Chapter 6

Observation of solar UVR in campus of university Malaya

6.1 Introduction

The objective of this measurement to check the intensity of solar UV radiation at different climate conditions. This measurement can help us to get an idea how to determine the intensity of UV radiation using TL material. The hourly and daily measurements of solar UVR showed that the high irradiance of UVR at campus of university Malaya, Kuala Lumpur (latitude 3.5 ^{o}N, longitude 101.5 ^{o}E and height 19 m over see level), compare with other regions of the world. During the measurements, the haze was lasting for three month, starting from August until the beginning of November. The high concentration of the haze was in September.

6.2 Average daily UV irradiance

The measurements showed that the average UVB irradiance was increased ~2 times around noontime from August to December, whereas, UVA was increased ~1.3 time during that time, as shown in figure (6.1) for UVA and figure (6.2) for UVB. According to the measurement of solar UVA in figure (6.1), the UV irradiance in September should be higher than in August, but the measurements showed the UVA irradiance in September was less than in August. It is possible that part of the UVR was absorbed by the haze particle, which its concentration was higher in September compare with August (Malaysian Environmental Quality report, 1997).

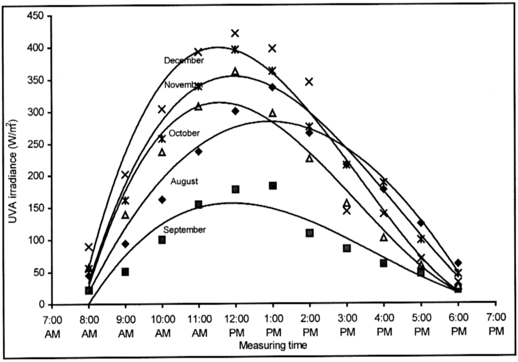

Figure (6.1): The Average monthly irradiance of UVA (August – December 1997) (Direct measurement)

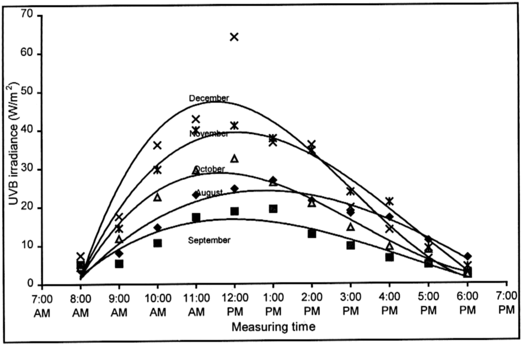

Figure (6.2): The Average monthly irradiance for UVB (August – December 1997) (Direct measurement)

UV irradiance was high at noontime between 11:00 am - 1:00 pm where the sun is directly overhead. The irradiance was higher ~8 times compare with the morning and the evening. The most daily reading of solar UV is measured around noontime to determine the value of UV index.

Due to the low sensitivity of TLD materials to solar UV radiation, It is prefer to expose them around the noontime where the intensity of UV radiation is too high and the reading of TL intensity for TLD materials is considered mainly caused by primary UV radiation.

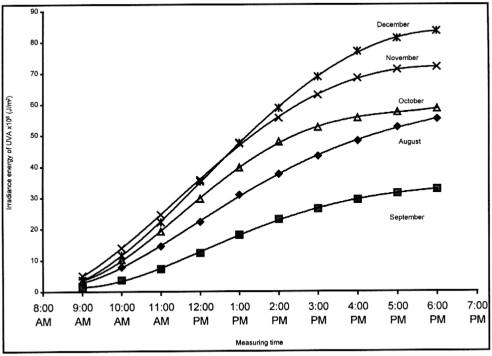

Figure (6.3): The Average monthly accumulation of UVA irradiance energy (August – December 1997)

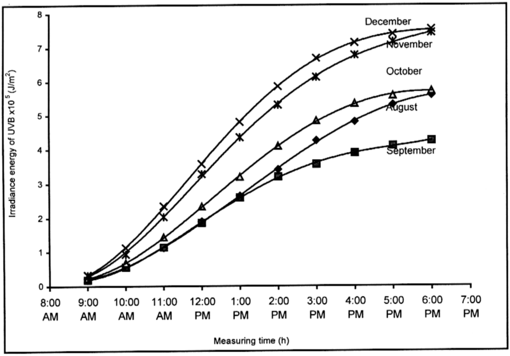

Figure (6.4): The Average monthly accumulation of UVB irradiance energy (August – December 1997)

During the measurements, the rain was starting in the most of measuring days around 2:00 pm until late evening from October until December. Due to the absorption of UVR by the rain droplets, the average UV intensity at evening time in October to December was less than August, figures (6.3 and 6.4). From this data, it is clear that the rain can affect the daily measurements but not to the average measurements.

6.3 Accumulation of UV radiation

Same as the hourly monitoring, the accumulated measurement of UVR irradiance energy was its lowest value in September due to the haze absorption. The total UVR irradiance energy was increasing from August to December. The total UVA irradiance energy in December was higher than in August by the factor of ~1.5, whereas, the total UVB irradiance energy was higher in December by the factor of ~1.3.

It was observed also that the total UVR irradiance energy did not affect by the quantity of rain, where the total dose UVR dose in December is higher than in August although the quantity of rain was higher in December.

We can divide the UV irradiance energy to three regions, see figure (4.24) for UVA and figure (4.25) for UVB. The rising part was from sunrise until 10:00 morning. The linear part, which is the most important part, was between 10:00 morning and 3:00 afternoon and the saturation part is approximately after 3:00 until sunset.

It was found that the total average of the daily irradiance energy at Kuala Lumpur is high compare to other region of the world. For instance, the total average of the daily irradiance energy of UVA in December 1997 was 7.66×10^6 J/m^2 compare with Penang (5.3 °N, 100.2 °E. Malaysia) 5×10^5 J/m^2 (Ilyas 1991), Dhahran (26.2 °N, 50.1 °E, Saudi Arabia) 1.2×10^6 J/m^2 (Abu-Jarad 1996) and Glasgow (55.5 °N, 4.2 °W, UK) 7×10^5 J/m^2 (Moseley et al 1983).

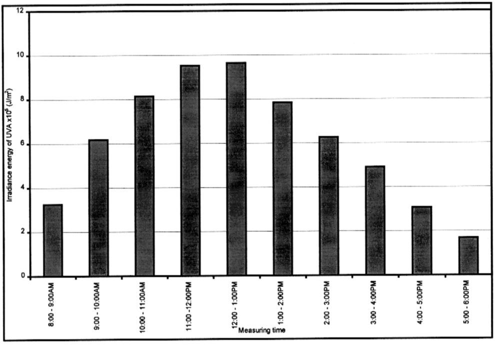

Figure (6.5): The hourly accumulation of UVA

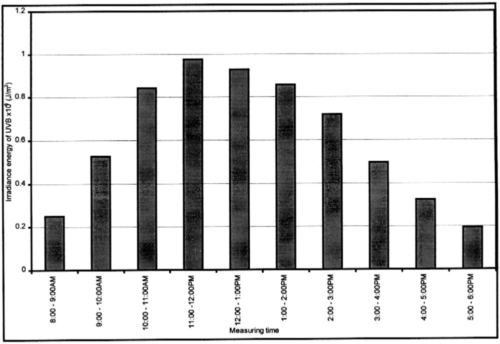

Figure (6.6): The hourly accumulation of UVB

6.4 Hourly percentage variations of UV radiation

Solar UV dose was high at noontime (10:00 am – 3:00 pm) compare to early morning or late evening due to the position of the sun.

It represents ~ two third of the total UV dose from 8:00 am morning until 6:00 pm evening (Moseley 1988). The average UVR dose is identical from 11:00 am to 12:00 pm and from 12:00 pm to 1:00 pm.

6.5 Direct and indirect measurement of solar UV

For clear and cloudy day, the intensity of solar UV is similar for direct and in direct measurements. We found that the UV intensity was slightly different in the early morning and late evening in the direct and indirect measurements.

It is possible that the diffuse or scatter radiation can contribute to the total UV intensity during that time, which can cause an increasing in UV intensity in indirect measurement compare with the direct measurement.

During the haze time, the measurements showed that the indirect measurement was higher than the direct measurement from the morning until evening. It is possible that high number of UV radiation can be reflect by the haze particles that can contribute to the total UV intensity and lead to an increasing in the UV intensity in indirect measurement. The fitting lines in figure (6.7) show the difference in UV intensity in direct and indirect measurements at different weather conditions.

6.6 The effect of the climate changes in the intensity of solar UV radiation

Rain can absorbed UV radiation up to 94%. It has strong effect in the absorption of solar UV radiation. The effect of haze was lower but higher than that from the cloud. Strong concentration of haze can absorb up to 90% of solar UV. The range of cloud absorption is between 50% to 70%. See figure (6.8) for the reduction in UV intensity due to the haze and cloud.

The absorption of solar UV due to the rain, haze and cloud is showing in the following table (6.1) and was measured at 3:00 pm.

Climate conditions	UVB	UVA
Rain	85.1 – 94.2 %	84.9 – 92.5 %
Haze	81.8 – 83.5 %	86.9 – 88.8 %
Cloud	49.3 – 68.0 %	52.9 – 69.8 %

Table (6.1): The absorption of solar UV

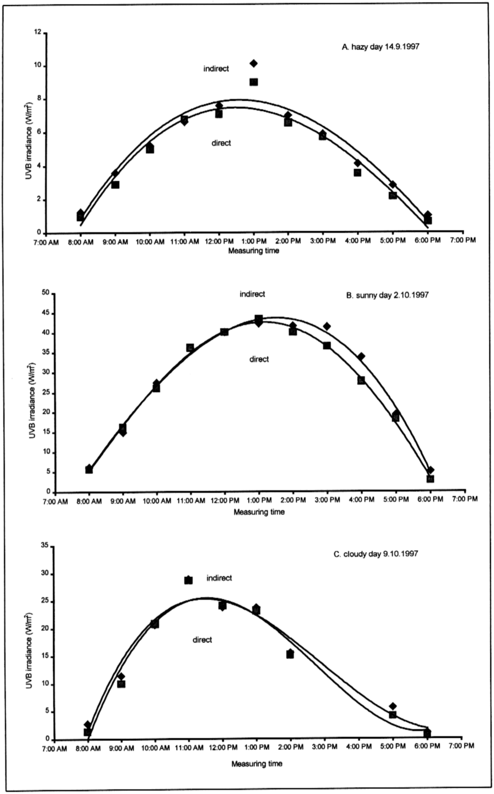

Figure (6.7): UV intensity measurements for direct and indirect measurements.

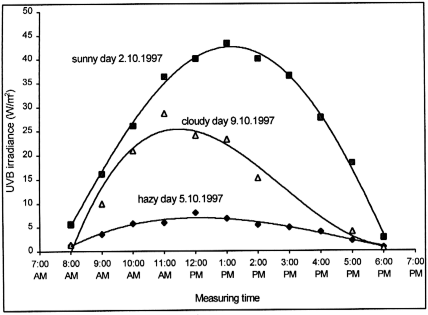

Figure (6.8): The effect of the cloud and haze on the intensity of solar UV radiation

6.7 Conclusion

The high intensity of solar UV radiation at the campus of University of Malaya agreed with the previous measurements in Penang by Ilyas (1991). The intensity of solar UV radiation was found to be very high at the equator compared to other locations away from the equator.

In order to protect our selves from the harmful part of solar UV radiation, it is advisable to follow the instructions mentioned in the section (1.9.3) of the first chapter.