NITON Connects

LEADER IN PORTABLE XRF TECHNOLOGY • CASE STUDY • MAY 2000

Detecting Arsenic in Soil Using Field Portable X-Ray Fluorescence (XRF)

Current models of the NITON 700Series offer limits of detection of 15 ppm for As in soil, for testing times between 30–60 seconds.

Rapid Assessment of Arsenic

Rapid, accurate on site determination of arsenic and heavy metal levels in soil is a powerful tool in efforts to rebuild and revitalize abandoned and under-utilized industrial properties. The EPA is actively spearheading initiatives to encourage assessment, clean-up and re-use of these industrial properties. In the case of heavy metals (often the eight RCRA metals Pb, As, Cd, Cr, Hg, Ag, Ba, Se), the technology of choice is field portable x-ray fluorescence (XRF) analysis. NITON's field portable XRF offers a number of advantages for expediting site characterization and cleanup.

On-Site Investigations

Rapid, inexpensive site characterization methods for identifying priority pollutants in soil can be achieved. Field based XRF can be used *in situ* following EPA Method 6200. A large number of *in situ* tests can be performed quickly, allowing for extensive geographic profiling which details metal contaminants and quantitates their levels. XRF is also non-destructive to the samples, allowing a sub-set to be sent for confirmatory laboratory analysis.

The NITON XRF used at a remediation site.

Remote Detection of Arsenic in Soil

Practical Applications of the Field XRF Under Stringent Field Requirements

A large Canadian power company has been recently required to assess arsenic levels in soil around several of their facilities located throughout Canada. Because many of their facilities are in remote locations, laboratory turnaround times often take weeks. They plan to use NITON's portable XRF, with its innovative features, that provide rapid, quantitative results on-site in "real time."

The company requires a very accurate analysis of a limited number of samples at each site. For this reason, the appropriate testing method requires that samples be carefully prepared by sieving out the larger particles such as small rocks and organic matter, then grinding the remaining soil to an average particle size of 125 µm, producing a fine homogeneous powder. The powder will then be placed in special XRF sample cups prior to taking the reading. For many large site characterizations, the preferred method is to measure samples, *in situ*, or directly on the ground. This method is less accurate, but allows a very large area to be assessed and "screened" for contamination. In this case, however, accuracy is critical and therefore, correct sample preparation is essential.

The NITON XRF used in situ.

Initial results for arsenic levels found using this method are shown in Figure 1. The correlation is outstanding, with an r^2 of 0.993. The limit of detection is 15 ppm after only 30 seconds of testing time, although longer testing times (2 minutes) are generally employed to obtain more precise results. Since most clearance levels for arsenic in the United States are less than or equal to 30 ppm, the NITON XRF is a reliable assessment tool to determine whether levels are below standard clean-up criteria.

Site Characterization Down Under

In an old industrial site in Southeastern Australia[1], a more traditional XRF testing protocol was required to assist with site characterization and remediation. The site is a large property with suspected wide-spread arsenic contamination. Project goals

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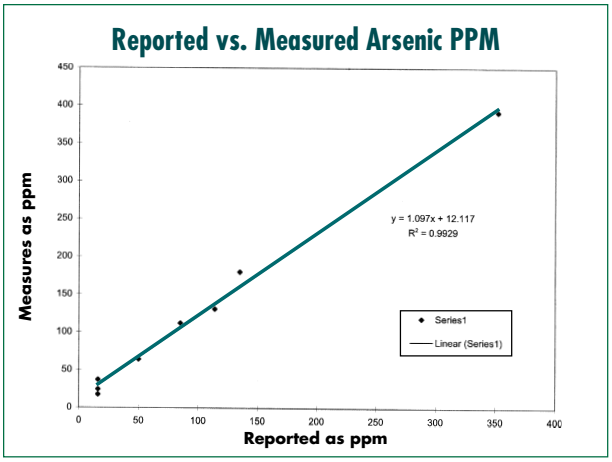

Figure 1. Comparison of reported arsenic ppm vs. measured arsenic ppm for the Canadian powerplant.

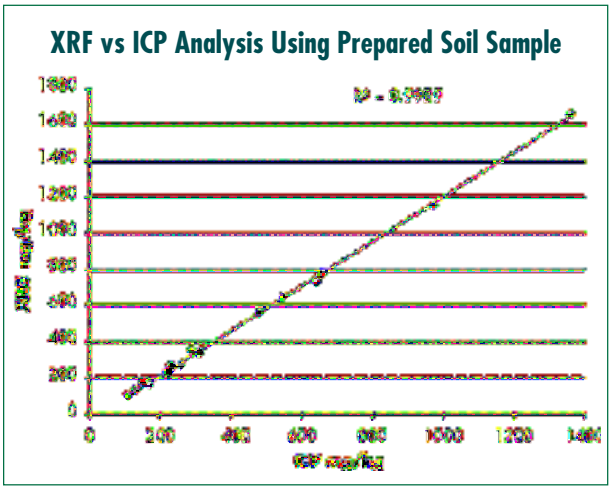

Figure 2. Comparison of NITON XRF results to laboratory results for arsenic in soil.

require a rapid assessment of the site to determine "hot spots" of arsenic, and expedite remediation. Remoteness of the site also makes extensive laboratory analysis both time consuming and expensive.

The NITON XRF is the perfect analytical tool to meet these demands. The XRF could be used for *in situ* testing, due to requirements of rapid site profiling and the need to quickly locate regions of high contamination. Operators will perform thousands of tests directly on the ground to thoroughly profile the arsenic contamination pattern. Several hot-spots will be mapped out, so remediation can begin immediately.

A limited number of samples were collected, homogenized and sieved to particle sizes < 250 μ, and tested both by the NITON XRF and then sent for laboratory ICP analysis. Past work (shown in Figure 2) has demonstrated an excellent correlation between the field and laboratory results (r^2 = 0.9989).

The XRF is also a valuable tool during remediation efforts. For this site, remediation mainly consists of soil removal. A "dig and test" process will be employed to ensure that only contaminated soil is treated or removed, thus generating additional savings. Layers of soil will be removed and freshly exposed soil tested again with the NITON XRF, providing information on the depth of contamination. This allows the operator to stop digging when results are below action levels.

The use of portable XRF analysis for this site will assist in expediting site clearance and keeping analytical costs as low as possible. Site managers are able to eliminate the guesswork in determining if concentrations are below action levels. Samples pulled for final clearance are prepared and analyzed on site. If readings are near or exceed clearance levels remediation efforts will continued until on-site analysis indicates contaminant levels have met clearance criteria. This strategy reduces analytical costs, since only one set of clearance samples are sent for laboratory confirmation. Moreover, the likelihood of a failed clearance is virtually eliminated, thus reducing costly remobilizations of remediation crews for continued work if laboratory analysis indicates arsenic levels exceed action levels.

Summary

The two applications, presented above, for arsenic in soil testing using a NITON field portable XRF illustrate the versatility of this instrument. In one application, the customer requires that a limited number of samples be tested with a high degree of accuracy. For this case, samples are finely ground and placed in sample cups for testing. Results are obtained with testing times of 20 to 30 seconds and a detection limit of 15 ppm. In the second application the customer requires that a very large number of samples be rapidly tested to profile the site and find "hot spots." In this case, a lower level of accuracy is acceptable and the customer chooses to perform rapid, in-situ tests followed by limited laboratory confirmation.

References

1 M. Ridings, A.J Shorter, CSIRO Tropical Agriculture, 306 Carmody Road, St. Lucia, Q4067, AUSTRALIA and J. Bawden-Smith, JBS Environmental Services & Technologies Pty Ltd, PO Box 1480 Bondi Junction, NSW 1355, Australia.

The NITON hand-held XRF.