XRF Analyses of Pre-Hanford Orchards

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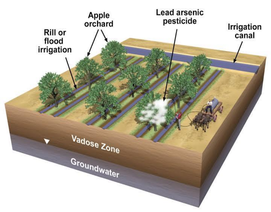
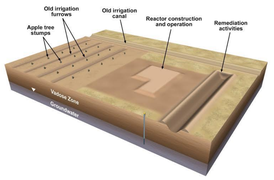
Introduction

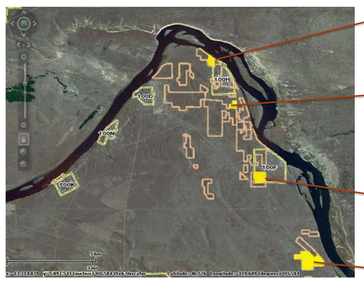




Since the 1890s, the area now known as The Hanford Site was home to thousands of farmers and orchardists. Amongst these farmers, the most common pesticide used was lead arsenate ($PbHAsO_4$). Lead arsenate was dispersed using various methods and quantities, leading to a vast variability of lead (Pb) and arsenic (As) concentration in the soil. For this study, four decision sites were chosen: OL-14, OL-32, OL-FR2-1, OL-IU6-4 to evaluate the lead arsenic concentrations in the topsoil.

An optimization study was conducted using a variable number of replicates, count times, and positioning of the x-ray fluorescence spectrometer (XRF).

The Decision Units OL-14 (46.4 acres) and OL-IU6-4 (250.6 acres) were used for confirmatory soil samples. Both these sites display existence of orchards and other remediation actions associated with the mission of the Hanford Site.



Methods/Procedure

Sample Collection: Six samples were collected ranging above, at, and below the screening criteria of 250 mg/kg for Pb and 20 mg/kg for As at the Decision Units OL-14 and OL-IU6-4, and labeled respectively.

Sample Preparation: Samples were sieved, homogenized and placed in sample cups
Three replicates were prepared for each sample.

Sample Analysis: Each sample cup was analyzed 3 times for 30 sec. A Standard Reference Material (SRM) was analyzed after every 20 readings.

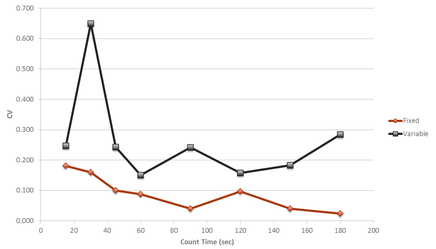
Time Count Determination: Three samples were selected for 15, 30, 45, 60, 90, 120, 150 and 180 seconds in variable positions.

Field Variability: Two transects at OL-14, and one at OL-IU6-4 were created by selecting locations 90° around ground zero at distances of 0.5, 1, 2, 4, 8 and 12 feet (16 ft for OL-14). Locations were scanned in triplicate for 60 seconds each.

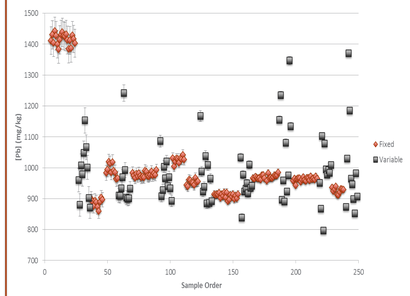




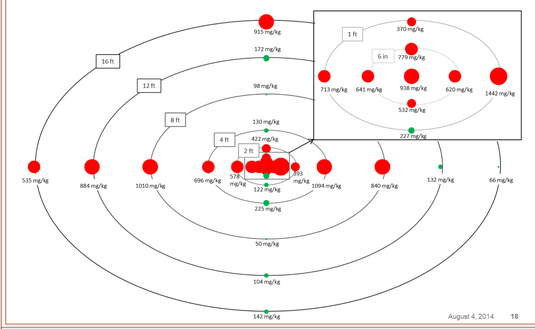
Results



Arsenic coefficient variability with different count times using fixed and variable positioning of the XRF



Fixed and variable instrument sensitivity for lead measurements of a medium sample (OL-IU6-4-M)



Field variability of transect 1 at Decision Unit OL-14

Conclusion

Factors that contributed to the variability of the lead and arsenic concentrations are:

- Operator
- Instrument
- Field

Greater variability was observed in the field over the other two factors.

Operator variability was minimized using a fixed position. Accuracy checks after 20 readings were completed to quantify instrument variability.

References

DOE-RL (U.S. Department of Energy-Richland Operations Office). 2007. Hanford Analytical Services. Quality Assurance Requirements Documents. DOE/RL-96-68, 2007, Rev. 3, Volumes 1, 2, 3, and 4. Richland, Washington.

Peryea FJ and TL Creger. 1994. "Vertical Distribution of Lead and Arsenic in Soils Contaminated with 5 Lead Arsenate Pesticide Residues." Water, Air, and Soil Pollution 78:297–306.

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