On-site screening and monitoring of pollution by a field-portable X-ray fluorescence measuring device

Mária Tolner, Emese Vaszita and Katalin Gruiz
Budapest University of Technology and Economics, Department of Applied Biotechnology and Food Science
1111 Budapest, Gellért Sq. 4. HUNGARY; e-mail: mtolner@mail.bme.hu, www.ecorisk.hu

Introduction

In situ or on site metal detection methods are able to spot on site the extent, the size and heterogeneity of the pollution. They have gained an important role in site assessment, site characterisation, pollution mapping, environmental monitoring and in the follow up of the effects of interventions.

Characterization of the reliability of the XRF measurements

- Preliminary assessment and selection of an experimental plot
- Identification of pollution transport routes
- High resolution mapping
- Pre-remediation mapping of toxic metal pollution

The work was supported by the “Anyos Jedlik” (NKFP-3-020/2005) and “BANYAREM” (GVOP-3.1.1-2004-05-0261/3.0) Hungarian Research Programmes

Objectives

To demonstrate the possibilities and advantages of in situ metal detection using field-portable XRF instrument through the following applications:
1) pollution transport pathway identification,
2) pollution mapping in a flooded allotment,
3) high resolution mapping,
4) preliminary assessment and selection of an experimental plot.

Distribution of the detected metal concentration within the assessed area was visualised on 3D charts using STATISTICA®6.0 and ArcView ArcGIS™ software.

In situ applications of the field portable XRF instruments

Identification of pollution transport routes

Fig. 6. shows the As, Pb, and Zn concentration distribution based on 23 measurement points within the assessed 60m² area. The graph outlines the heterogeneity of the assessed site thus draws the attention on the advantages of the in situ XRF measurements able to outline in a relatively short time the most polluted sections of an area.

The pollution transport routes from the Matárszentimre waste rock disposal site were identified based on 55 XRF measurement points. The 3D Contour plot visualizes the arsenic and zinc concentrations within the waste rock disposal site and along the seasonal runoff pathway. The pollution transportation route is clearly outlined on the pollution map: it agrees with the runoff path. The photos above confirm the effect of erosion by water within the mine waste disposal site (Fig. 6).

Pre-remediation mapping of toxic metal pollution

Some of the polluted allotments in the flooded area along the Toka creek were has been assessed to identify remediation field plots. The maps prepared from XRF measurement points show an increasing metal gradient in the Toka direction. The effect of floods along the Toka creek becomes obvious: the low-lying landscape near the creek shows extremely high metal concentrations (Fig. 9).

Conclusion

The hand-portable XRF device is able to perform immediate, non-destructive, quick multi-element detection. It can be successfully applied to field pollution screening, delineation of point sources and mapping of diffuse toxic metal pollution on large areas. It is able to provide continuous and real time data, so that the assessment strategy can be modified during the assessment. It is suitable for source and transport route identification, source delineation and shortens the time of the preparatory works of risk reduction. The field portable devices allow assessment of large sites, even whole catchments, on site monitoring of polluted sites and remediation technologies. The in situ metal detection methods have lower precision compared to the laboratory analysis, but the number of measurements have practically no limit, which is often more important. The field portable XRF methodology is cost- and time effective for the in situ assessment of metal polluted sites.

The work was supported by the “Anyos Jedlik” (NKFP-3-020/2005) and “BANYAREM” (GVOP-3.1.1-2004-05-0261/3.0) Hungarian Research Programmes