ABSTRACT

Geotechnical properties of soils are influenced by their index properties. Cost, time and other constraints restrict the scope to determine the index properties of the entire project site by conventional field and laboratory based methods. Thus, there is a necessity to develop efficient methods to determine the properties rapidly and accurately. This thesis is concerned with the evaluation of the potential of hyperspectral radiometry to determine the index properties of soils in a rapid and accurate manner.

A total of two hundred and fifty samples were collected from Kolli hills and Pachamalai, Musiri and its surroundings, Veppur and its surroundings and Guduvanchery in the state of Tamilnadu, south India. The samples are tested for their index properties such as water content, gradation, Atterberg limits and density. Tests were also conducted to determine the organic contents and mineral composition. Laboratory methods used include sieve analysis, oven drying method, X-ray Fluroscene analysis, determination of Atterberg limits and determination of organic matter content. A portable spectro-radiometer, specifically designed to acquire visible near-infrared (VNIR) and short-wave infrared (SWIR) spectra is used.

The spectral parameters derived from spectral curves are: (i) Maximum Reflectance value, (ii) Depth of absorption value at particular region (iii) Width of spectral curve at particular region (iv) Slope of the spectral curve at one particular region (v) Area under the spectral curve (AUC), (vi) Radius of

curvature at particular region, and (vii) Shift in the position of maximum / minimum reflectance value.

A few salient observations and inferences are as follows: the overall reflectance increases when the grain size decreases, provided soils have uniform colour and mineralogy. The slope of the spectral curve in the 350-800nm region relates very well to the soil texture with R^2=0.9114. Spectral response in the entire region (350-2500nm) is governed by texture of soils with uniform mineralogy, while the NIR region is well suited for textural analysis of soils with mixed mineralogy. Textural analysis of beach sand and river sand can be done using the , 'Slope at 1000-1400nm region' as a parameter. "Area under the curve" is the best suited parameter to estimate the soil texture of red and black soils.

When the water content in soil increases, the overall reflectance decreases. Spectro-radiometry may not be suitable to derive information on 'soil-water' for soils with moisture content close to liquid limit. However, depth at 1400nm is the best suited parameter for analysing water content in soils even beyond saturation limit.

Area under spectral curve of the visible region is the best suited parameter to quantify Soil Organic Matter (SOM). While calcium carbonate rich soils have high reflectance in the visible, NIR and the SWIR regions, beach sand with heavy minerals can be identified using the Slope parameter calculated at 350nm region.

From this study, it is established that while certain parts (850nm, 1400nm, 1900nm and 2200nm regions) of the spectrum are strongly influenced by index properties, the remaining parts of the spectrum are moderately or feebly influenced by the index properties.