DEPARTMENT OF TOXIC SUBSTANCES CONTROL

ENVIRONMENTAL CHEMISTRY LABORATORY

A LOOK INSIDE THE ENVIRONMENTAL CHEMISTRY LABORATORY (ECL)

January 2015

WELCOME TO THE ENVIRONMENTAL CHEMISTRY LABORATORY

Our Mission

Provides scientific leadership for DTSC in analytical and environmental chemistry to protect public health and the environment from adverse effects of chemicals.

Our Vision

Nationally recognized scientific leadership in the analytical and environmental chemistry of toxic chemicals for a healthy, sustainable, and prosperous California.

Our Values

Scientific Excellence * Data Defensibility * Transparency
Integrity * Innovation * Customer Service

Our People

Joe	Acedillo	Winnie	Kam, Ph.D.	Roshni	Sarala
Hyounggee	Baek, Ph.D.	Taiho	Kim, Ph.D.	Guilan	Sartippour
Reber	Brown, Ph.D.	Mui	Koltunov, Ph.D.	Beverly	Shen
Barbara	Bush	Bruce	La Belle, Ph.D.	Gurmail	Sivia, Ph.D.
Jiong	Cao	Hae (Jean)	Lee	Martin	Snider
Oscar	Cheung	Wen	Li, Ph.D.	Aleksandr	Soin, Ph.D.
Min	Cho	Eddie	Lui	Juliet	Tabajonda
Sabrina	Crispo-Smith, Ph.D	Eric	Lytle	Sayaka	Takaku-Pugh, Ph.D.
Joginder	Dhaliwal	Yue-Dong (Jason)	Men	Darcy	Tarrant, Ph.D.
Wendy	Duong	Ken	Neely	Anna	Toma
Cesar	Fernandez, Ph.D.	Barry	Nicholson	Mario	Vinoya
Ranjit	Gill	Mehdi	Nikbakht	Judy (Yunzhu)	Wang
Weihong	Guo	Eric	Lytle	Miaomiao	Wang, Ph.D.
Wayne	Halozan	June-Soo	Park, Ph.D.	Todd	Whitehead, Ph.D.
Arthur	Holden	Emily	Parry, Ph.D.	Lloyd	Williams
Erika	Houtz, Ph.D.	Myrto	Petreas, Ph.D.	Carol	Wortham
Linda	Johnson	Sissy	Petropoulou, Ph.D.	Caiyun	Xu
Kathleen	Jones-Tucker	John	Quinn, Ph.D.	Gregory	Yeh

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INTRODUCTION TO ENVIRONMENTAL CHEMISTRY LABORATORY

Who we Are

The Environmental Chemistry Laboratory (ECL), formerly known as the Hazardous Materials Laboratory (HML), was created in 1974 within the California Department of Health Services (now the Department of Public Health) to help address problems from growing volumes of potentially toxic chemicals in municipal and industrial wastes. The laboratory developed and standardized test methods for the characterization and identification of hazardous wastes. It has been instrumental in providing the scientific underpinning to the regulatory definition of "hazardous waste" and related laws and regulations for California. These early efforts helped set the standards for the Federal government's RCRA hazardous waste program. In 1992, the laboratory became part of the Department of Toxic Substances Control.

ECL serves as the reference laboratory for what is now the State Water Resources Control Board's Environmental Laboratory Accreditation Program (ELAP), the State's laboratory "certification" program under Title 22 California Code of Regulations (CCR) Section 64811(g). ELAP is essential to ensure commercial laboratories that operate in California comply with analytical testing requirements for hazardous waste. ELAP relies on ECL to validate and update new and alternative test methods, verify and refute data from commercial laboratories, and help investigate allegations of lab fraud. As the reference laboratory, ECL provides legally defensible data for the Department and its programs. This includes responding to requests from project managers, participating in special projects and initiatives, researching and identifying emerging chemical issues of which the Department may not yet be aware; and exploring new technologies to find solutions to address these concerns and issues.

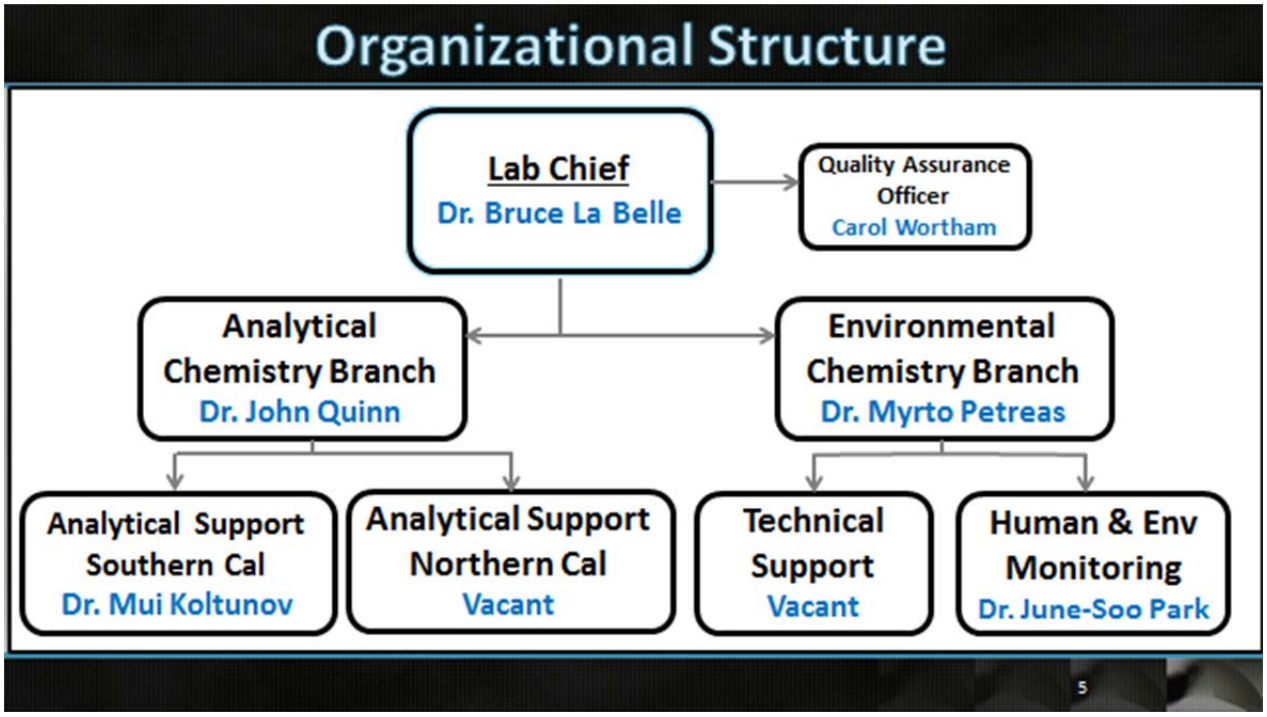
Over the years, ECL has expanded its scope of work to not only provide analytical testing and consultation services to the Department, but also to collaborate with other State and federal agencies in biomonitoring and exposure assessment studies of persistent, bioaccumulative and toxic chemicals in humans and wildlife. With support from federal grants, ECL provides valuable information for the assessment of fate and transport and long term health effects of these chemicals. One of the positive outcomes of these studies is the establishment of new regulatory standards on the use of these chemicals.

The work of ECL is shared between two labs, located in Berkeley and Pasadena. The two labs are strategically placed in Northern and Southern California to be in proximity of the various DTSC regional and field offices. It is the ongoing goal of ECL to develop and augment the labs so they have common baseline capacity along with differing specialized capabilities and expertise to meet the current and future needs of the Department.

Currently, our laboratory has 44 DTSC scientists and support staff and ten grant-funded Visiting Scholars to carry out the critical activities of the laboratory. We have a diverse group of scientists with different technical expertise and experience and of various levels of educational background (over one-third of ECL scientists have doctoral degrees). All of our staff are highly trained and have demonstrated competency in their work.

What we Do

ECL is structured with two Branches, Analytical Chemistry Branch (ACB) and Environmental Chemistry Branch (ECB). Each Branch has its own specialization and expertise in supporting DTSC and other State and federal agencies. Overarching the two Branches is ECL's Quality Assurance Officer who oversees and manages the quality and defensibility of laboratory activities and data.



Both Branches Provide:

- Sample analysis to measure chemicals in soils, sludges, wastes, products and groundwater from hazardous waste facilities and generators; complaint responses; criminal investigations; and contaminated sites.
- Consultation services for:
  - ✓ Analytical chemistry input to DTSC guidance documents
  - ✓ Technical support to DTSC field staff on sampling and test methods
- Development and validation of sample preparation and testing methods to measure toxic chemicals in consumer products and other non-standard matrices
- Development of methods for testing priority chemical/product combinations
- Special projects to comply with Legislative mandates

Specific Activities of the Analytical Chemistry Branch Include:

- Expert witness testimony in support of DTSC enforcement and criminal investigations
- Validation of new and alternative test methods of commercial labs
- Conduct lab fraud investigations of commercial labs
- Perform split sample analyses to check on quality of commercial labs

- Development of new methods to measure emerging contaminants and tentatively identified compounds (TICs)
- Consultation services:
  - ✓ Review quality assurance project plans (QAPPs) and work plans to meet data quality objectives (DQOs)
  - ✓ Assist in updating analytical testing section in statutes and regulations

Specific Activities of the Environmental Chemistry Branch Include:

- Biomonitoring studies and exposure assessment of persistent, bioaccumulative and toxic chemicals in humans and wildlife
- Special studies on toxic chemicals in dust and consumer products
- Extramural grants and contracts to study emerging issues
- Overseeing the ECL Laboratory Information Management System (LIMS)
  - ✓ Sample tracking and chain of custody
  - ✓ Data collection, storage, backup and security
  - ✓ Automated analytical report generation
- Providing oversight on contract labs, including review of all data packages

Lab Quality Management Activities include:

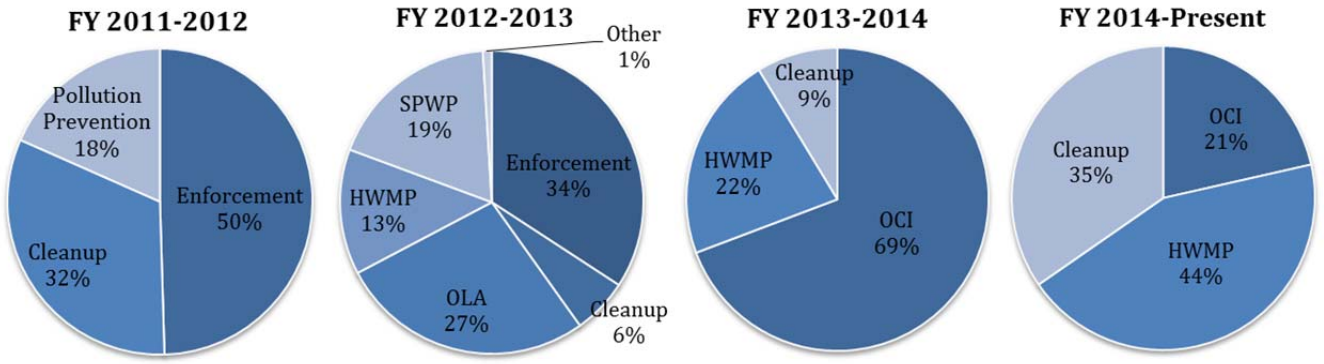
- Implementation, maintenance and improvement of ISO/IEC 17025 Quality Management System
  - ✓ Document control
    - Quality Manual
    - System and technical procedures
    - External documents
  - ✓ Maintenance and control of records
    - Test results and reports
    - Instrument & equipment maintenance and check logs
    - Lab notebooks
    - Training
    - Requests, tenders and contracts
    - Purchasing services and supplies
    - Obsolete documents
  - ✓ Internal audits
  - ✓ Corrective actions
  - ✓ Preventive actions
  - ✓ Complaints
  - ✓ Management reviews
  - ✓ Customer service
- Validation of test methods
- Coordination with Environmental Laboratory Accreditation Program (ELAP)

PERFORMANCE INDICATORS

We use Performance Indicators (PIs) to measure how well we're doing our job (qualitatively and quantitatively) and to set targets for continuous improvement. We have developed, and we track, PIs for the numbers and types of samples we analyze; the numbers of publications in peer-reviewed journals; our performance in national and international quality assurance programs; the quality of our contract labs and the achieved turn-around-time for analyses.). PIs help us set targets for continuous improvements of our internal lab practices and on coordinating and collaborating with our stakeholders. Below are some of our PIs:

Number of Samples by Program

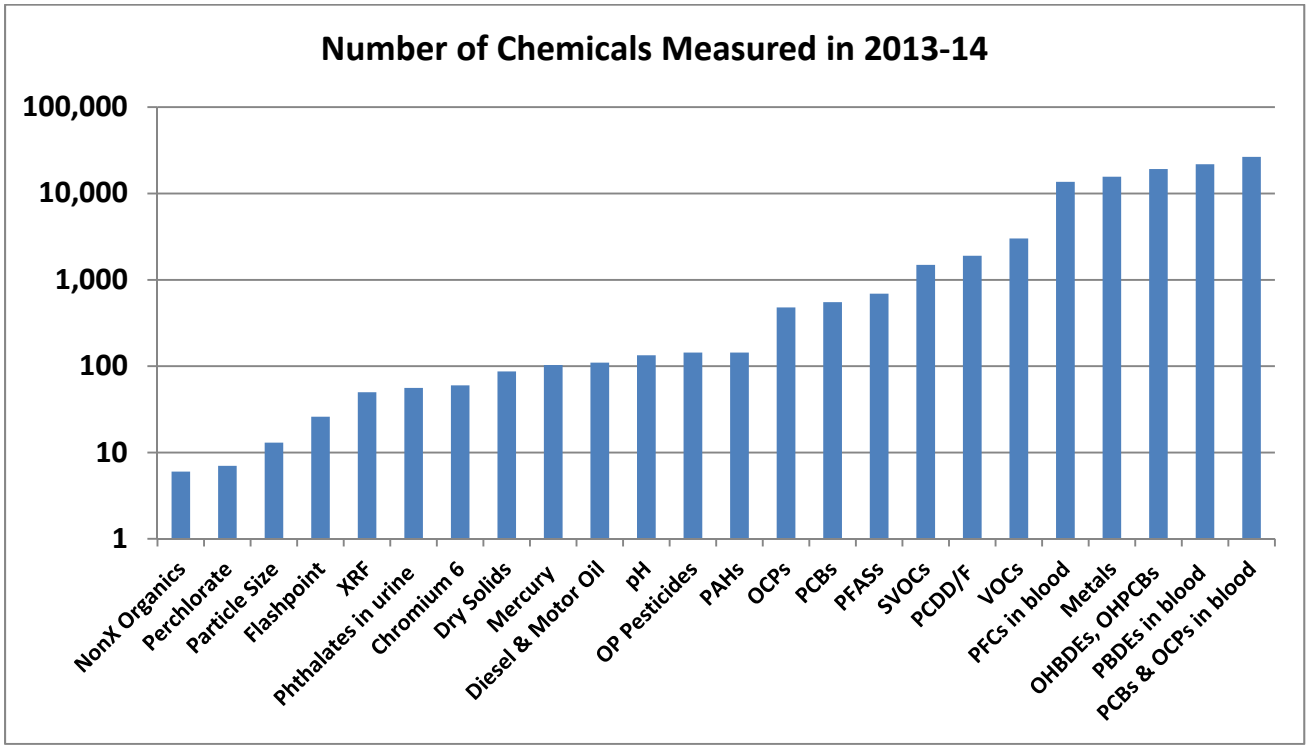
These pie charts show the distribution of samples received from DTSC core programs for the past four fiscal years. Due to the recent reorganization of the Department, the name of the core programs has changed over the years. HWMP = Hazardous Waste Management Program; SPWP = Safer Product and Work Place; OLA = Office of Legal Affairs; OCI = Office of Criminal Investigation.



Number of Chemicals Measured

Environmental samples (soils, liquids, products and other material) are submitted to the laboratory by inspectors from many DTSC programs, including Criminal Investigations, Enforcement, Brownfields and Site Clean-up. Samples from special projects, such as Biomonitoring (analyses of blood and urine) and Consumer Products (toxic chemicals in dust and products) are also analyzed. Using state-of-the-art equipment, ECL scientists perform analyses for more than 2,000 individual chemicals. When the ECL's capacity is exceeded, samples are sent to commercial labs contracted and overseen by ECL staff. The table shows work performed by ECL and its Contract Labs over the last 3 years. The graph shows the various chemicals analyzed in 2013-14.

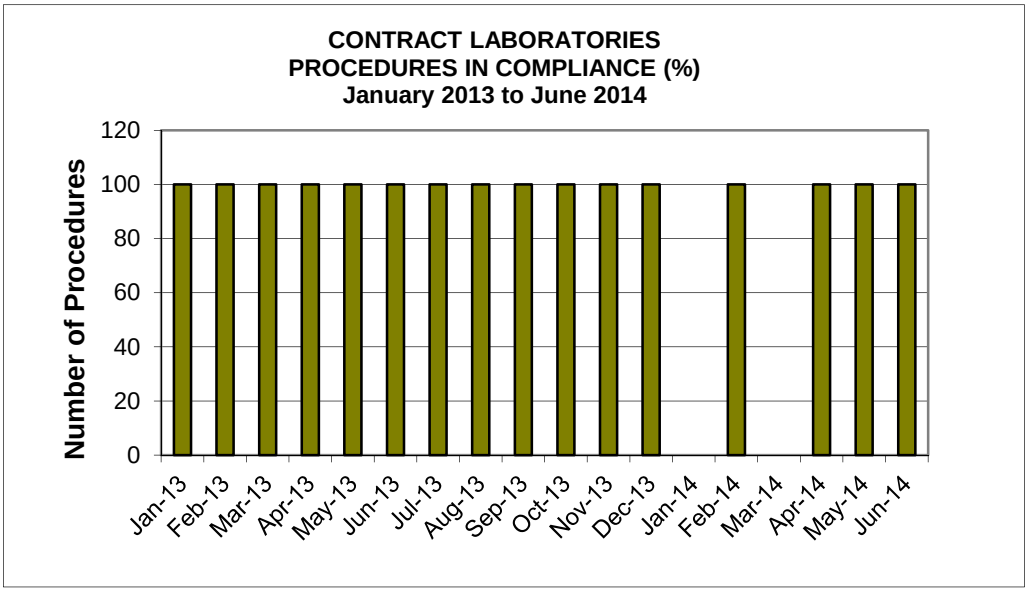
	ECL	ECL Contract Laboratories	ECL	ECL Contract Laboratories	ECL	ECL Contract Laboratories
# of Samples Received	2,593	251	3,673	170	2,167	143
# of Analyses Requested	5,703	423	13,806	357	6,417	183
# of Chemicals Measured	100,263	8,194	234,932	5,215	102,851	1,799



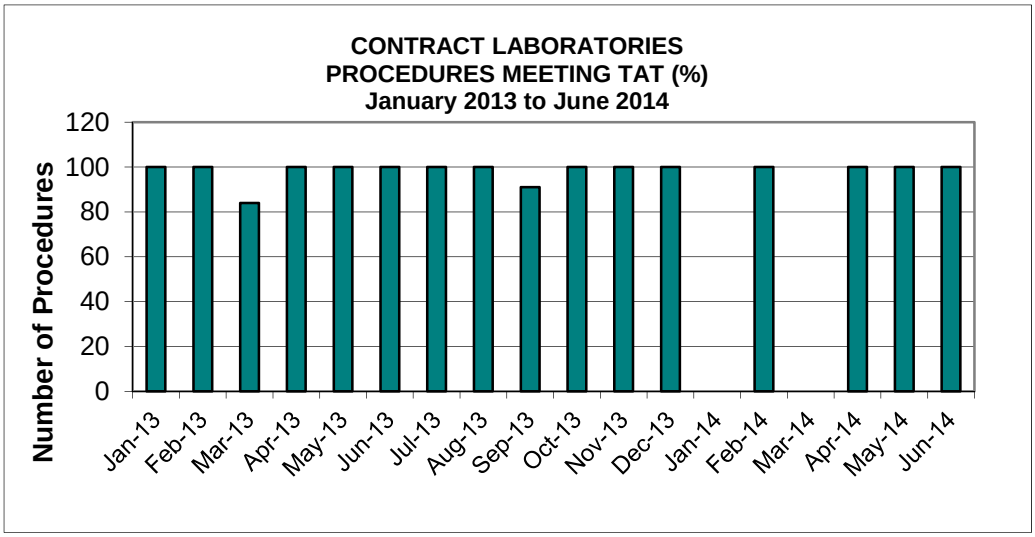
Performance of Contract Labs:

All data packages from contract labs are reviewed and monitored continuously to ensure all QA/QC criteria are met and all data are legally defensible. ECL tracks the performance of Contract labs (% procedures in compliance) as well their meeting requested Turn-around-time (TAT). TAT is the number of calendar days beginning from the day the samples were received by the Contract Laboratory to the day the reports were submitted to DTSC/ECL.

Target: Over 99% Compliance



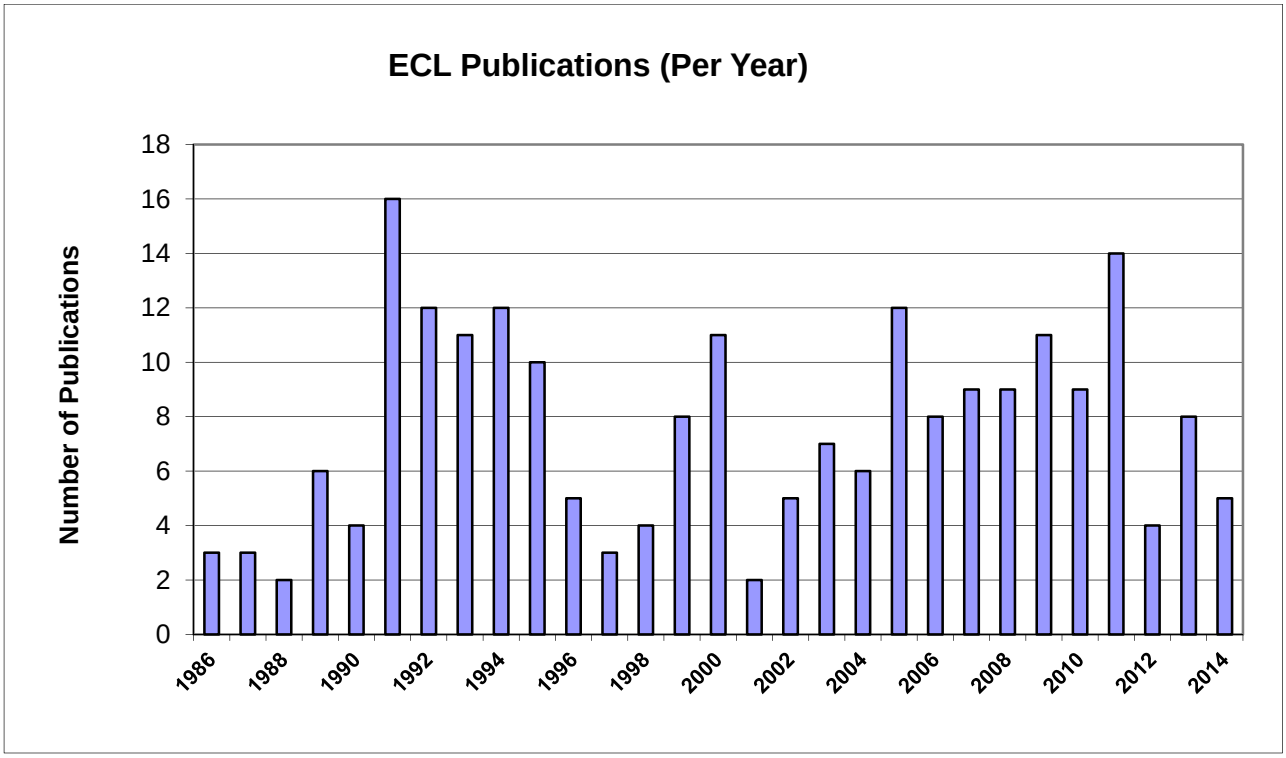
Target: Over 99% meeting TAT



Number of ECL Staff Publications:

Peer Reviewed Publications: ECL has a long tradition in scientific excellence. A list of ECL Publications since 1985 is maintained, updated regularly, and reprints are made available to the public. The number of peer-reviewed scientific publications by ECL staff is an indicator that ECL is a highly proficient laboratory, with highly qualified scientific staff. The following chart represents ECL Publications per year from 1985 through 2014.

Target: 6-7 Publications per year



For a complete list of publications and to request reprints, please visit:

http://dtsc-share/Support/ecl/ECL%20List%20of%20Publications/Forms/AllItems.aspx

SUPPORT TO THE CORE PROGRAMS

Sample Analysis

ECL receives and analyzes samples collected by various DTSC programs, such as Office of Criminal Investigations, Enforcement and Site Cleanup. Field staff submits samples from different environmental sites and industries and from various special projects and initiatives of the Department (see examples of specific projects below for details). We measure over 2,000 chemicals in wide range of materials (matrices) such as water, sludges, oils, soils, vegetation, wood, electronic-wastes, plumbing fixtures, brake pads, jewelry, glass beads, auto shredder wastes, plastic toys, products and biological samples (fish, eggs, human tissues). We follow standard methods issued by authoritative bodies (such as USEPA SW-846) but we also often adapt and/or develop new methods to measure chemicals in new matrices (children's toys, jewelry, e-wastes, glass beads, fabrics and foam) or new, previously unknown or yet-to-be-regulated chemicals. Each matrix has unique attributes that the lab needs to consider such as sample heterogeneity, sample preparation techniques, digestion or extraction procedures and appropriate analytical methods. For more traditional matrices such as soils and water, we follow standard methods issued by authoritative bodies (such as USEPA SW-846). However for the more complex or non-standard matrices, we often must adapt existing methods or even develop and validate entirely new methods. Our chemists have the experience and expertise to analyze difficult matrices that commercial laboratories cannot handle. **Our focus is to produce results that are scientifically valid, meaningful, and defensible in legal proceedings in support of the Department and State.**

Sometimes, requests for sample analysis exceed our capacity. When this occurs we use commercial labs to handle the extra work flow. The commercial labs are also used for analyses in certain fields that are outside the scope of ECL's work, such as Fish Bioassays and Asbestos analysis. Through a bidding process, ECL awards contracts to commercial labs, and monitors their work to ensure that they that provide the same data quality as if the analyses were performed by us. We avoid using a contract lab for samples that are likely to be subject to legal proceedings or are otherwise for critical decision-making.

Chemist Caiyun Xu performing acid digestion for metals analysis

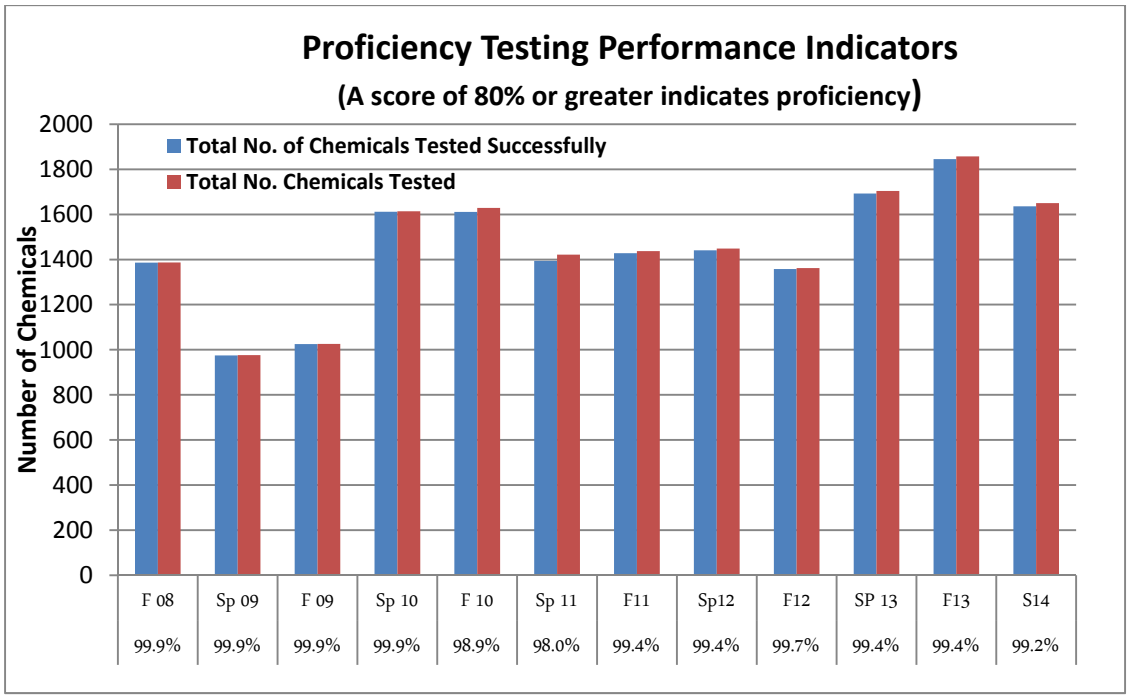
Expert Witnessing

Before legal proceedings, ECL staff needs to review and defend before opposing experts not only the information in the laboratory reports, but all the underlying data. This includes not just sample results but all instrument calibration and data quality information. One sample submitted to the lab for a single analytical method often results in over 60 data points, along with the lab notebook notes, resulting calculations, etc., that need to be carefully reviewed in preparation for testimony and cross-examination. As a result, before a lab report is finalized and sent to the requestor, we have an extensive internal quality review process.

DATA QUALITY

ECL Continues to Get High Scores on Proficiency Testing

It is essential that accurate and precise results be reported by ECL for decision-making by all DTSC programs. Tracking our performance is one of the ways in which we evaluate and document the quality of the data we generate. We participate in proficiency studies and compare our results on hundreds of chemicals with the study's acceptance criteria, with other previous studies and with the results of other participating laboratories. The National Environmental Laboratory Accreditation Program requires that laboratories pass two out of the latest three single blind, single-concentration proficiency testing studies for each field of testing (program-matrix-analytes) per year. Laboratories are considered proficient if they score 80% or above. ECL consistently achieves scores above 99%. The graph shows ECL's scores for the Spring and Fall of the last few years.



For its work with chemical contaminants in biospecimens, ECL participates three times per year in proficiency testing organized by the Centers for Disease Control and Prevention (CDC) and by the Arctic Monitoring Assessment Program (AMAP). ECL has received perfect scores in all the fields of testing offered by these two programs.

ANALYTICAL CHEMISTRY BRANCH (ACB): EXAMPLES OF RECENT ACTIVITIES

Metal Recycling Enforcement Initiative

Metal recycling is a major industry (with over 1,000 metal recycling facilities in the State) in which automobiles and appliances at the end of their useful lives are required to be "de-polluted" by removing hazardous components containing mercury, lead, other metals and polychlorinated biphenyls (PCBs). In the recycling process, automobiles and appliances are dismantled and shredded to separate and recover ferrous and non-ferrous metals. The remaining components are often referred to as shredder waste which is a mixture of foam, plastics, rubber, glass, wood, paper, leather, textiles and a small fraction of remaining metal pieces. Facilities can recover a majority of the metallic components with the current available technology, but the resulting shredder waste often contains toxic chemicals. Sometimes the waste is piled on facility sites (Figure 1) or dumped in landfills. When the waste contains hazardous constituents, there is the potential for environmental releases and ground contamination. In 2012 in California, an estimated 440,000 tons of metal shredder waste was generated.

Figure 1. Pictures of a metal recycling facility with piles of dismantled components and debris from the recycling process. Soil and metal-contaminated debris samples were collected for analysis.

To address this major concern, in 2012, DTSC began a Metal Recycling Enforcement Initiative to focus on inspection of small and medium sized metal recycling facilities that pose significant health and environmental threats to surrounding communities. The facilities were inspected for compliance with Hazardous Waste Control Law and any environmental release and ground contamination of hazardous waste. The initiative stretched over a 13-month period resulting in 16 investigations conducted by Enforcement and OCI staff. ACB labs received samples (from one to more than twenty) from ten facilities in Central and Southern California. ACB was asked to carry out multiple tests including total concentration of metals, mercury and PCBs and leachable concentrations of metals and mercury from the metal-contaminated debris and surface soil.

The results from samples collected at the ten facilities show high levels of lead, copper, zinc, mercury, chromium, nickel, cadmium and PCBs. Some samples exceeded the hazardous waste levels for lead, copper, zinc, chromium, cadmium, nickel and PCBs on total (Total Threshold Limit Concentration, TTLC) and/or leached

concentrations (Soluble Threshold Limit Concentration, STLC or WET and Toxicity Characteristic Leaching Procedure, TCLP). All ten facilities exceeded the regulatory thresholds for at least one constituent.

Figures 2a, 2b and 2c are graphical presentations of the measured lead concentration in samples from the ten facilities (labeled A to J). Figure 2a shows results for lead TTLC with a vertical red bar to indicate the regulatory threshold at 1,000 mg/kg. Samples above 1,000 mg/kg are considered hazardous. Figure 2b shows results for lead TCLP. Samples above 5 mg/L lead are considered hazardous. Similarly, Figure 2c summarizes results for STLC/WET lead concentration; samples with lead result above 5 mg/L are characterized as hazardous.

Tables 1a and 1b summarize metal recycling facilities where samples exceeded regulatory thresholds for various hazardous waste constituents. The Metal Recycling Enforcement Initiative has resulted in three criminal convictions with a fourth criminal matter pending and five civil referrals to the Attorney General's Office which are in progress. This Initiative is one phase in the Department's goal to provide oversight of the metal recycling industry with the objective to protect California's most vulnerable communities from hazardous waste contamination. ECL's labs will continue to support this important effort.

Figures 2a-c. Lead concentration in samples from the ten facilities (A to J). Three different procedures (TTLC, TCLP and STLC/WET) were performed to measure the total and leached concentration of lead. The regulatory thresholds for each are shown as red lines at 1,000 mg/kg for TTLC and 5 mg/L for TCLP and WET.

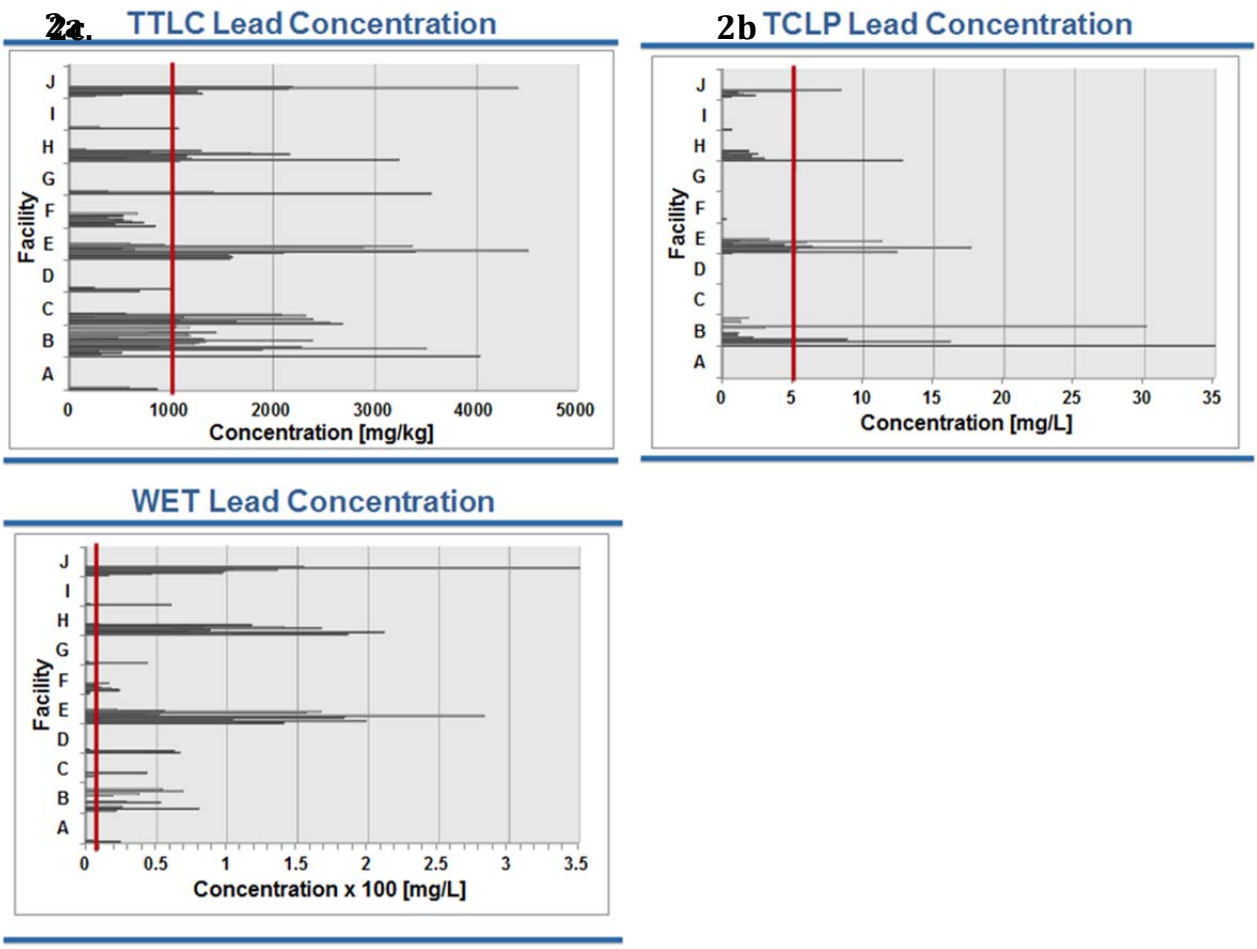


Table 1a-1b. Summary of facilities with samples exceeding regulatory threshold for the various constituents.

1a. Facility Exceeding Regulatory Thresholds

	Lead (Pb)			Zinc (Zn)		Copper (Cu)	Mercury (Hg)
Facility	TTLC	WET	TCLP	TTLC	WET	TTLC	TTLC
A		X			X		
B	X	X	X	X	X	X	
C	X	X		X		X	
D	X	X			X		
E	X	X	X	X	X	X	X
F		X		X	X	X	X
G	X	X		X	X	X	
H	X	X	X	X	X	X	
I	X	X			X		
J	X	X	X	X	X	X	

1b. Facility Exceeding Regulatory Thresholds

	Chromium (Cr)		Nickel (Ni)		Cadmium (Cd)	PCBs	
Facility	TTLC	WET	TTLC	WET	WET	1242	1248
A							
B							
C							
D		X			X		
E		X			X	X	
F	X	X			X		
G	X	X	X	X	X		
H		X			X		X
I					X		
J					X		

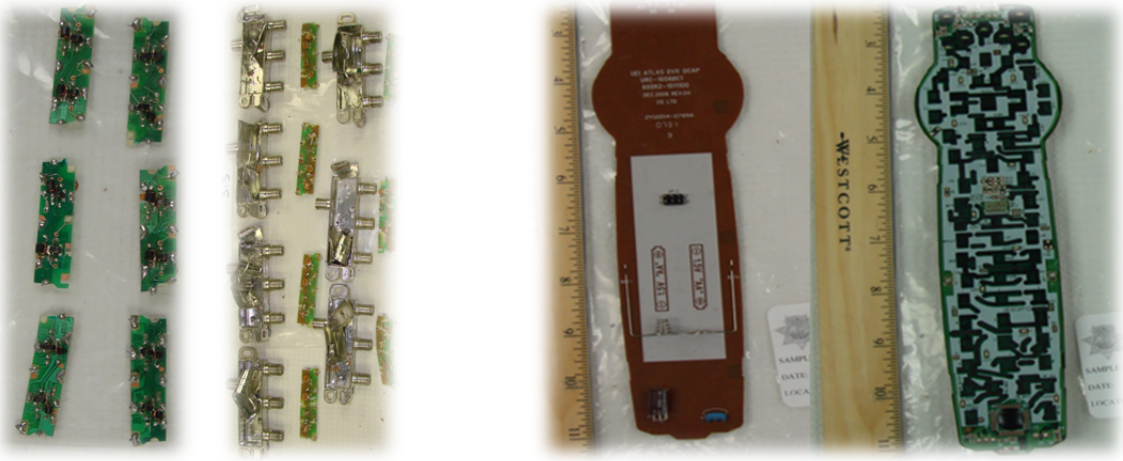
Electronic Wastes – Office of Criminal Investigations

The Analytical Chemistry Branch has been working closely with our Office of Criminal Investigations staff, the Attorney General's (AG) Office and local prosecutors for the past several years to analyze electronic wastes such as cell phones, remote controls, cable splitters, circuit boards, etc., to determine whether these devices are considered hazardous waste. The lab has analyzed samples submitted by OCI staff from over 100 projects. These samples were collected through dumpster diving and landfill collection from companies such as Comcast, AT&T, Time Warner Cable, Dish Network, Charter, Cox Communication, etc.

When the lab was initially approached with requests to test these devices, we faced both an analytical and a regulatory challenge. The analytical challenge was on how to analyze electronic waste? Consider the following two electronic devices: cable splitter and remote control (Figure 3). They certainly are not the soil or water matrices for which traditional sample preparation methods were designed. When they are disassembled, we can see that the splitter has metallic covers and an internal circuit board while the remote control has a cover made of plastic and rubber and an internal circuit board (Figure 4). The various components and materials would require different sample preparation, extraction or digestion procedures, cleanup procedures and analysis approaches.

Figure 3. Pictures of electronic devices submitted for analysis; cable splitters (left) and remote controls (right).

Figure 4. Pictures of disassembled electronic devices from Figure 3. Components of cable splitters (left two pictures) and components of remote controls (right)



In collaboration with the AG's Office and local prosecutors, the lab assessed whether the devices exceeded the TCLP. A possible source of leachable metals is from solder or other metals components in the circuit board within the devices. Thus, by using the TCLP, these electronic devices could be assessed for hazardous waste classification.

ACB developed the following approach to analyze electronic devices:

- Dismantle the device
- Weigh each component of the device
- Grind to appropriate size using different equipment/tools
- Extract and analyze the sample
- Determine the concentration
- Account for the total weight of the device

Over the years, the lab has analyzed over hundreds of devices submitted by OCI staff. Table 2 summarizes the results for four devices. Three of the four devices show high levels of lead that are above the regulatory TCLP threshold of 5 mg/L. Thus, the three devices are considered hazardous waste.

Table 2. Summary of results for four electronic devices

Toxic Metals in Electronic Devices

Berkeley 1311/6010	#1 (mg/L)	#2 (mg/L)	#3 (mg/L)	#4 (mg/L)
Arsenic (As)	ND	ND	ND	ND
Barium (Ba)	ND	0.10	0.35	0.47
Cadmium (Cd)	ND	ND	ND	ND
Chromium (Cr)	ND	ND	ND	ND
Lead (Pb)	ND	20.5	15.4	137
Silver (Ag)	ND	ND	ND	ND
Selenium (Se)	ND	ND	ND	ND

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The work of the Department and State and local prosecutors on electronic devices has resulted in large Statewide settlements that encourage compliance and deter future violations. These cases, such as a recent successful settlement with ATT have generated a lot of interest by the press in DTSC's enforcement capabilities and earned ECL praise from the DTSC team.

Lead and Arsenic in Glass Beads

Several years ago ECL recognized that metals in glass were of potential interest for Restrictions on Hazardous Substances (RoHS), for Toxics in Packaging, and for hazardous waste determinations. In order to ensure development and validation of a robust and accurate method for testing for metals in glass, Berkeley and Pasadena labs, each worked independently to develop standard operating procedures for the digestion and analysis of glass beads. The method development took several months to optimize the conditions and parameters for the digestion. Specialty glassware, instrument parts and standard reference materials were purchased to carry out the analysis. The two labs then exchanged samples to demonstrate that they and other labs could achieve consistent results. At the same time, the two labs evaluated the effectiveness of using an X-ray Fluorescence spectrophotometer (XRF) as an inexpensive non-destructive screening tool that could be used by companies to stay in compliance and by DTSC field inspectors for initial assessment of samples collected during investigations.

Enforcement needed a way to accurately determine lead and arsenic levels in glass beads. California passed a law, AB 1930 – Lead and Arsenic in Glass Beads, to restrict the amount of lead and arsenic in glass beads. It specifies that lead cannot exceed 100 mg/kg and arsenic cannot exceed 75 mg/kg.

Glass bead blasting media is a major health concern since glass beads are regularly used in the machinery industry to clean metallic surfaces. Because of the stability and abrasive properties of glass beads, they are very effective in removing rust, oil and debris from hard surfaces. Surfaces are cleaned by sand blasting with glass beads under high pressure; workers are required to protect themselves by wearing proper personal protection equipment during the blasting process (Figure 5).

Figure 5. Pictures of glass beads used to remove rust from metallic surfaces. Top two pictures to the right show the effectiveness of using glass beads to clean rusty parts; parts cleaned with glass beads are shinny and polished. Bottom picture shows worker sand blasting with glass beads to clean large tube.

The conundrum the Department faced with the Statute was that it was not able to effectively enforce the law. Specifically it could not find a reliable commercial lab that was capable to provide the analytical data to

accurately determine the amount of lead and arsenic in glass beads. ECL's background work allowed it to respond to this request.

The Statute, AB 1930, stipulated the use of EPA Method 3052 (or its modification) and X-ray fluorescence (XRF) to determine the amount of lead and arsenic in glass beads. There are several problems with the proposed language for the analytical testing. First, commercial labs cannot use EPA Method 3052 because it is not an accredited field of test by the Environmental Laboratory Accreditation Program (ELAP). Second, the method requires the use of very harsh corrosive and oxidizing conditions such as hydrofluoric acid and nitric acid to fully digest the matrix, which commercial labs are reluctant to perform. The reasons are safety concerns and the need for specialized glassware and equipment to perform the analysis. Rather, commercial labs use an alternative method, EPA Method 3050, which is intended for digestion of glass matrix. Third, EPA Method 3052 is actually a guideline for labs to use as a foundation as they develop their own standard operating procedure to optimize and validate the digestion process. Finally, the use of x-ray fluorescence is not recommended for quantitative measurement. The XRF analyzer is a qualitative screening tool that detects the presence of elements on the surface of sample. If the sample is not homogeneous, it can bias the result depending on where on the sample the measurement was taken. Also, inherent with this technique, lead and arsenic are known to interfere with each other, thus the analyzer is not applicable to measure the concentration of lead and arsenic in glass beads.

Both labs analyzed submitted samples with very similar results, thus validated each other's data (Table 3). Results from both labs show Sample #1 with high levels of lead and arsenic that exceed the allowable amount in the Statute. Therefore, Sample #1 would be deemed noncompliant according to AB 1930. The other samples show non-detect (ND) for both analytes.

Table 3. Lead and arsenic concentrations in six glass bead samples.

Berkeley 3052 / 6010	#1 (mg/kg)	#2 (mg/kg)	#3 (mg/kg)	#4 (mg/kg)	#5 (mg/kg)	#6 (mg/kg)
Arsenic	166	ND	ND	ND	ND	ND
Lead	105	ND	ND	ND	ND	ND

LA 3052/6010	#1 (mg/kg)
Arsenic	133
Lead	93

Both labs also independently tested the digestion efficiency using EPA Method 3050 and confirmed that the method could not digest glass matrix (Table 4) Thus, commercial labs that utilize EPA Method 3050 for digestion of glass beads would consistently underestimate the amount of lead and arsenic and would report as non-detect (ND) samples that actually contained lead. As a consequence, industries would fail to determine if they were in compliance with the law due to unreliable analytical data.

In a recent case, Enforcement challenged the analytical data submitted by S.L. Fusco, a distributor of glass beads. S.L. Fusco sent samples to a commercial lab in an attempt to demonstrate that their glass beads were in compliance with AB 1930. The results obtained from that lab showed no detectable level of lead and arsenic. When Enforcement obtained split samples from the vendor and sent them to ACB lab, high levels of

lead and arsenic were detected in some of the samples. S.L. Fusco initially disputed ECL's results. At a joint meeting to discuss the analytical data from ECL and the commercial lab, ECL scientists served as technical experts, presenting their data and discussing the science. Faced with this information, the commercial admitted that they did not have the proper equipment or the appropriate SOP to effectively analyze glass beads. S.L. Fusco pleaded no contest and agreed to pay the fine for noncompliance. **The case underscores the importance of a State regulatory laboratory to verify and validate the work of commercial labs.**

Table 4. Same six samples were digested using EPA Method 3050 and analyzed for lead and arsenic. Sample #1 did not show any detectable amounts compared to result from Table 3 when it was digested using EPA Method 3052. Visual inspection of the digestate showed incomplete dissolution of the glass beads.

3050 / 6010	#1 (mg/kg)	#2 (mg/kg)	#3 (mg/kg)	#4 (mg/kg)	#5 (mg/kg)	#6 (mg/kg)
Arsenic	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND

When AB 1930 was about to expire (January 1, 2015), a new law, AB 324 was proposed as replacement to extend the sunset date to January 1, 2020. ACB was asked to provide improved language for the analytical testing section of the Statute. From our experience with the work on glass beads, the following recommendations were proposed for the improved language for AB 324: (i) XRF should not be used for determining concentration of lead and arsenic in glass beads; (ii) EPA Method 3052 with the use of hydrofluoric acid shall be followed as guidelines for lab to develop its own SOP for digestion of glass beads; and (iii) glass matrix reference material from the National Institute of Standards and Technology (NIST) shall be used to verify the recovery of lead and arsenic from glass beads. The recommended language was included in an updated Statute passed by the Legislature.

Toxic Metals in Jewelry

Toxic Metals in Jewelry was another successful collaborative project between ACB and Enforcement. DTSC launched an enforcement taskforce to inspect stores and warehouses in Los Angeles for selling tainted jewelry, some imported, full of lead and cadmium. DTSC investigators initially screened the samples and discovered more than 340 jewelry items containing lead levels potentially exceeding regulatory limits. When these samples were sent to ACB for analysis and confirmation, the lab found that the majority contained high levels of lead and other metals such as cadmium, nickel and antimony. Some of the jewelry items had toxic metal concentrations as much as 1,000 times the legal limit in California. (Figure 6)

Figure 6. Examples of jewelry with high levels of lead and cadmium. Jewelry items were purchased from stores and warehouses in Los Angeles by DTSC field staff.

ECL's data allowed DTSC investigators to determine that these stores and warehouses had violated the California's Metal-Containing Jewelry Law (http://www.dtsc.ca.gov/HazardousWaste/Jewelry/upload/Jewelry-Fact-Sheet.pdf). Based on the data, the cases were referred to State Attorney General's Office which filed complaints against 16 businesses that allegedly had been supplying or directly selling jewelry containing high levels of lead to Californians (https://www.dtsc.ca.gov/HazardousWaste/Jewelry/ToxicJewelry.cfm).

DTSC enforcement of toxic metals in jewelry resulted in widespread TV coverage, such as in the following media:

- **LA Times:** 16 L.A. businesses accused of selling jewelry tainted with lead
- **CBS TV:** LA Merchants Face Hefty Fines Over Toxic Jewelry Charges
- **Huffington Post:** Lead In Jewelry: California Testing Reveals Dangerous Levels Of Lead Despite Continual Warnings
- **Univision:** Joyas contaminadas con plomo se vendían en Los Ángeles
- **La Opinión:** Cuidado al comprar joyas

Other Projects

Among other toxics in products projects are Lead in Plumbing Fixtures, Copper in Brake Pads, Phthalates in Children's Vinyl Toys and Toxics in plastic and glass bottle Packaging. These projects were in response to State legislative mandates. They are multi-year projects that required close coordination with core programs and other agencies. ACB had to develop new methodologies to prepare and analyze these various types of samples. The success for these projects has been the lab's adaptability and flexibility to meet the needs of the Department and provide defensible data.

Currently, ACB is working on a number of other initiatives for the core programs. We are validating procedures and testing auto shredder waste in support of the recent passage of senate bill, SB 1249 Hazardous Waste:

Shredder Waste. In anticipation of upcoming environmental issues, we are developing screening methods for metals in plastic and other consumer goods using XRF and other techniques. We are supporting the Cleanup Program by developing and validating a test method for rare earth lanthanides in waste from Carlton Forge that may be impacting nearby community of Paramount. We are also validating a method for Cr(VI) in drinking water at the new health-based levels.

The overall goal is to provide high quality, legally defensible data to support DTSC's projects and initiatives.

Consultation Services

Another major area of services ACB provides is consultation to DTSC core programs on:

- Review of data packages from commercial laboratories
- Review of quality assurance project plans (QAPPs) and work plans to meet data quality objectives
- Provide analytical chemistry input to DTSC guidance documents

Core program staff can request consultation services through EnviroStor. The lab has established a comprehensive approach that includes review of all documents to ensure scientifically sound, impartial and legally defensible recommendation. For example, when the Cleanup Program requests review of data packages submitted by their consultants, it is our policy to obtain a full Level 4 data package that includes:

- EPA Methods
- Standard Operating Procedure (SOP)
- Sample Data Package: sequence run log; instrument tune checks or performance tests; CCV criteria; quantitation reports; data reduction worksheets; sample prep log; sample analysis log; and certificate of Analysis of reference standards
- Instrument Calibration Data Package: sequence run log; instrument tune checks or performance tests; initial calibration criteria; initial & continuing verification criteria; calibration standard quantitation reports; standards prep log; and certificate of Analysis of reference standards

To this date, ACB has provided consultation services on major, high profile projects such as:

- **Santa Susana Field Laboratory** Site: we spent two years consulting on the project. We were involved with laboratory selection associated with background study and reviewed Area IV co-location study and its connection to the look up tables. We provided guidance on the proper scientific approach towards assessing reporting limits and limitation of method measurement associated with the testing being performed at the site.
- **PG&E Topock**: we reviewed the analytical testing section of the Quality Assurance Project Plan to evaluate the appropriate methods for Cr(VI) and other analytes in water and soil samples. We also assessed analytical reports for data validation from commercial labs.
- **Autumnwood Development in Wildomar**: The local community requested that ECL evaluate the analytical reports submitted by consultants for DTSC's Cleanup program. ECL performed a data validation and identified problems that could have impacted data reliability on soil vapor intrusion, metals and volatile organics in water and soil. ECL then worked with the Cleanup Program project managers to determine the impacts of the problems on data usability, recommended additional work by the commercial labs (such as identifying unidentified peaks in the chromatograms), and advised the project managers on ways the data could still be used to achieve their overall project objectives.
- **Malibu High School Project**: the lab analyzed split samples obtained from the school to test for PCBs, pesticides and metals in soil. We worked closely with Cleanup Project Manager to present analytical

data in a transparent manner and address deficiencies and potential problems that could arise during public meetings.

- **Electro-Forming**: the lab analyzed samples and provided assistance to Office of Legal Affairs on interpretation of analytical data.
- **Gallo Glass**: the lab is currently providing analytical data and technical support to Legal Counsel on the interpretation of analytical data.

Construction of the New Laboratory in Pasadena

For the past three years, we worked on finding a new space, designing and constructing the new lab in Pasadena to relocate from the Los Angeles Lab on Temple Street. The Temple building was built in the 1950s to house a laboratory for the Department of Health Services. The building had not been renovated since its construction, thus the infrastructure was outdated and slowly deteriorating. The building is not earthquake reinforced; asbestos is found on pipes and on bench tops; fume hoods have poor air balance; and HVAC system is too costly to replace and parts difficult to find for maintenance and repair. It became clear that the building could no longer provide a safe environment and working facility for ECL to carry its activities.

When, after an extensive site search, a new space was identified in Pasadena, we provided recommendations and specifications to the architect and Department of General Services (DGS) for the lab layout. Some pictures of the new lab during construction are shown. Due to the specialized work of ECL, we thought carefully of designing the lab to meet the current and future needs of the Department. The design was based on practicality, functionality and efficiency. Thus the concept of five zones emerged: Inorganic - Instrumentation and Main Labs; Organic - Instrumentation and Main Labs; Advanced Technology – Emerging Chemicals and Vapors & Gases Labs; Lab Support; and Lab Services. Details were meticulously sketched out such that power, data, voice, high purity gas and water requirements are sufficient to accommodate lab instruments and equipment now and into the future; spacing and dimensions of the instrument benches were carefully calculated and measured; fume hoods were selected based on the types of analytical testing; lab rooms within each zone are interconnected to open more space, provide continuity and workflow; and exits and corridors are maximized for safety.

The construction of the Pasadena lab required enormous amount of work, collaboration and coordination of DGS, DTSC admin services, architect, engineers, contractors and project manager. We are happy to see the completion of the construction with the lab being occupied as of February 2, 2015. Move-in is only the first step in occupancy. It takes months to clean all glassware, check all supplies, calibrate all instruments, re-validate all methods in the new location. Before each analyst can test samples submitted by the core programs, they must first re-document their ability to perform the test by successfully running Performance Evaluation samples.

ENVIRONMENTAL CHEMISTRY BRANCH (ECB): EXAMPLES OF RECENT ACTIVITIES

Fireworks: A heads-up

Fireworks light up the sky with flames and sparks of many colors to add to the festive spirit. There is a lot of chemistry in fireworks: They are propelled by explosives and combustible material and the bright colors come from a variety of metals. To reduce risks, firework handling and use is restricted to professionals with the general public having access only to versions containing small amounts of explosives. Sometimes, however, police confiscate and need to dispose of illegally possessed fireworks. A simple option is a controlled burn. Unfortunately, as ECL scientists found, burned fireworks leave behind highly toxic dioxins and furans in the ash. The concentrations ECL found were thousands of times higher than background. What is more of concern is that the samples came from the "bottom ash", i.e., what's left behind after the burn. Most of the dioxins/furans travel along with the smaller particles in the "fly ash" and get transported in the air and deposited over large areas.

Technical Support to the Safer Consumer Products Program

ECL staff participates on DTSC's Safer Consumer Products program, Consumer Product Evaluation Team (CPET). Staff reviews chemical and physical properties of candidate chemicals and products, the availability and limitations of existing analytical methods, and the need for method development. Recent activities included new methods developed for testing of house dust and children's foam products for TDCPP/TCEP and other organophosphorus flame retardants (OPFRs), as well as urinary metabolites of OPFRs.

What's in Your Dust?

House dust (as well as dust in our office and cars) contains a number of different types of environmental contaminants. Correlations have been shown between contaminants in house dust and in blood and breast milk, suggesting that exposure to contaminants in house dust is a route of exposure for residents.

ECL measures several categories of persistent organic pollutants in dust, including, but not limited to: polychlorinated biphenyls (PCBs); polycyclic aromatic hydrocarbons (PAHs); polybrominated diphenyl ethers (PBDEs); and several types of brominated and phosphorous-based flame retardants (OPFRs).

ECL has already measured contaminants in dust from over 200 northern California residences, and dust from the living quarters of fire houses in southern California. PBDEs in fire station dust were much higher than in residential dust, emphasizing the risks to fire fighters.

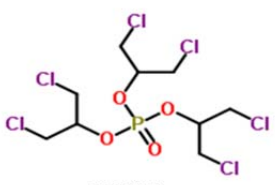
ECL's dust analysis projects are important for several reasons. Dust is a link between chemicals in products and human exposures. Measuring levels of contaminants in house dust may serve as a surrogate for assessing exposure of the residents, in a more convenient and less intrusive means than collecting blood or urine samples. And finally, as some components in various consumer products are replaced with less toxic alternatives, measuring the concentrations of both the original and replacement components in house dust will help to assess the efficacy of the change and the potential for continued exposure.

Emerging Contaminants: Organophosphate Flame Retardants in Dust

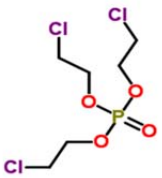
With the phase out of polybrominated diphenyl ethers (PBDEs), replacement flame retardants have been introduced into consumer products and building materials. ECL is developing methods to identify and measure many of these chemical classes in consumer products, indoor dust as well as biological samples (human and wildlife tissues and fluids).

Our new method currently measures 13 phosphorus-based flame retardants (OPFRs) in dust, including three compounds listed as carcinogens under California's Proposition 65 list: Tris(2-chloroehtyl) phosphate (TCEP), Tris(2,3-dibromopropyl) phosphate (TDBPP) and Tris(1,3-dichloro-2-propyl) phosphate (TDCPP). In addition, TDCPP in foam is one of the first chemicals/products combinations of DTSC's Safer Consumer Products initiative.

ECL's OPFR analysis includes a more environmentally friendly sonication extraction method which will provide analytical results with less solvent use. Detection and measurement of OPFRs in dust is performed by gas chromatography tandem mass spectrometry (GC-MSMS). One goal is to characterize indoor dust for the presence of replacement flame retardants such as organophosphate flame retardants (OPFRs) and investigate dust as an exposure route.



TDCPP



TCEP

TDBPP

ECL Provides Technical Support to the Department of Consumer Affairs for SB1019

In 1975, when California adopted a flammability standard (TB117, a flame test) to protect consumers from house fires, use of chemical flame retardants (FRs) was a cost efficient way to meet this standard. In recent years, however, significant concerns were raised regarding both the efficacy of FRs to protect from fires and the environmental and health impacts of FRs. As a result, a new standard was developed (TB 117-2013, a smolder test) . In addition, a new law (SB1019) requires manufacturers of furniture products to disclose whether or not those products contain FRs above 1000 ppm. Failure to correctly disclose such information is subject to fines enforced by the California Department of Consumer Affairs (DCA). Our laboratory has been tasked with analyzing samples submitted by DCA for the presence of FRs.

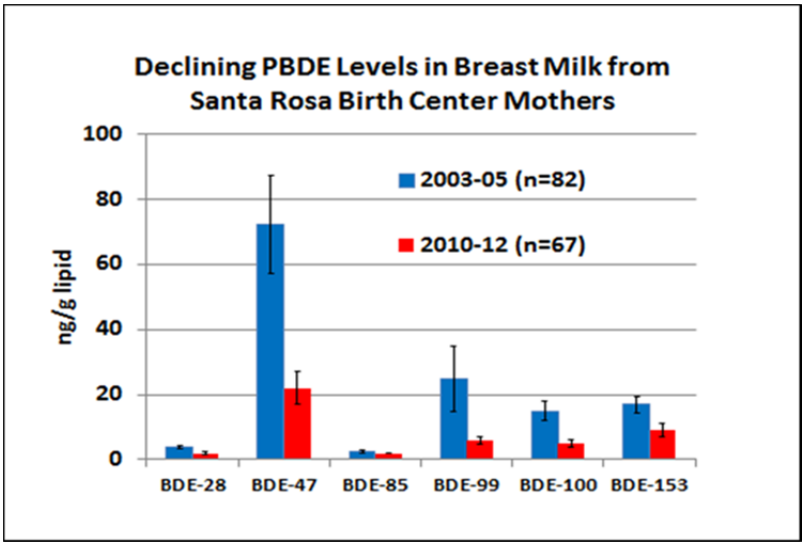
Working closely with DCA, we have employed several advanced techniques with sophisticated instruments to identify and measure several classes of FRs (OPFRs, BFRs, melamine, etc.) in furniture components. With such techniques we can reliably report results to DCA to enforce the law. Another goal, however, is to develop and validate a screening approach to enable commercial laboratories to provide information to manufacturers and consumers on the presence of FRs in products using simpler instrumentation.

ECL Measures Chemical Contaminants in the Blood, Urine and Breast Milk of Californians

Contaminants such as polybrominated diphenyl ethers (PBDEs), PCBs, organochlorine pesticides (OCPs) and Perfluorinated chemicals (PFCs) can enter our body from the food we eat, the products we use and from contact with dust. As these chemicals persist in the environment and get stored in our bodies, there are concerns about adverse effects on our reproductive, developmental, as well as immunologic systems. ECL scientists were the first to identify the world's highest levels of PBDEs in humans and wildlife in California. For about 20 years, ECL scientists have measured several chemical classes, including perfluorinated chemicals used in food packaging, cookware and other everyday products; PBDEs along with long-banned pesticides (OCPs) and industrial chemicals (PCBs) in the blood and breast milk of Californians. Metabolites of some new flame retardants (OPFRs) are measured in urine. ECL obtains permission from the Committee to Protect Human Subjects before any participants donate blood or urine for analysis.

ECL's Biomonitoring Studies Show Dropping Levels of Flame Retardants, a Possible Result of Their Phase-out

Our most recent study focused on measuring chemical contaminant levels in reproductive-age California families. In collaboration with the Santa Rosa Women's Health and Birth Center by clinic, we collected maternal blood, cord blood and breast milk samples over two time periods (2003-05; and 2010-12) from healthy, first-time mothers.



We found that pesticide and PCB levels in breast milk were similar throughout the time periods measured, whereas PBDE levels appeared significantly lower in the recent years (2010-2012). These results are in agreement with our measurements of PBDEs in serum from pregnant women, a probable outcome of the restriction and ban of PBDEs since 2006.

From the paired maternal and cord blood Santa Rosa study, we found that cord blood has similar or even higher levels of contaminants compared to the maternal blood, suggesting that chemicals can cross the placenta and that the fetus may have higher exposure than the mother, given their relative small body weights.

Biomonitoring California Program

The Biomonitoring California Program (a collaborative effort of DTSC, the Office of Environmental Health Hazard Assessment and the California Department of Public Health) puts California at the forefront of measuring chemical contaminants that can be found in our bodies. The Program focuses on chemicals of specific interest and concern to California, such as perchlorate and PFOS (contaminants in our groundwater), flame retardants (used in furniture and other consumer products), and some heavy metals such as mercury (from abandoned gold mines) and arsenic (naturally occurring in some drinking water). With a cooperative agreement with the Centers for Disease Control, laboratory capabilities and capacities have increased and we have measured over 150 chemical contaminants in the blood or urine of approximately 3,500 Californians. Thus far, the Program has investigated exposures to mothers and infants; firefighters and teachers; Central Valley residents; and is now measuring chemicals in pregnant women from the statewide Genetic Disease Screening Program.

The Biomonitoring Program's efforts have started to bear fruit: We found that firefighters carry in their bodies very high levels of many chemicals and we identified practices that may lower exposures. We clearly showed that chemicals that a mother is exposed to also appear in her newborn infant at birth. The Program brings us some good news: levels of flame retardants (PBDEs), banned by legislation a few years ago, are decreasing. On the other hand, there is more work to do: Levels of replacement flame retardants are increasing.

Flame Retardants in Household Cats

Not only people, but their pets get exposed to flame retardants from indoor dust. ECL, in collaboration with local veterinarians, conducted a study to explore the presence of certain environmental chemical contaminants (PCBs, pesticides, PBDEs, and newer flame retardants) in the blood of cats and in their environment (house dust and cat food). The study was prompted by a report on the possible role of such chemical contaminants in the development of hyperthyroid disorders in cats. PBDE levels in

household cats were extremely high, about 50 times higher than in California residents. In addition, cats had different PBDE profile than humans and other wildlife, indicating different exposure pathways in cats and pointing to house dust as the main route. We found no association with hyperthyroidism, however, perhaps because of the small sample size, other risk factors in play, and/or a complicated causal mechanism. However, these high levels in cats are of great concern as cats can be a sentinel for toddlers and young children playing on the floor with frequent hand-to-mouth contact resulting in exposure to chemicals in the dust.

Poly- and Per-fluorinated Chemicals: From Products to Ground Water and Blood

ECL is investigating the occurrence of poly- and perfluoroalkyl compounds (PFASs) in human blood and groundwater. These chemicals as a class are extremely persistent in the environment and some individual species are found at high concentrations in human breast milk and blood. Negative human health effects have been correlated with general population exposure to the two most abundant PFASs, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). While all PFAS chemicals are currently unregulated at the state and federal levels, the U.S. EPA has proposed provisional health advisories for PFOS and PFOA in drinking water and has required public water treatment facilities to monitor for 6 PFASs. As California shifts towards groundwater and aquifer recharge to accommodate its drinking water needs, the presence of PFASs in groundwater is of increasing concern. Measuring PFASs in blood provides an overall sense of PFAS exposure trends in humans from all sources: food packaging, stain repellents, cookware, etc. ECL has measured PFAS in thousands of blood samples from Californians.

ECL has expanded its original list of PFASs to measure additional species that are relevant to modern PFAS manufacturing practices. Some of them have been used in firefighting foams, severely contaminating Air Force bases and other firefighting drill areas. Methods are in development for their analysis in groundwater. ECL is currently working with DTSC's Geological Services Unit to obtain groundwater samples from a range of industrial, urban, and military sites to assess the magnitude and extend of PFAS presence.

ECL OUTREACH AND EDUCATION

ECL in the Media

ECL staff works closely with our Office of Communications to disseminate information on what the laboratory does and how it helps DTSC's mission. From reporter interviews, to video clips and DTSC Newsletter articles, we try to demystify the lab operations for all to appreciate.

Local and National TV, newspapers and journals have interviewed ECL staff or published stories on our work. Recent examples include a Sacramento Bee's story on the declining levels of PBDEs in pregnant California women; Inside EPA's article on ECL's work on PFAs in groundwater; a WNYC NY Public Radio series about environmental exposure and cancer; and a San Francisco Chronicle's story on DTSC's contributions in the study of Flame Retardants.

Training on Lab Services

ECL staff has put together training material to familiarize staff from various DTSC Programs with the services ECL provides. In the past year ECL took the show on the road and visited all regional offices. Information and examples were given on how to request services, how to fill forms and submit them electronically, how to request consultation, how to select appropriate analytical tests data quality objectives. In addition, the training included the interpretation of analytical results and particularly quality assurance issues. The training was well received based on a short survey of the participants at every region. Comments and suggestions from those surveys helped update the material for future training events. ECL has also provided training for DTSC legal office and State and County prosecutors. A module on "Science for Prosecutors" was highly appreciated by the participants at the California District Attorneys Association (CDAA) convention.

Visiting Scholars

ECL's reputation as a center of excellence on emerging chemical issues has resulted in a number of collaborations with Universities, other government agencies, industry and NGOs. ECL has competed for federal funding and has been awarded several research grants from the USEPA, US Fish & Wildlife, National Institute of Environmental Health Sciences, USAID, Department of the Army, California Breast Cancer Research Program, CDC. In addition, ECL has received research contracts from the California State Water Resources Control Board, OEHHA, CA Department of Public Health and the CA Department of Food & Agriculture, to assist these agencies on special projects of mutual interest. Funds from such grants and contracts are used to augment and expand ECL resources while providing deliverables to the funding agencies. In addition to operating expenses, equipment and supplies, funds are used to hire temporary grant-supported staff to conduct the contracted work under ECL's supervision.

This has been a very successful program. Grant-supported staff (Visiting Scholars) with the right qualifications is brought on board to work on specific projects, while sharing their training and expertise with ECL staff. Several of these Visiting Scholars opted to join State Government and were hired by ECL or other State agencies, proving to be a good model for recruitment and succession planning. Others returned to their original organizations or moved on to different careers; most are in contact with ECL colleagues and have continued collaborations.

Students in the Lab

It is important to provide encouragement to budding scientists as they contemplate their careers. To help inspire the next generations of scientists, ECL offers opportunities and resources including work experience, mentoring and training, lab tours/visits and seminars. ECL has often hosted High School students. Young students and their teachers tour ECL and interact with our scientists. It is one of the ways to inspire and mentor future generations of scientists. http://www.dtsc.ca.gov/ECL/Kids-Visit-to-Berkeley-ECL.cfm

Occasionally, High School students volunteer to work at ECL. We currently have a senior as a Lab Assistant getting hands-on experience. She is now applying to various Biochemistry Programs.

ECL maintains a contract with the University of California, Berkeley, to hire Undergraduates to work as Lab Assistants in the laboratory. Staff serves as mentors for the students. Students assist chemists in laboratory

tasks such as preparing reagents, packing chromatography columns with absorbents; washing glassware; performing simple chemical analyses; establishing and maintaining a database for logging and tracking environmental and biological samples, tabulating and graphing results, etc.

Publications

Since the mid-1980s, ECL scientists have published more than 200 scientific papers, averaging six to seven papers per year. Last year's publications:

- Whitehead TP, Crispo Smith S, Park J, Petreas M, Rappaport S, Metayer C. Concentrations of persistent organic pollutants in California women's serum and residential dust. *Environmental Research*, 136:57-66, 2015 (PMID: 25460621)
- Petreas M and de Boer J, Eds. Flame Retardants in the Environment - Papers presented at 6th International Symposium on Flame Retardants (BFR2013), San Francisco from April 7-10, 2013. *Chemosphere*, 116:1-124, 2014
- Brown FR, Whitehead TP, Park J, Metayer C, Petreas, M. Levels of non-polybrominated diphenyl ether brominated flame retardants in residential house dust samples and fire station dust samples in California. *Environmental Research*, 135:9-14, 2014.(PMID 25261858)
- Guo W, Nelson D, Hurley S, Reynolds P, Guo T, Wang W, Park J, Petreas M. Pilot study to assess effects of collection tube types and processing delay on measurements of persistent organic pollutants and lipids in human serum. *Chemosphere*, 116:75-82, 2014.(PMID: 2479582)
- Petropoulou SSE, Duong W, Petreas M, Park J. Fast liquid chromatographic–tandem mass spectrometric method using mixed-mode phase chromatography and solid phase extraction for the determination of 12 mono-hydroxylated brominated diphenyl ethers in human serum. *Journal of Chromatography A*, 1356, 138-147, 2014. (PMID: 25001336)
- Whitehead TP, Brown FR, Metayer C, Park J-S, Does M, Dhaliwal J, Petreas MX, Buffler PA, Rappaport SM. Polychlorinated biphenyls in residential dust: Sources of variability. *Environmental Science and Technology*, 48, 157-164, 2014. (PMID: 24313682)

For a complete list of publications or to request reprints please visit:
http://dtsc-share/Support/ecl/ECL%20List%20of%20Publications/Forms/AllItems.aspx

ECL Seminar Series

ECL has been hosting biweekly seminars in Berkeley with simultaneous webcasting. These seminars are open to other researchers and to the public. Both in-house work and the work of guest speakers is presented and discussed.

For more on ECL and to request services, please visit:
http://share/Support/ecl/default.aspx

CHALLENGES AND SIGNIFICANT ISSUES FOR ECL

Currently, ECL faces the following challenges and significant issues and is working towards solutions:

- Update and replace obsolete and outdated lab equipment to meet needs of the Department
  - ✓ More than 50% of our instruments are past their life expectancy
  - ✓ Vendors no longer support maintenance and repair of instruments and equipment
  - ✓ Inefficient use of resources such as staff time and supplies to troubleshoot instrument problems and maintenance of equipment
  - ✓ Data storage and security are in question due to outdated software

- Obtain ISO/IEC 17025 Accreditation to meet Goal 4, Objective 4.6 of DTSC's Strategic Plan
  - ✓ *Goal 4, Objective 4.6: Strengthen and augment the capability and capacity of ECL to provide scientific leadership and serve DTSC's programs by prioritizing work, updating equipment and implementing an internationally recognized quality management system*
  - ✓ Validation of ECL's competency as reference lab for California

- Obtain Laboratory Information Management System (LIMS) in coordination with OEIM
  - ✓ Synchronization of instruments and equipment
  - ✓ Data storage, backup, mining and security
  - ✓ Control of documents and records
  - ✓ Management and tracking of samples and lab activities
  - ✓ Electronic notebook, automated reports generation and electronic deliverables of documents and records

- Method Development on Vapor Intrusion/Soil Gas Analysis
  - ✓ Meet an immediate need of the Department
  - ✓ No standardized method for analysis of soil gas; not an accredited field to test by ELAP; requires ECL to validate method for commercial labs

- Develop procedure and guidance to assess Tentatively Identified Compounds (TICs)
  - ✓ No guidance on how to assess TICs that may pose potential health risks
  - ✓ Great approach to identify emerging contaminants not on DTSC's radar screen

- Methods development and validation for measuring chemical/product combinations identified as priorities by the Safer Consumer Products regulations
  - ✓ Need specialized sample screening, sample preparation, and analytical instruments to be able to develop methods for testing the non-standard chemicals in the product matrices

- Technical support to the Dept. of Consumer Affairs for SB1019 implementation
  - ✓ We need efficient ways to screen samples for classes of flame retardants
  - ✓ As the list of flame retardants expands, we need more resources

- Recruitment of highly qualified research scientists from major universities to fill vacancies
  - ✓ Recognition that to build and maintain a scientifically sound laboratory requires hard work of knowledgeable scientists