.

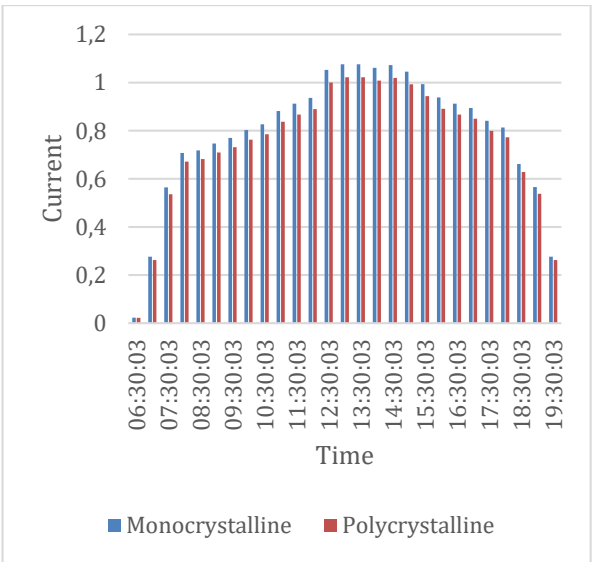

Figure 3.2. Current-time graph

The monocrystalline and polycrystalline solar panels differ in their reactions to the same sun rays as their production is different. As seen in Figure 3.2, the monocrystalline solar panels in the Afyonkarahisar province Dazkırı district show a much lower current output compared to the polycrystalline solar panel.

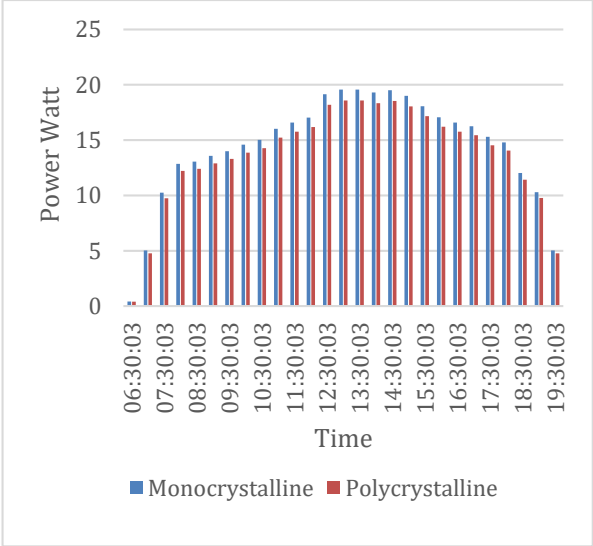

Figure 3.3. Power-time graph

Monocrystalline and polycrystalline solar panels have high yields, high sunlight angle, ambient temperature and many other factors. In some places and times the monocrystalline solar panel is more efficient, while the polycrystalline solar panel on the base can be higher. Figure 3.3 shows a daily power-time curve.

When a day's power chart is blurred, the power generated in the early hours of the morning stays at the limit of 5-10 watts, but reaches the limit of 20 watts at noon when the sun's rays are steepest. The energy that is produced after noon is gradually falling down.

IV. Conclusion

Afyon Kocatepe University Dazkırı Vocational School Electrical Department students have gained technical information about solar panels in practice. In addition, the most efficient solar panel was determined for Afyomkarahisar and Dazkırı District.

The monocrystalline solar panel achieved an energy production of 194.9522 Wh. on 20/06/2017, while the Polycristal solar panel produced an energy production of 185.2046 Wh. Monocrystalline solar panel produces 5% more electricity than the polycrystalline solar panel.

Acknowledgment *(Heading 5)*

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