TRANSMISSION OF OPTICAL SOLAR RADIATION

Elias Saion, Mohd. Maarof, H.A. Moksin,
Mahdi Abdul Wahab and Zainal Abidin Sulaiman

Faculty of Science and Environmental Studies
Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia

Keywords: solar radiation, mirror light pipes, transmission of light.

Introduction

This research work covers the development, characterisation and application of transmission of the mirror light pipes (MLP_S). A MLP consists of a metallic reflective closed wall structure with highly transparent open ends. Light falling on the entrance is transmitted through the pipe to the exit by multiple reflections off the reflective inner wall and used at the exit. Currently, the MLP_S have been constructed using 3M silverlux™ plastics and the characteristics of the pipes have been studied.

Materials and Methods

Samples of MLP have been fabricated using 3M Silverlux plastics of different lengths and diameters, in cylindrical forms. The MLP_S were exposed at the entrance to the light generated from the quartz tungsten halogen lamp at various incident angles. The emerging light at the exit was directed to the optical spectrograph consisting of a diffraction grating and a photodiode array detector (PAD). The transmission spectrum of the light in the range from 430 nm to 750 nm was measured for different incident angles and aspect ratios.

Results and Discussion

Observation of the measured transmission spectra showed that the transmission of light decreased with incident angle and the aspect ratio. On average, the transmission reduced from about 5% to 90% at the incident angles of 3° and 18° respectively. The spectrum decreased gradually as the aspect ratio increased as to be expected, since light interacts and bounces with more frequency at the reflective wall. The decrease in the transmission spectrum was due to the multiple reflections in the pipe that increase with the length of the pipe and the incident angle of the incoming radiation. However, the result showed that, the incident angle was the dominant factor in the reduction of the intensity of the transmission spectrum, as compared to the pipe length. Detailed study is still needed to verify qualitative these two factors as well as some other factors such as the reflectivity and the uniformity of the inner wall that may also affect the transmission of the light pipes.

Conclusions

Mirror light pipes with different aspect ratios can be easily constructed using commercially available reflective plastics. Light transmission spectra through these MLP_S have been measured by using PAD to determine the transmission intensity at various wavelengths. The transmission spectra were utilised to study the characteristics of solar radiation passing through the light pipes for day lighting applications.

Supported by IRPA Grant 09-02-04-0016