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THE CHEMISTRY OF TCLP TESTING OF FLUORESCENT LAMPS

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In the course of developing a protocol for fluorescent lamp TCLP testing, it was discovered that some variation in test results can occur irrespective of controlled test conditions. Some causes for variation are conditions under which the test is performed, unique lamp structure, and chemical reactions that are not at equilibrium after the prescribed test time. Test conditions, lamp structure, and chemical factors that affect fluorescent lamp TCLP test results will be described. An understanding of these factors has been critical to the development of TCLP compliant fluorescent products.

YOUR CONTRIBUTION TO THE CO_2 BUILDUP IN THE ATMOSPHERE

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INTRODUCTION

It is customary to speak of global carbon budgets in gigatons or other large measures. How much do we, as individuals, contribute to the rising concentration of CO_2 in the atmosphere? This poster will present data on the annual CO_2 output of one person and one car, and the approximate area of various forests required to absorb this CO_2 by photosynthesis.

The average person exhales 445 liters of CO_2 per day[1] which is roughly 700 pounds/year. That is dwarfed by the CO_2 production of the average car that uses 552 gallons of gasoline/year[2], producing roughly 10,000 pounds (5 tons) of CO_2. For the purpose of this presentation we will consider the areas of various forests required to absorb 5 tons of CO_2/year.

Nature's response to the CO_2 buildup is the process of photosynthesis which absorbs CO_2. Lawns contribute to this process but do not serve as a permanent repository because they are mineralized in a relatively short period of time. Forests are a more permanent repository of carbon, therefore they will be the focus here.

NET PRIMARY PRODUCTIVITY

The actual storage potential of CO_2 is determined by the photosynthetic rate of a given system minus its respiration rate. Trees absorb CO_2 but they also emit a portion of it in respiration. Roots of trees and growing plants emit CO_2, as do microbes in the soil. Therefore, in assessing the potential of a forest to absorb CO_2 it is necessary to measure both the CO_2 absorbed by the system and how much it emits over a long period of time. An alternate approach is to measure gains in the size of trees and their roots, and make measurements of soil emission rates. These are difficult and time-consuming tasks but they provide a measure of the net primary productivity (NPP).

The data shown in the ensuing sections represent estimates of the area requirements for various forests to absorb 5 tons of CO_2/year. Obviously, variables such as rainfall, latitude, and temperature would influence the performance of each forest.

FOSSIL FUEL EMISSIONS IN PERSPECTIVE

The focus of this presentation is on one's personal contribution to the atmospheric buildup of CO_2 by driving a car. At the same time, mention should be made of the buildup of CO_2 relative to other processes.

It is estimated[3] that the respiration of vegetation worldwide accounts for 60 billion metric tons per year, while the burning of fossil fuels accounts for only 6.5 billion metric tons. Therefore, fossil fuels account for little more than 10% of the CO_2 produced by vegetation.

About 40 years ago, the atmospheric CO_2 concentration was approximately 300 ppm, but it is now approximately 365 ppm

WHAT SIZE FOREST IS REQUIRED TO ABSORB 5 TONS OF CO_2/YEAR?

In the following slides, estimates are shown of the acreage of forest required to absorb 5 tons of CO_2/year (that of one car) based on net productivity. Variations in tree growth rates from year to year are to be expected because of changes in temperature, rainfall, etc. but the numbers shown are considered to be representative of the types of forest shown.

COMMERCIAL FOREST

In testimony given before the Senate Committee on Energy and Natural Resources, September 15, 1988, it was stated[4] that "the U.S. is still the largest single source of CO_2 to the atmosphere from fossil fuel burning (including a small contribution from cement manufacture) with 1202 million metric tons of carbon emitted in 1986. This comes to just over 5 tons of carbon per person - - it would require 15.68 acres of commercial forest to take up our individual CO_2 contribution."

Converting tons of carbon to tons of carbon dioxide requires a factor of 44 / 12, therefore 5 tons of carbon represents 18.3 tons of carbon dioxide.

Based on the uptake rate cited above, the area of commercial forest required to absorb the CO_2 produced by one car would be 4.28 acres.

AMERICAN SYCAMORES

Based on a 4-year rotation of American sycamores in Georgia[5], the area required to absorb 5 tons of CO_2/year would be 1.7 acres.

EFFECT OF INCREASED ATMOSPHERIC CO_2 CONTENT ON GROWTH

From 1996 to 1998, growth measurements of loblolly pines, both at atmospheric CO_2 concentrations and at 200 ppm above atmospheric, were made in North Carolina[6]. Increases in NPP for the last two years were 24% and 25% respectively.

Based on these studies, the acreage required for the forest to absorb 5 tons of CO_2/year decreased from 1.1 acres to 0.9 acres under the influence of the higher CO_2 concentration.

Other studies, however, indicate that such gains decrease over longer periods of time.

A Comparison of the NPP of Other Forest Types and Locations[7]

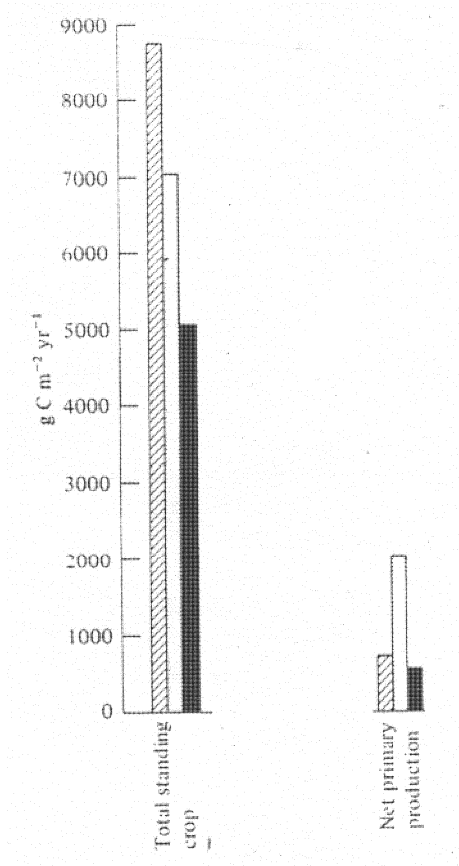
State	Type	NPP ($g/m^2/yr$)	Area Required
TN[8]	Mixed Deciduous	726	1.04 acres
NC[9]	Pine Plantation	2056	0.37 “
NY[10]	Oak Pine	542	1.39 “

NPP vs. Standing Crop

Below are representations of the comparative values of standing crop and NPP for the forests cited in the preceding figure:

COMMENTS

1. The emphasis here has been on the annual CO_2 production (5 tons) of a car using 552 gallons of gasoline, and the area of forest required to absorb it.
2. Data concerning carbon uptake is normally presented in terms of grams C/m^2/year. For the purposes of this discussion, these data have been converted to tons CO_2 /acre/year.
3. Net Primary Production has been the variable common to all of these studies. A more realistic figure would be the Net Ecosystem Production, but that is generally not available. It is roughly ¼ of NPP. Therefore, the acreages shown in these slides should be multiplied by 4 to give a more realistic picture of the CO_2 absorption potential of a forest.



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THE UTILIZATION OF XRF LEAD SCREENING AND XRF LEAD ANALYSIS AT A RCRA CORRECTIVE ACTION SITE

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ABSTRACT

The use of X-ray fluorescence (XRF) field screening and XRF analysis for lead has been used extensively at Lake Success Business Park (LSBP), a RCRA corrective action site. The evaluation of laboratory lead and XRF lead concentrations indicates an excellent agreement between the lead concentrations when compared against the site media protection standards. Based on the results of the evaluation and the implementation of a thorough quality assurance/quality control program, EPA has granted approval to use XRF for lead analysis for all delineation, post-excavation and confirmatory sampling conducted at the site. The approval to utilize XRF procedures at the site has resulted in expedited field activities and a significant cost savings for the project. Additional evaluations have shown field screening data can provide immediate and accurate lead concentrations in the field. In addition, the project team has identified and is investigating the effectiveness of other XRF uses for remediation activities, such as analysis of other metals (arsenic, mercury, copper) and the analysis of air samples by XRF procedures.

INTRODUCTION

The Lake Success Business Park (LSBP) is a 422-acre facility located in Bridgeport and Stratford, Connecticut. LSBP, formerly known as Remington Park, was a small arms and ammunitions manufacturing facility operated from the late 1800s to 1989. The site manufactured, tested, and stored small-caliber and other ammunitions.

LSBP is regulated as an interim-status RCRA facility. In 1990, the site entered into an Administrative Consent Order (ACO) with the EPA for the performance of corrective action activities at the facility. A Phase I RCRA facility investigation identified fifty-one areas of environmental concern (AECs). The majority of AECs are composed of upland-type soils with lead as the main constituent of concern. Corrective actions are presently being conducted at the site in accordance with the ACO.

USE OF XRF AT LSBP

With the recent enhancements to the x-ray fluorescence technology, the LSBP site has been able to efficiently utilize XRF capabilities to expedite corrective action activities. The site utilizes two Niton® 700 XRF instruments for the detection of lead in soils. The average detection limits for lead analysis achieved by the Niton® instruments is approximately 50 ppm.

The instruments are used both in the field and in the on-site XRF laboratory. XRF field procedures are used to delineate AECs, direct excavation activities and confirm remedial activities. Field screening procedures are designed to provide immediate lead concentrations in soil. Two types of XRF field screening are utilized during field activities:

- *In Situ*
  This procedure analyzes the soil *in situ* (in the ground) prior to sampling. The procedure is most practical for surface samples but can also be used on the bottom and sidewalls of test pits and excavations. The XRF analyzing window is placed directly on the surface of the soil for analyses.

- *Point-and-Shoot*
  This procedure is used to analyze soil in the field after the soil has been collected and homogenized. The soil is homogenized in a stainless steel pan or plastic bag. The XRF analyzing window is placed directly on the soil in the pan or bag for analyses.

The on-site XRF laboratory is utilized to analyze prepared XRF samples that provide lead results representative of laboratory lead results when compared against the site media protection standards. The prepared XRF procedure uses a process of drying, sieving and grinding the soil sample prior to analysis. This procedure is designed to eliminate or limit the effect of moisture and non-homogeneous soil samples on XRF lead results.

QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

The LSBP XRF sampling program implements a thorough quality assurance/quality control program (QA/QC) program in accordance with the site's quality assurance project plan (QAPP). Procedures included in the QA/QC program include:

- *Daily Calibration*
  The Niton® 700 XRF instrument calibration for lead and other metals comes pre-programmed from the manufacturer. Prior to use, a baseline check of the factory calibration is performed against a tungsten shield located within the instrument. To check the factory calibration, three National Institute of Standards and Technology (NIST) standards are analyzed. Calibration checks are performed at a minimum of once per day. The XRF result must fall within +/- 10 percent of the NIST certified lead value for each standard. The NIST standards used for daily calibration and acceptable XRF result ranges for each standard are listed below:

NIST Standard	Certified Lead Value (mg/kg)	90% Lower Limit (mg/kg)	110% Upper Limit (mg/kg)
2704	161 mg/kg	145 mg/kg	177 mg/kg
2711	1,162 mg/kg	1,046 mg/kg	1,278 mg/kg
2710	5,532 mg/kg	4,979 mg/kg	6,085 mg/kg

- *Routine Calibration Checks*
  During the course of sampling and analysis, routine checks of the instrument calibration are performed. The XRF sampling/analysis program includes the analysis of the NIST 2711 standard at a frequency of 5 percent (once after every 20 samples analyzed) or at the end of an analytical sequence if it is less than 20 samples are analyzed. This procedure is designed to follow the laboratory spike sampling procedures performed for sample batches. The NIST standard result must be within the upper and lower acceptance limits shown above.

- *Duplicate Analysis*
  A duplicate XRF analysis is performed on prepared soil samples at a frequency of 5 percent or one for every 20 samples analyzed. XRF duplicate sample results are evaluated in the same manner laboratory analytical duplicates are evaluated, as documented in the site QAPP.

- *Blank Sample*
  A blank sample is analyzed at a frequency of 5 percent (once after every 20 samples analyzed) or at the end of an analytical sequence if it is less than 20 samples are analyzed. The blank sample is a silica-based sample that contains no lead. The blank sample is analyzed to ensure the XRF instrument has not been contaminated through extensive use in the field.

- *ELPAT Program*
  The LSBP XRF laboratory participates in the Environmental Lead Proficiency Analytical Testing (ELPAT) program administered by the American Industrial Hygiene Association (AIHA). This program is recognized by the EPA's National Lead Laboratory Accreditation Program (NLLAP) as an approved lead accrediting organization.

  The ELPAT program is established to evaluate the proficiency of analytical procedures (XRF, ICP, AA, etc.) in determining lead concentrations in soil. Blind samples are sent out to program participants by AIHA on a quarterly basis, analyzed by the participant and the results returned to the AIHA. AIHA evaluates the performance of the analytical lead results and publishes upper and lower acceptable limits for lead results. In order for a method of lead analysis to comply with the standards of the ELPAT program, analytical results of the blind samples must lie within the acceptable limit range established by the AIHA. The ELPAT program acceptable limits are determined independent of the analytical method used for analysis.

  To date, LSBP has participated in thirteen quarterly rounds of the ELPAT program. Results from these rounds show that the LSBP XRF laboratory is proficient in analyzing lead concentrations in soil. A regression analysis of XRF results and ELPAT lead concentrations shows very good correlation between the lead concentrations (see Figure 1).

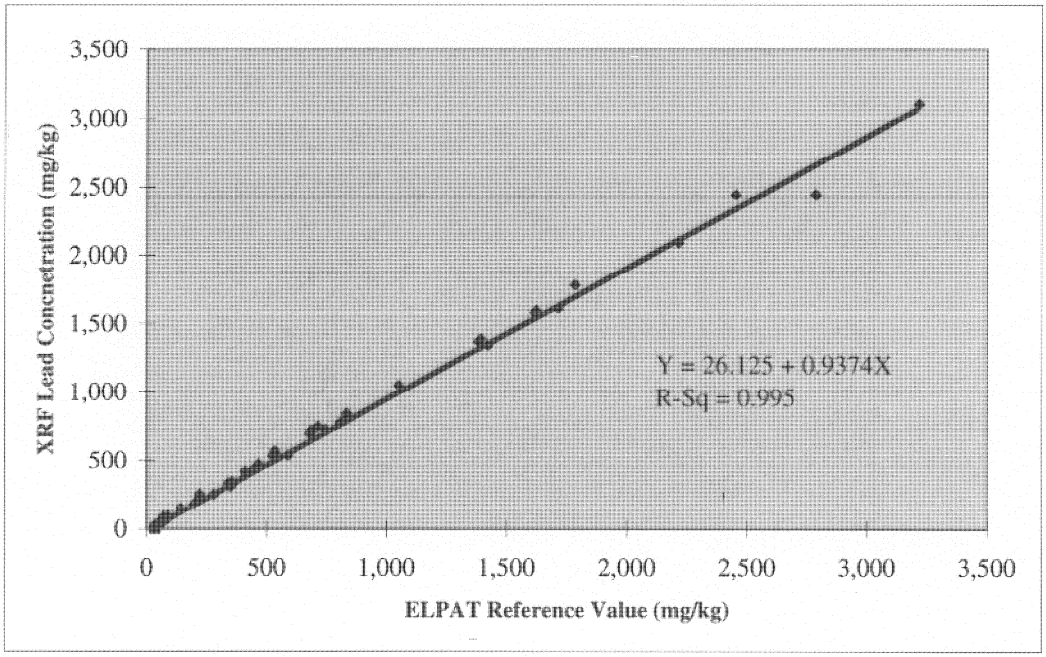


Figure 1. LSBP XRF Lead Concentration vs. ELPAT Reference Values

EPA APPROVAL FOR XRF USE AT LSBP

Based on initial data collected at LSBP, a proposal was submitted to EPA requesting the use of XRF lead analysis for soil samples. The proposal documented the QA/QC procedures implemented at the site and results from the ELPAT program. The proposal also included a statistical evaluation that focused on the reliability of the XRF to replicate lab results.

After review of the proposal, EPA requested that further evaluation be conducted by comparing the sample pairs to site media protection standards. A sample pair is identified as two aliquots from one sample with one aliquot analyzed for lead by laboratory procedures and the other aliquot analyzed for lead by prepared XRF procedures.

Evaluation of sample pairs monitors the occurrence of sample pair disparities (false positives or false negatives). LSBP re-submitted their XRF proposal documenting the sample pair disparity frequency. Of the initial 206 sample pairs evaluated, there was a sample pair disparity frequency of 1.5 percent, or a 98.5 percent agreement between the lead concentrations in the sample pairs when compared against the 500 ppm media protection standard. Comparison against the 1,000 ppm media protection standard resulted in a sample pair disparity frequency of 0.0 percent, or a 100 percent agreement between the lead concentrations in the sample pairs.

Based on information provided in the proposal and the results of sample pair evaluations, EPA approved the use of XRF procedures for lead analysis, contingent on the adherence to the following steps:

- Evaluating lead sample pairs on a routine basis and documentation of sample pair disparities (false negatives/false positives) and associated corrective actions. Evaluation results are reported to EPA every six months.
- Participation in the ELPAT program to show the XRF instrument and procedures are proficient in providing lead concentrations in soil.
- Adherence to and implementation of the QA/QC procedures documented in the site QAPP.
- Ten percent of prepared XRF lead analysis confirmed by laboratory lead analysis.

SUMMARY OF XRF EVALUATIONS

To date, 793 soil sample pairs have been collected and analyzed by both prepared XRF and laboratory analytical procedures. Sample pairs have been monitored for the frequency of sample pair disparities against the site media protection standards (1,000 ppm and 500 ppm). Evaluation of the sample pairs indicates a 99.0 percent agreement between XRF and laboratory lead concentrations when compared against the 1,000 ppm lead media protection standard, and a 97.4 percent agreement when compared against the 500 ppm lead media protection standard. Figure 2 provides a visual description of the sample pair evaluation process. Figure 3 provides a sample

pair evaluation of a sub-set of the prepared XRF and laboratory lead concentration population. 104 of the 793 sample pairs are included in the subset evaluation.

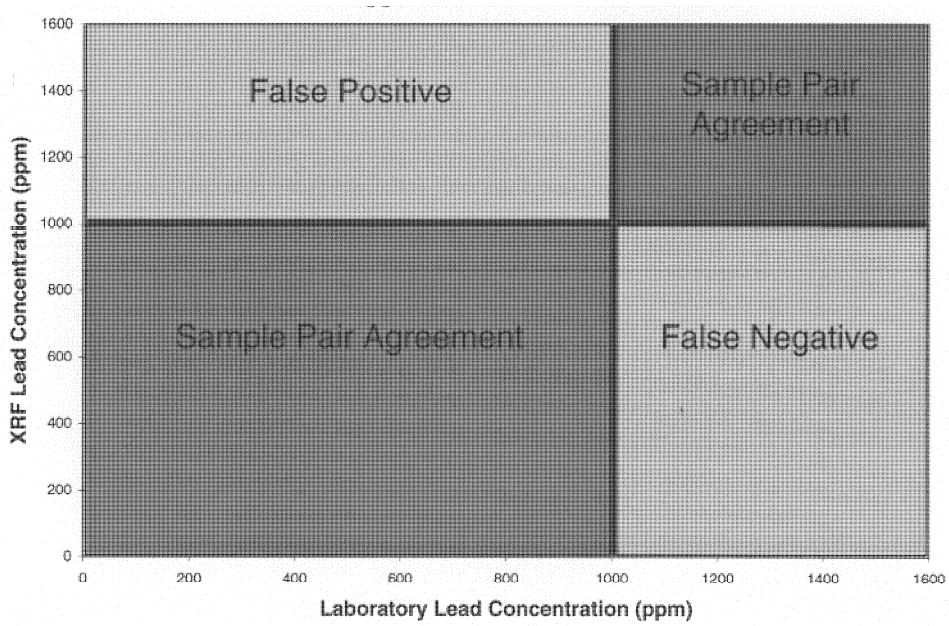
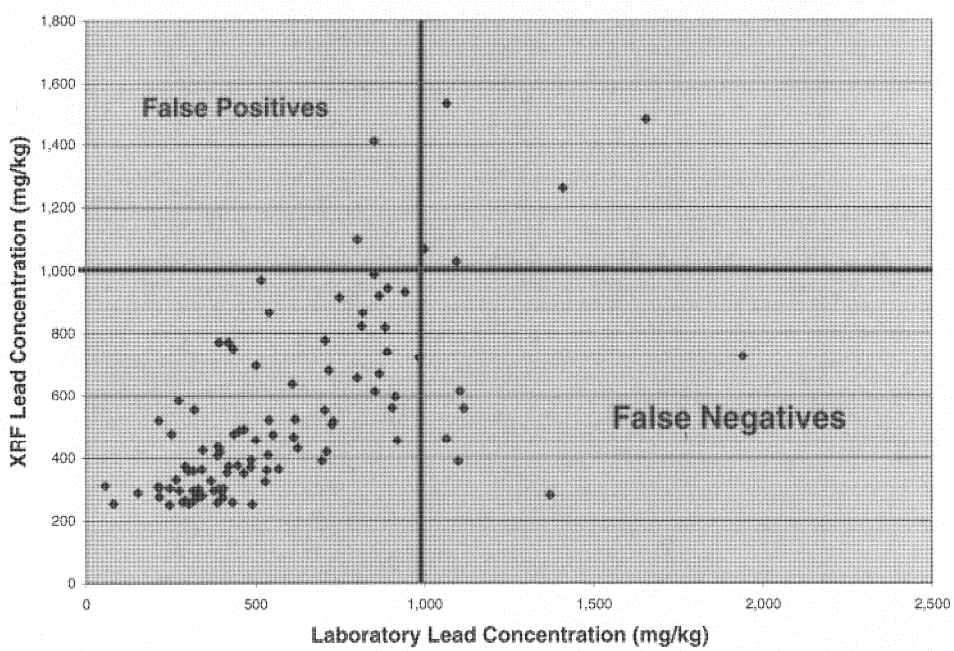


Figure 2. Sample Pair Evaluation Process. 1,000 ppm Media Protection Standard



Further evaluations have been conducted to evaluate lead results from both field-screening procedures used at LSBP (*in situ* and point-and- shoot). Sample pairs were created using field screening results and both the laboratory lead results and prepared XRF lead results. The table below summarizes the disparity frequencies for each sample pair.

Figure 3. Sample Pair Evaluation Against 1,000 ppm Media Protection Standard. Subset of Prepared XRF vs. Laboratory Population - 104 Sample Pairs

Sample Pair	Number of Sample Pairs	Percent Agreement of Sample Pairs to 500 ppm MPS	Percent Agreement of Sample Pairs to 1,000 ppm MPS
Prepared XRF vs. Lab	793	97.4	99.0
Point-and-Shoot XRF vs. Lab	652	95.7	99.0
Point-and-Shoot XRF vs. Prepared XRF	3,153	96.4	99.2
In Situ XRF vs. lab	521	93.1	98.5
In Situ XRF vs. Prepared XRF	1,864	91.4	97.5

Disparity frequencies increase slightly for field screening data; however, a very good agreement between field data and prepared XRF/laboratory data is still shown. The data also indicates that the more the soil is prepared (homogenized, dried, etc.) for XRF analysis or screening, the better agreement between sample pairs is exhibited.

ARSENIC EVALUATION

Arsenic is a secondary constituent of concern at LSBP. Arsenic was used as a rounding agent in the production of lead shot. LSBP has recently started an evaluation of the capabilities of the XRF instrument for arsenic analysis. To date, the only arsenic evaluation conducted at the site was the analysis of NIST standards. The table below provides XRF arsenic analysis of three NIST standards and a blank.

NIST Standard	XRF Arsenic Concentration (ppm)	NIST Arsenic Concentration (ppm)
2710	679	626
2711	80.6	105
2709	<27.0	17.7
Zero Blank	<18.0	0.0

The XRF analytical results of NIST standards indicate that the XRF instrument is capable of adequately replicating arsenic concentrations in prepared XRF samples. The one concern for XRF arsenic analysis is the detection limit, which, based on the results from the blank sample, is around 20 ppm. Most remediation goals for arsenic soil are in the range of 10 ppm to 20 ppm. Based on this quick evaluation, it appears the Niton® XRF instrument can adequately show that a soil sample exceeds arsenic clean-up levels, but at the present time, the detection limit is too high to show samples meet or are less than most arsenic clean-up levels.

SUMMARY

Over the past four years, the LSBP site has utilized XRF field screening and analysis extensive. Based on suggestions from EPA, the effectiveness of the XRF instrument to produce accurate lead data is evaluated based on comparison of sample pair results to the site media protection standards. Evaluations monitor the disparity frequency (false positives/false negatives) of the sample pair lead concentrations when compared to the site media protection standards. Results of these evaluations indicate XRF analysis is capable of adequately replicating laboratory lead data. The favorable results of XRF evaluations along with the implementation of a thorough QA/QC program has led EPA to approve the use of XRF lead analysis for post-excavation and confirmatory analysis at the LSBP site.

Evaluations of field screening data also indicate that XRF field screening procedures provide reliable lead data. Although not as accurate as prepared XRF lead results, field screening procedures provide a reliable tool for delineation and directing excavation activities. Recent evaluations of XRF analysis for arsenic also appear to show another beneficial use of XRF procedures.

To date, the use of XRF field and analytical procedures has significantly increased the efficiency of characterization and remedial activities at the LSBP site. Realized cost savings over the past four years, from the cost of laboratory lead analysis alone, have been approximately $225,000. Uncalculated cost savings and benefits include expedited excavations, reduction in contractor down-time during excavations, limitation of required re-excavation and same-day turnaround for lead analysis.

In the near future, additional information will be available surrounding the effectiveness and cost benefits of XRF technologies at remediation sites. The LSBP project team is beginning to evaluate XRF capabilities for other metals (i.e., arsenic, copper, mercury) and is also conducting more sophisticated statistical analysis on the relationship of prepared XRF and laboratory lead concentrations. In addition, the project team plans to further investigate the relationship of field XRF readings with laboratory lead concentrations and prepared XRF results. Recent procedures that have been developed for the analysis of air samples by XRF procedures will also be evaluated.

LAB ACCREDITATION

INTERGOVERNMENTAL DATA QUALITY TASK FORCE

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Abstract
In the fall of 1997, the EPA Federal Facilities Restoration and Reuse Office (FFRRO) convened the first meeting of an Intergovernmental Data Quality Task Force (IDQTF). The consensus mission of the Task Force is to document an intergovernmental quality system in an effort to address real and perceived inconsistencies or deficiencies with quality systems within and across governmental organizations that result in increased costs, time delays, and increased potential risk. The Task Force identified three initial goals to accomplish its mission:

- To document an intergovernmental Quality System, based upon ANSI/ASCQ E-4, beginning with the Hazardous Waste Programs
- To develop a guidance/framework that outlines the roles and responsibilities of the EPA (headquarters and regions) and other Federal agencies with regard to QA/QC oversight; and
- To develop guidance for implementing Federal government-wide requirements and procedures regarding data quality.

The IDQTF has been working on several products designed to address its first goal--a written agreement on an adequate QA program, and plans to begin to address its second goal in the fall. Using the ANSI/ASCQ E-4 standard, *Specifications and Guidelines for Environmental Data Collection and Environmental Technology Programs,* as the foundation for identifying the requirements of a Quality System, the IDQTF has initiated development of two major products:

- ***Uniform Federal Policy for Implementing a Quality System.*** Based on Part A of E-4, this policy outlines the requirements for a Quality System that must be addressed by all departments and agencies that agree to develop a Quality System consistent with this policy.
- ***Consensus Guidance on Documentation of Quality Assurance Project Plans (QAPP).*** Designed to fulfill the requirements of Part B of E-4, this guidance document is intended to ensure that Federal departments and agencies use consistent QAPPs that reflect a systematic planning approach to collection and use of environmental data and technology.

In addition, the IDQTF is in the process of identifying consistent QA and QC measures used in the Superfund program by the EPA Regions and other Federal agencies. This effort, which began with data collection, will define “presumptive” QA/QC expectations for Superfund data collection and reduce the time and effort currently spent in negotiating QAPP requirements.

Formal agency review of the Uniform Federal Policy for Implementing a Quality System has begun, and completion is expected in the winter of 2001. The draft Consensus Guidance on the Documentation of Quality Assurance Project Plans is currently under revision and will be sent out for review in the fall. Document completion is planned for the spring of 2001.

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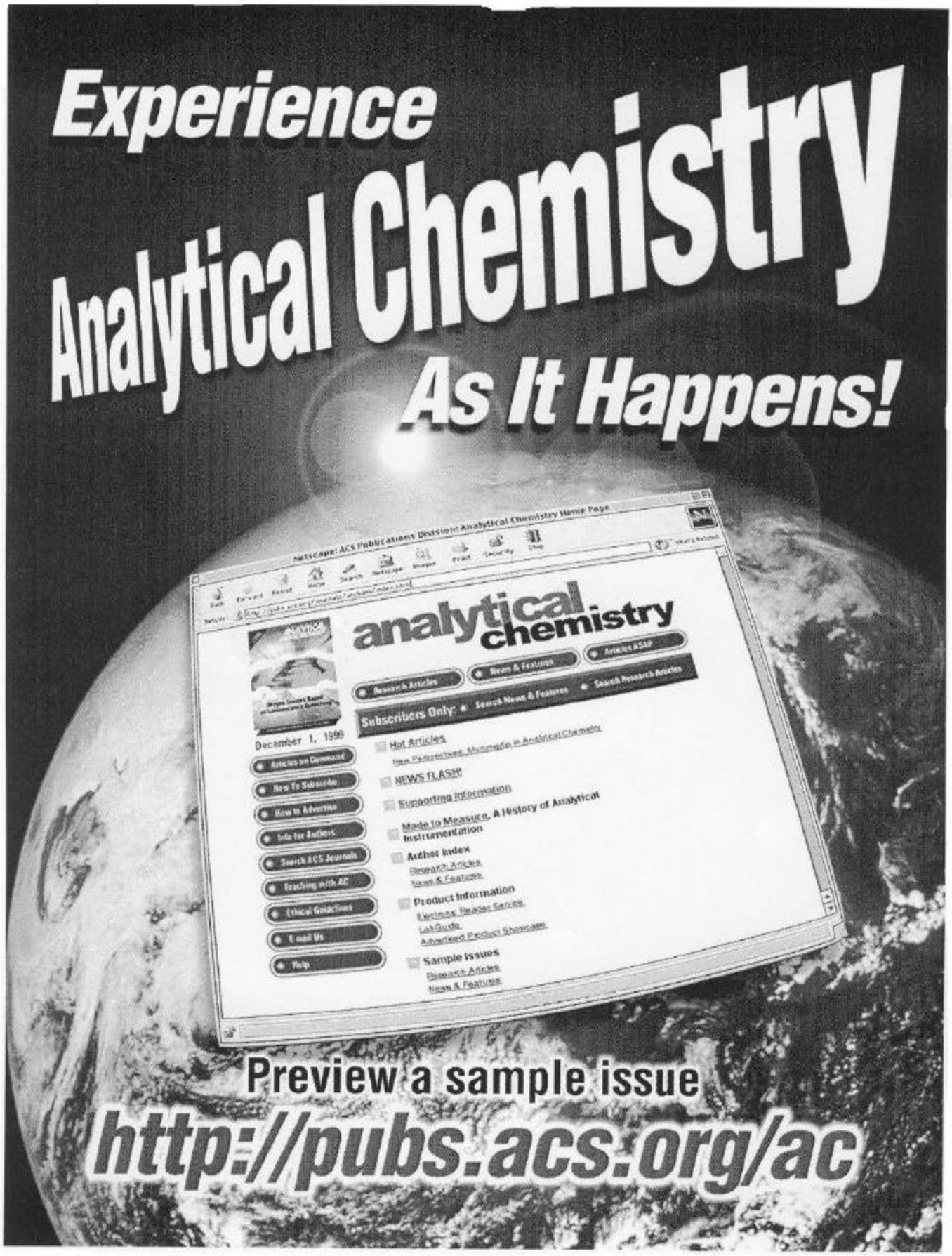
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