DEVELOPMENT OF A TECHNIQUE FOR SPECTRAL SOLAR ULTRAVIOLET ALBEDO MEASUREMENTS OF BUILDING MATERIALS

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INTRODUCTION

Excessive and repeated exposures to solar UV radiation have been linked to the induction of skin cancers, skin damage, premature skin aging and wrinkling, and sun related eye disorders. Personal UV exposure is due to sunlight received as both direct and diffuse radiation. Part of this diffuse radiation may be due to the UV reflected and scattered from building materials.

METHODS

An ultraviolet spectroradiometer system at the University of Southern Queensland (latitude 27.5^{o} S) was employed in the research project. The spectroradiometer is based on a dual holographic grating (1200 lines/mm) monochromator and a UV sensitive, temperature stabilised photomultiplier tube detector, to measure the spectral irradiance in nanometre increments. The input optics of the spectroradiometer are provided by a 15 cm diameter integrating sphere that can be manually rotated to allow firstly measuring the incoming solar UV spectral irradiance on a horizontal plane and then the UV spectral irradiance at a distance of 1 m from each of the simulated walls in turn. Four simulated walls of medium density fibre (MDF), black plastic, green and grey colourbond, approximately 1 m x 1 m on a vertical plane and normal to the sun's azimuth were employed. For each material, the calculation of the biologically effective irradiances employed the action spectra for human erythema and photoconjunctivitis.

RESULTS

For the solar elevation angles of 33 to 39 degrees in this research, the erythemal UV measured in the direction of the wall material was of the order of 0.4 MED/h where an MED is defined as a minimum erythemal dose. The UV albedo calculated as the ratio of the irradiance in the direction of the wall and the solar irradiance on a horizontal plane for human erythema was 0.27, 0.24, 0.22 and 0.19 for the MDF, black plastic, grey colourbond and green colourbond respectively. In comparison, employing the photoconjunctivitis action spectrum, the albedo was 0.23, 0.21, 0.20 and 0.15 for the MDF, black plastic, grey colourbond and green colourbond respectively. The measured UV albedo may be due to the UV albedo from the material and the diffuse component of the UV solar radiation. This is shown by the albedo of 0.15 and 0.20 for the UVA (320 to 400 nm) and UVB (280 to 320 nm) respectively for the green colourbond. At the shorter wavelengths, there is a greater fraction of diffuse radiation.

DISCUSSION

The UV albedo of building structures is important in a number of settings, including schools, where school children are particularly vulnerable due to a predominance of outdoor activities in

the school meal breaks. The UV albedo for human erythema and the photoconjunctivitis action spectrum measured for the four materials employed in this research are of importance for skin prevention programs. The UV albedo contributes to the diffuse UV component. It is more difficult to protect from this component with the usage of hats and shade structures.