Possibilities and drawbacks of portable XRF instrumentation for characterization of metal contaminated sites

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Metal contamination is one of the most ubiquitous, persistent and complex environmental issues, encompassing legacies of the past (e.g. abandoned mines) as well as current anthropogenic activities (e.g. smelting, fuel combustion or electroplating activities). As a consequence, one of the challenges facing society today is the identification, evaluation and remediation of contaminated areas to protect public health and environment quality. These studies are heavily dependant on observation and quantitative measurements of the amounts and distribution of metals, leading to the necessity of having appropriate analytical methodologies.

Rapid, simultaneous, multi-element analysis can be performed using X-ray fluorescence spectrometry which is a versatile, non-destructive analytical technique commonly used in the environmental field. Field-portable XRF instrumentation (FPXRF), is particularly interesting for such purpose since provides near real-time data by in situ measurements necessary to guide critical field decisions in extent of contamination, removal and remediation actions. In recent years, the development and commercialization of portable/benchtop tube powered XRF spectrometers, which offer extreme simplicity of operation in a low-cost compact design, has added the advantage of increasing instrumental sensitivity compared to hand-held instrumentation using isotope sources, thus improving both precision and productivity and approaching such technique in the environmental field for many analytical problems.

Despite that FPXRF analyzers are generally less sensitivity (have higher element detection limits) than laboratory equipment, obtained data is sufficient to meet site action level requirements in most cases. However, to obtain in situ reliable analytical data, a number of factors that may affect FPXRF response must be considered (sample matrix effects, accuracy and suitability of calibration standards, sample morphology) and usually, comparison with established laboratory methods and analysis of reference materials is also necessary.

In the present contribution, the implementation of different configurations of portable XRF spectrometers (benchtop and hand-held systems) for in-situ analysis has been evaluated to achieve reliable analytical results for several types of environmental samples analyses at many different scales (from micro to macro). Comparison with established laboratory methods has also been evaluated to test the real capability of portable equipments for the intended purpose.