Use of portable X-Ray fluorescence signal for characterization of soil physical parameters: A feasibility study

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Main problem
In aim of environmental assessment of urban areas or of restoration of ancient industrial sites, high-yield field methods for soil characterization such as portable XRF (X-ray fluorescence), have advantage of providing the main chemical composition within being rapid, cheap and non destructive (Peinado et al. 2010). Recent studies highlighted that portable XRF data can be considered as quantitative for some of analysed metal elements and semi-quantitative for others (Branchu et al. 2013). However, the portable XRF (PXRF) was shown to be sensitive to matrix variations (water content and texture, Zhu et al. 2011).

Objectives
Main objective of the present study is to assess, through laboratory and filed investigations, the feasibility of using the drift of the signal (or part of it) recorded by the Niton XL3T PXRF spectrometer for approaching physical characteristics of the soil (ie. water content and bulk density) in complement to the measurements of the chemical composition.

Methods
The raw PXRF signal of the PXRF was recorded for three energy levels during two experiments conducted in field conditions and at the laboratory. The first experiment compared four levels of aggregation of the same natural soil sample with reference measurements made on the crushed sample at the stationary test station. The second experimental design consisted in the analytical comparison of 13 mixtures of 6 controlled solids, respectively kaolin, peat and four sands of various grain size and chemical matrix (basaltic, siliceous and carbonate). Control of the two studied physical parameters was performed by crossing the response to 3 moisture levels obtained for the studied solids and their mixtures of various matrix and grain-size.

Results and conclusions
A systematic response was found to the effect of water content. However, this was depending on the nature of the chemical matrix of the sand thus limiting the feasibility of using the drift of the raw signal for approaching information about the soil moisture.

The aggregation level of the soil has lead to a systematic shift of the raw signal. A similar systematic drift was found by comparing the mixtures of controlled solids of various grain-size with the same milled blend mixtures. Results relative to the texture of the soil allow to envisage the use of the raw signal drift to obtain informations about the density of soils by the portable XRF method.

References