Field portable XRF analyser for mine waste and red mud polluted soil

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The field portable X –ray fluorescence device (FP-XRF) developed for multi-elemental analyses was applied in our practice to simultaneously measure metals and semi metals in soils and other solid media without extracting metals from the samples. This non-destructive technique can save costs owing to its rapidity and ability to analyse solid environmental samples *in situ* or on site. The information collected *in situ* or on site make the decision making process and contaminated land management environmentally and economically more efficient compared to traditional laboratory analyses.

In spite of these advantages FP-XRF usage is not widespread and the information provided by it is typically not adequately used. The application of such a versatile method and easy to use portable device should be integrated into a tiered assessment concept, taking into account its possibilities and barriers.

The FP-XRF analyser is able to detect metals within large areas and can map the contamination along whole catchments, agricultural lands or hazardous waste sites. The FP-XRF device has gained an important role in contaminated site characterisation, pollution mapping and environmental monitoring moreover in the follow up of the effects of any technological interventions aiming at risk reduction and remediation of the environment.

Using the portable device for preliminary assessment, source, hot-spot and transport route identification as well as delineation of metal-contaminated areas the risk manager is able to take *in situ* decisions on the modification of the assessment plan and monitoring concept, to check whether the samples taken for laboratory analyses or microcosm tests represent the hot spots or the average of a certain site, or whether the removal, treatment or other costly manipulations are done at the right place. All these uses significantly decrease the uncertainty of site characterisation, site specific risk assessment and contaminated site management.

On the other hand, the measuring uncertainties of the FP-XRF compared to the very precise laboratory analyses discourages and misleads many of the potential users, as well as the authorities and the regulatory entities. Several efforts have been made to establish the basis of FP-XRF applicability (similarly to other *in situ* measuring devices), comparing *in situ*, on site and laboratory measurement uncertainties. Despite this the benefits of its application have still not been clearly stated. By statistical evaluation of the comparative results of two specific cases: 1. mine waste and the mine waste contaminated soil, 2. red mud and red mud contaminated soil this study contributes to the clarification of the facts, of the advantages and disadvantages of the use of FP-XRF.

To characterise the measurement uncertainties of the portable XRF device the measurement results of conventional laboratory analyses were compared with those of the portable XRF function of testing time and various environmental conditions, such as, moisture content, particle size distribution and heterogeneity of the tested samples.

We compared by statistical analyses the XRF measurements with the results of chemical analysis done by ICP-AES on Aqua Regia, acetate and water extracts of different mine wastes and mine waste contaminated agricultural soils, red mud and red mud contaminated soils to evaluate the correlations and non-correlations and the standard deviations.

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