Estimation of some maturity parameters on composts and sewage sludges using NIR spectroscopy

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In this work, the use of near-infrared reflectance spectroscopy (NIRS) was studied as a potential method to estimate some maturity parameters on composts and sewage sludges. The parameters that have been studied were: C mineralization, soluble carbon, E4/E6 and E2/E3 ratios, ash percentage, total carbon (TC) and total nitrogen (TN).

For the development of the models, two sets of samples (consisting of composts and sewage sludges) were used. The first set (122 samples, 27% sewage sludges and 73% composts) was used to estimate C mineralization, soluble carbon, E4/E6 and E2/E3 ratios and ash percentage. The second set consisted of 125 samples (29% sewage sludges and 71% composts), in which TC and TN were studied. The samples (dried at 40ºC and ground) were placed in glass Petri-dishes, and scanned on reflectance mode from 12000 to 3800 cm^{-1}. For these measurements, a Fourier-Transform near infrared (FT-NIR) spectrophotometer (MPA, Bruker Optik GmbH, Germany) was used. Partial least squares (PLS) regressions were performed to relate the spectral information with the parameters studied. Typical spectroscopic preprocessing of the spectra were tested and cross validation was used for the model construction.

Satisfactory results were obtained for C mineralization (R^2=94.23; RPD=4.19), E4/E6 ratio (R^2=92.4; RPD=3.12), soluble C (R^2=81.04; RPD=2.30), ash percentage (R^2=76.88; RPD=2.09), TN (R^2=95.49; RPD=4.87), and TC (R^2=60.77; RPD=2.45),

according to the RPD value.

NIRS presents interesting characteristics, such as low cost, low time-consumption, minimal pre-treatment of samples, no need for chemicals and precise accuracy. The results indicate that NIR spectroscopy can be a very useful tool to estimate some maturity parameters. This information can be very helpful for land applications of organic wastes, for the waste water treatment plants management, as well as for monitoring the composting processes.