

Application of VIS -NIR-SWIR reflectance spectroscopy (400-2500nm) to quantitative analyze of settled dust in the indoor environment during spring and summer Seasons. A case Study in Tel-Aviv

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Today, the basic academic training related to indoor and outdoor air quality is within a single discipline and a new multidisciplinary paradigm is needed. The synergy of reflectance spectroscopy and multivariate statistical methods to quantitatively measure dust loadings could eventually become the preferred method for accurate, comprehensive, and almost real-time assessment of the indoor-environment dust condition. Reflectance spectroscopy of solid particles in the Visible-, Near Infrared-, and Short Wave Infrared (VIS-NIR-SWIR; 400-2500nm) region is a well-known technique by which the chemical composition of many materials can be rapidly and quantitatively obtained. The constraints inhibiting the adoption of this method are 1) the relatively low sediment dust load anticipated to pass through the sensing detectors and 2) the strong spectral responses of the target's background.

The total mass of dust particles settling in an indoor environment is an important parameter for estimating people's exposure to dust in both their residences and workplaces. In view of the above, in this study, we examine the potential of the reflectance spectroscopy method over an actual indoor dwelling environment during two different seasons (summer and spring). For this purpose, the relationship between spectroscopic measurements and total gravimetric weight was examined and later modeled to predict the relationship between the dust loads and the reflectance (in-situ) readings. A multivariate data analysis based on Partial Least Squares (PLS) regression was run; and spatial data analyses using ARC GIS software was applied in order to map the results over the city of Tel-Aviv.

Within this study, we investigated the influence of the outdoor environment on the total amounts of indoor dust. In this regard, we quantitatively examined the indoor dust that settled under different synoptic situations: Dust storm events during Spring season and the constant influence of Red Sea Trough during the Summer. During the April 2005, indoor dust was collected for a 28-days period by placing the dust trap on flat surfaces (tables, shelves and boxes) at a height of 1.3 m above the floor and the total of 45 dwellings were sampled within Tel-Aviv city. The study was expanded and during August 2005, the measurements were performed in 90 dwellings across the same

area. Two different patterns of dust distribution for each season were generated and compared on a spatial domain.

It was concluded that the extracted spatial information (which can be generated almost in real time) can be used for initial decision making, improving indoor conditions, and tracking dust contamination following environmental change. We believe that the possibility of building a model or models (perhaps different for different seasons) that will give an immediate qualitative and quantitative answer regarding the indoor dust conditions, opens up new opportunities for more professional indoor environmental monitoring and meet the need to look for newer (multidisciplinary) paradigm.