Application of Solar Cells for Daytime Weather Study

N. Choosakul, M. Buddhakala, N. Barnthip, A. Muakngam and C. Banglieng

Abstract*— *Solar cell is the instrument that can convert solar radiation into electricity. The electric current is generated by the solar cell when the solar radiation is incident onto the Solar cell. The intensity of the incident solar radiation can control the amounts of generated electric current. In daytime, the variation of intensity of the incident solar radiation mainly comes from the cloud over the solar cells. It caused the variation of generated electric current. This phenomenon serves the new way to use the solar call for meteorological purpose. In the period of experiment days, the results showed that the variation of generated electric current might be plausible to the daily weather condition. On the sunny day, the generated current was small fluctuation and has high level. Otherwise, a small fluctuation with low level one is appear in the cloudy day. On the rainning period, the generated current could drop down more than 3000 mA in compare with the sunny period.

***Keywords*— Solar cell, weather, cloud, rainy day**

1. INTRODUCTION

In recent year, many instruments, methods and techniques were applied to the used of solar energy. Solar cell is the one of them that can use to convert the solar energy into another energy form. Generally, the solar radiation, which is incident onto the solar cell, generates the electric current [1]. The total of electricity that solar cell can produce are mainly depend on the intensity of the incident solar radiation (e.g. [2],[3],[4]and [5]) It is well known that there are several features affecting the performance of the solar cell such as effect of cloud and rain [6]. The generated current from solar cell is small when cloudy and the rainy day. For the solar cell engineering, there are set to be “the noise” of the solar cell used. In the other hand, the reducing current one is become “the meteorological signal” for meteorological study.

In this paper, we demonstrated the simply way and method to use the solar cell for meteorological study. The experiment was set to study the relationship between clouds over the solar cells and the generated electric current.

2. OBSERVATIONS AND RESULTS

The solar cell was installed on the top of the faculty of Science and Technology building, Rajamangala University of Technology Thanyaburi where is no any shadow effect to the solar cells, as shown in Figure 1. The Solar panel consists of eight of solar modules, which provide the power of around 1 kW. The specification of each solar module is shown in Table 1.

Sunny Data control is a computer programe. It was installed to monitor the solar cell. All of informations from the solar cell were recorded and stroged in the monitoring server with sampling rate of 24 data per hour.

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In this experiment, we used the data of direct current gennerated by solar cell (Ipv) in unit of mA. The Ipv was generated when the sun light incident onto the solar cell. [7] and [8] suggests that the amount of direct current from the solar panels can produce is directly dependent on the level of light they receive. In full, bright sunlight, solar panels receive maximum levels of light. During those peak sunlight hours, the solar panel will produce the maximum current, consecutively.

Figure 1 The Solar panel

Table 1. The specification of solar module

Solar moule	Detail
Name	Sharp Solar Module ND-130T1J
Maximun Power	130.0 W
Open-circuit Voltage (Voc)	22.0 V
Short-circuit Current (Isc)	8.09A
Volttage at point of Maximum power (Vmpp)	17.4 V
Current at point of Maximum power (Impp)	7.48 A
Maximum system voltage	600 V
Over-current protection	15 A

We used the Ipv data from 1 February 2011 to 14

February 2011. The data of each day was started around 7.00 Local time (LT) and ended of operating time around 17.00 LT. Total observational time per day is around 10 hours corresponding to the number of data per day of 240 data. Figure 2 is an example of Ipv data in the period of operating time. Figure 2 showed the Ipv of 2nd February 2011. The Ipv slightly increase in the morning section. The maximun Ipv was about 6000 mA at around 12.10 LT. Finally, Ipv slightly decreased in the afternoon section.

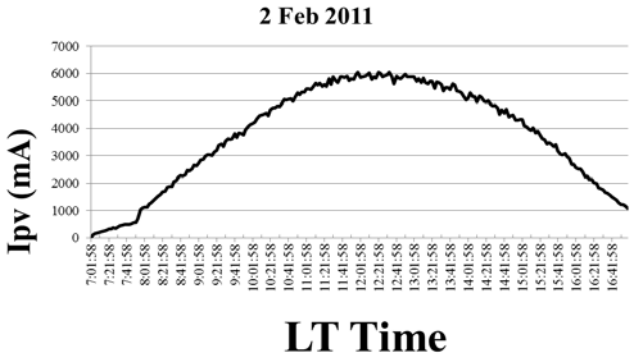

Figure 2 Ipv on 2 Feb 2011

In the period of 14 days of this experiment, we found four differrent of the daily weather condition; 1) The clear sky day, 2) the cloudy day without rain, 3) the cloudy day with rain, and 4) the rainy day. Table 2 showed the daily weather condition of all 14 experimental days.

Table 2 the daily weather condition of all 14 experimental days

Daily weather condition	Date
1) The clear sky day	4 and 8 Feb 2011
2) the cloudy day without rain	2, 3, and 5 Feb 2011
3) the cloudy day with rain	1,6,10, and 11 Feb 2011
4) the rainy day.	7,9,12,13, and 14 Feb 2011

Ipv of the clear sky days was used to make a reference index data (Ipv_i) by using smooth running avergae method with 15 points of window data. Finally, the index data were used to created the differrence Ipv (Ipv_d) by subtracting the index data with daily Ipv data as show by equation 1 below;

$$Ipv\_d = Ipv\_i - Ipv \quad (1)$$

Figure 3 showed the plotted of Ipv_d of day 1, 2, 4, and 13 February 2011. The 1 February 2011 was under to the daily weather condition 3. The 2 February 2011 was under to daily weather condition 2. The 4 February 2011was under to the daily weather condition 1. The 13 February 2011 was under to the daily weather condition 4.

3. DISCUSSION

According to the Figure 3, Ipv_d on the 1 February 2011 increased in a period of around 7.00 LT to 9.00 LT. It fluctuated from 9.00 to 10.00 and increased from 10.20 LT to 11.00 LT. It was plausible to the observation of daily weather condition on the 1 February 2011 that was the day with rain in the morning section and cloudy in the afternoon section. To investigate in detail, the comparisons of Ipv_d were conducted. Figure 4 illustrated that the comparison of Ipv_d between the clear sky day and the cloudy day without rain. The averge of difference between them is 342 mA. These difference showed to the fact that the current that generated by the solar cell would be depended on the intensity of the sunlight. On the clear sky day, solar cell will generate high level of Ipv with correspond to the low level of Ipv_d of that day. In the other hand, the Ipv_d of the cloudy day without rain will have higher level of Ipv_d than the Ipv_d of the clear sky day.

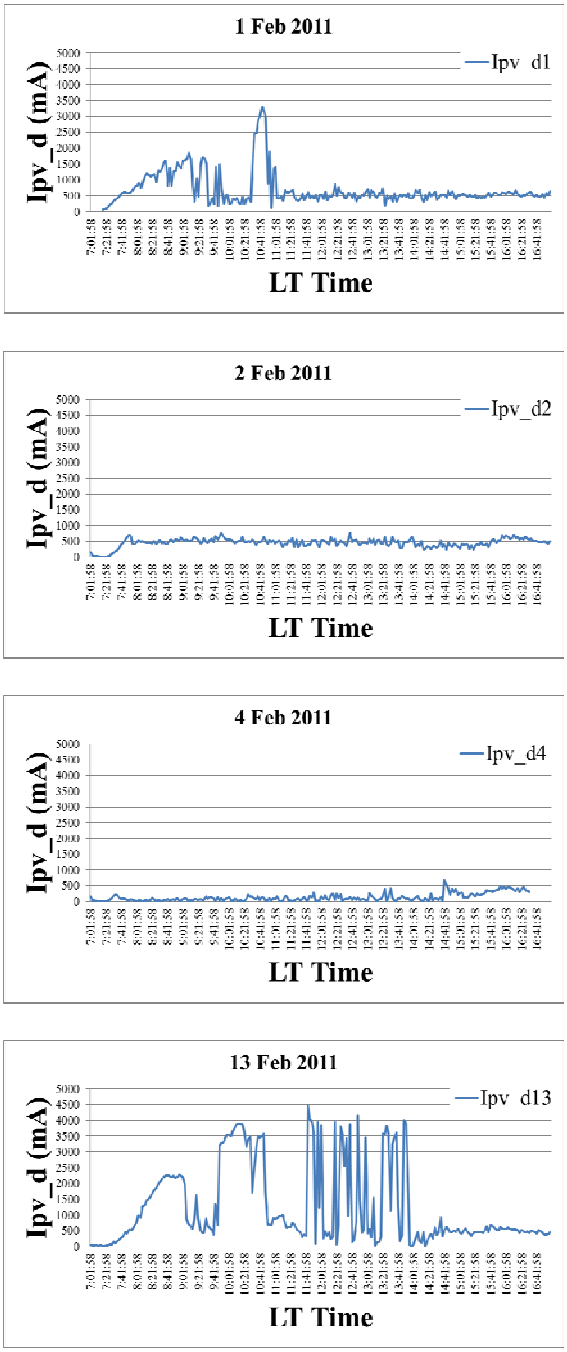

Figure 3 Ipv_d of day 1, 2, 4, and 13 Feb 2011

Figure 5 illustrated that the comparison of Ipv_d between the Clear sky day and the rainy day. The average

of difference in the raining period between both days is about 3138 mA. It is clearly seen from Figure 5 that rain affect the generated current on solar cell. On 13 February 2011 we observed that the first rain of the day started around 8.00 LT and ended around 9.00 LT, corresponding to the high level of Ipv_d in the period of 8.00 LT to 9.00 LT. The second rain started around 9.40 LT and ended around 10.40 LT, corresponding to the high level of Ipv_d in the period of 9.40 LT to 10.40 LT. The fluctuation of the rain appeared in the period of around 11.20 LT to around 14.00 LT, corresponding to the fluctuation at the high level of Ipv_d in the period of 11.40 LT to 14.00 LT.

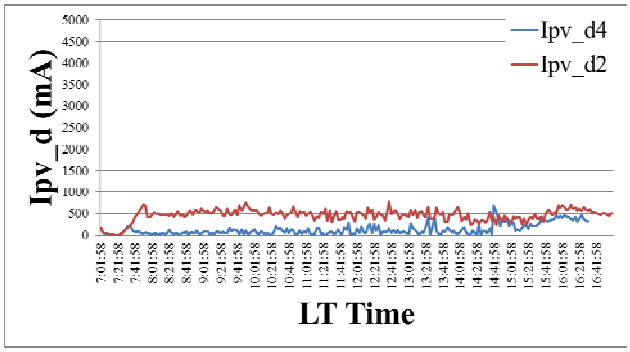

Figure 4 comparison of Ipv_d between day 2 and 4 Feb 2011.

The Ipv_d of the raining period on 13 February 2011 have high level and large fluctuation of Ipv_d in comparing with the Ipv_d of the clear sky day on 4 February 2011. It could be agreed with the fact that the sunlight can reflected and scattered by the rain drop. Then, the small intensity of the sunlight caused by the rain drop to the solar cell could reduce the current that generated by the solar cell. The Ipv_d on the clear sky day on 4 February 2011 had small fluctuation because they had no effect of the rain drop to the solar cell.

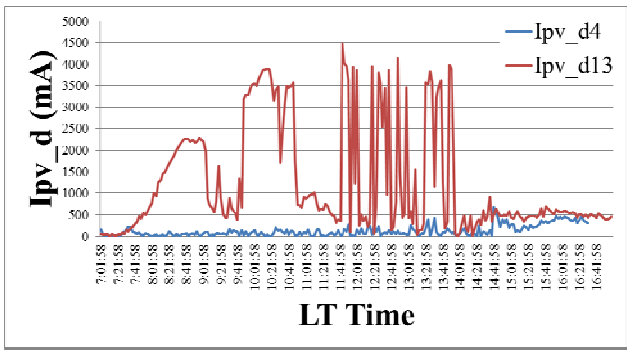

Figure 5 comparison of Ipv_d between day 4 and 13 Feb 2011.

4. CONCLUSION

Solar cell is the instrument that can convert solar energy into electric energy. The electric current occurs when the solar radiation is incident onto the Solar cell. The amounts of electric current depend on the intensity of the incident solar radiation. In daytime, the generated electric current is varied. It is caused by the varying of the intensity of the solar radiation. The variation of intensity of the incident solar radiation mainly comes from the cloud on the sky over the solar cells.

This experiment illustrated that the using of solar cell for daily weather study could be conducted. The variation of Ipv_d might be plausible to the daily weather condition. In the period of experiment days, the variation of Ipv_d showed good agreement with the daily weather conditions. The high level with small fluctuation of Ipv_d could refer as the cloudy day without rain. Otherwise, the low level with small fluctuation of Ipv_d could refer as the sunny day. The Ipv_d with the periods of rapid changing more than 3000 mA might be considering as the day with raining periods. However, there are some developments still existed. For example, the range of the using of Ipv data was limited. The Ipv in early morning and lately afternoon are very low. That means they cannot be used to study the daily weather via the method in this experiment. We need to investigate and find the solutions in the future studies.

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