THE LABYRINTH
ISDH LABORATORY
NEWSLETTER

Indiana State Department of Health Laboratories

Issue 3

July/August

U.S. Fish and Wildlife Service presents Award to ISDH Chemists

By: Robin Bruner

On June 9, 2009 members of the ISDH Laboratories, the Indiana Department of Environmental Management (IDEM) and the U.S. Department of the Interior Fish and Wildlife Service met in the atrium of the ISDH Laboratories building at 550 West 16th Street, Indianapolis, IN. The occasion of this gathering was the presentation by the U.S. Fish and Wildlife Service of a plaque to the ISDH Laboratories and letters of appreciation to several ISDHL chemists in recognition of the work performed by the ISDHL chemistry staff on a U.S. Fish and Wildlife Service project. The findings of this project were summarized in a study entitled "Preliminary Diagnosis of Contaminant Patterns in Streams and Rivers of National Wildlife Refuges in Indiana".

Water Lab Award Recipients

Photo by: Ken Severson, OPA

As the list of threatened and endangered species continues to increase in Indiana, the U.S. Fish and Wildlife Service undertook an investigation into the levels of contamination and the impacts of that contamination on the aquatic life in two watersheds affecting three of Indiana's National Wildlife Refuges (NWR) - Patoka River watershed which affects the Patoka NWR and the Vernon Fork of the Muscatatuck River affecting both the Muscatatuck NWR and the Big Oaks NWR. Both watersheds suffer from environmental stressors due to various types of land use within each watershed. Among the sources of contaminants are acid mine drainage, effluents from oil and gas exploration, high-density residential land use and agricultural runoff. The Big Oaks NWR includes portions of a former military base, the Jefferson Proving Grounds, and suffers from the residual contamination of exploded ordinance.

Sampling on this project began in 2006 and continued in 2007. The study consisted of two datasets. One was the cataloguing of the number and diversity of the aquatic species in the rivers and streams within the National Wildlife Refuges – biological assemblages. The study looked at fish, crayfish and macroinvertebrates. The other dataset was the results of the chemical analysis of those rivers and streams.

The chemical testing consisted of both field testing and laboratory testing. In the field, tests were performed for parameters such as pH, Temperature and Dissolved Oxygen. In the laboratory, samples were tested for Alkalinity, Hardness, Chemical Oxygen Demand, Total Organic Carbon and for inorganic chemicals, including Phosphorus, Fluoride, Chloride, Sulfate and Cyanide. Ammonia-Nitrogen and Nitrate+Nitrite-Nitrogen were also determined. The samples were also tested for 14 different metals, including aluminum, arsenic, copper, lead, mercury and selenium.

The U.S. Fish and Wildlife Service used the chemical data provided by the ISDH Chemistry Laboratories to plot "hot spots" for each analyte within each NWR. These data were compared to the biological findings to identify possible stressors. Possible sources of the contaminants were also identified. These data will be used as a baseline for long-term trends in the water quality at all three NWR.

Inside this issue: A Peak at the Chemisty Labs

Our Mission: The Indiana State Department of Health Laboratory partners with other public health agencies to provide timely and accurate information needed for surveillance and outbreak investigations to protect and improve Hoosier health.

What is Biomonitoring?

By: Roland Gamache

The Centers for Disease Control Prevention's (CDC) Environmental Health Laboratory conducts the National Biomonitoring Program (NBP). The Program specializes in biomonitoring, which is the direct measurement of exposure of people to toxic substances in the environment by measuring the substances or their metabolites in human specimens, such as blood or urine. Biomonitoring measurements are the most health-relevant assessments of exposure because they indicate the amount of the chemical that actually enters people from all environmental sources (e.g., air, soil, water, dust, and food) combined, rather than the amount that may enter their system[1].

Pardip Patel works on a condenser in the Chemistry Lab. Photo by: Brent Barrett

"From the national prospective, the overall purpose of this program is to provide unique exposure information to scientists, physicians, and health officials to help prevent disease that results from exposure to environmental chemicals."

The CDC has provided grants to states and consortiums of states for local biomonitoring programs. These programs collect samples from individuals in the community, test these samples for chemical concentrations of public health interest by methods approved by the CDC, and report these test results back to the CDC. These grant programs also include training for the chemist on the proper techniques and methodologies for the chemicals to be tested as well as updates to the equipment needed for the testing methods. Additionally, laboratory measurements undergo extensive quality control and quality assurance review, including tolerance limits for operational parameters, the measurement of quality control samples in each analytical run to detect unacceptable performance in accuracy or precision, and verification of traceable calibration materials. These procedures are also included as part of the grant agreement with the CDC.

From the national perspective, the overall purpose of this program is to provide unique exposure information to scientists, physicians, and health officials to help prevent disease that results from exposure to environmental chemicals[2]. Specific public health uses of the exposure information include -

- determining which chemicals are in Americans and at what concentration
- monitoring the prevalence of people with levels above those toxicity levels
- establishing reference ranges that can be used by physicians and scientists
- assessing the effectiveness of public health efforts to reduce exposure of Americans to specific chemicals
- determining whether exposure levels are higher among minorities, children, women of childbearing age, or other potentially vulnerable groups
- tracking, over time, trends in levels of exposure of the population, and

the setting of priorities for research on human health effects of potential exposure to environmental chemicals.

The current concept for a biomonitoring program in Indiana would initially focus on two areas. The first area would be the class of chemicals related to the surveillance of herbicides. The major herbicide in use in Indiana is Atrazine, which

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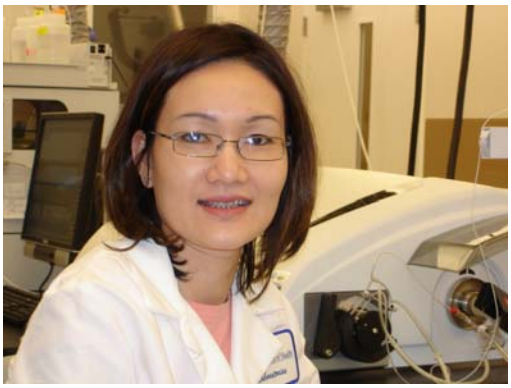

Pictured here is Taylor Dao working in the Chemistry Lab

Photo by: Brent Barrett

Biomonitoring-continued

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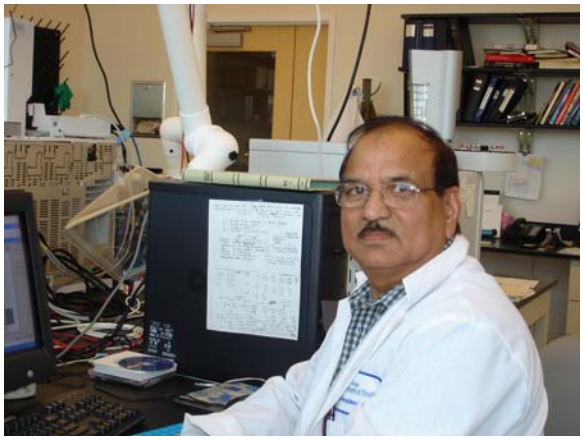
is widely used on corn crops (approximately 90%[3]) for weed control. Several studies have shown an association between occupational exposure to pesticides during pregnancy and adverse effects on the fetus. In addition, recent studies have found a significant relationship between a mother's home proximity to cultivated land and risk of birth defects. Recent studies have shown that mothers with an increased risk to spring time exposure to chemicals applied in farming communities were significantly more likely to give birth to babies with birth defects than were mothers without this exposure[4]. These results do not prove that the chemicals in use might be causal factors of birth defects, but these results do suggest that the association between this potential exposure and birth defects occurrence should be investigated further.

The second area of interest for a biomonitoring program in Indiana would be for the measurement of cotinine. Cotinine is a metabolite of nicotine in the body. The measurement of cotinine would be used to estimate the exposure of the fetus to tobacco. This analysis would provide a confirmation of current methods for surveillance measures of tobacco use during pregnancy. Additionally, cotinine levels would be able to monitor exposure to second-hand smoke among the population that does not use tobacco products.

"The second area of interest for a biomonitoring program in Indiana would be for the measurement of cotinine."

Biomonitoring exposure measurements are generally made by testing blood or urine. The analytical methods used for measuring the environmental chemicals or their metabolites in blood and urine are based on the use of standard techniques and equipment in our chemistry laboratory. The specific techniques and equipment include isotope dilution mass spectrometry or inductively coupled plasma mass spectrometry.

More information about the Biomonitoring Program and links to state web sites participating in the Biomonitoring Program can be found at http://



Mohammed Zaman factoring chemistry equations at his work bench in the Chemistry Lab

Photo by: Brent Barrett

Organic Chemistry-What Has It Done For Us Lately?

By: Mark Starzynski

It is spring in Indiana, and farmers are beginning to plant their crops. This means an increase in the number of samples being submitted to the Organic Chemistry Lab. The Organic Chemistry Lab is a part of the Chemistry Laboratories at the Indiana State Department of Health (ISDH). Among our customers are the Indiana Department of Environmental Management (IDEM), the bottled water program at the ISDH, the Food Chemistry Lab at the ISDH, local health departments, and others such as Purdue University, and Muscatatuck Urban Training Center.

The Organic Chemistry Laboratory provides a variety of analytical services to its customers. Analytical support is divided into three areas. The first area is Pesticides and Herbicides. This spring, IDEM will be sending staff out to the rivers and streams in Indiana to collect samples for us to test for the amount of pesticide run-off from the farmer's fields. The pesticide lab utilizes both gas and liquid chromatography and a variety of detectors. Gas chromatography (GC), is a type of chromatography used in organic chemistry for separating and analyzing compounds that can be vaporized without decomposing the analyte. The pesticide lab uses the GC to separate the different components of a mixture, helping to identify compounds. In gas chromatography, the moving phase is a carrier gas usually an inert gas such as helium or an unreactive gas such as nitrogin. The stationary phase is a microscopic layer of a liquid or polimer on a piece of glass tubing called a column. The gaseous compounds being analyzed interact with the walls of the column, which is coated with different stationary phases. This causes each compound to elute at a different time, known as the retention time of the compound. The comparison of retention times is what gives the GC its analytical usefulness in identifying compounds.

The second area is Volatile Organic Compounds (VOCs). VOCs analysis includes testing for halogenated compounds such as bromoform, tetrachloroethylene (PCE) (previously used as dry cleaning fluid), and trichloroethylene (TCE). VOC's analysis includes testing for the lighter petroleum products such

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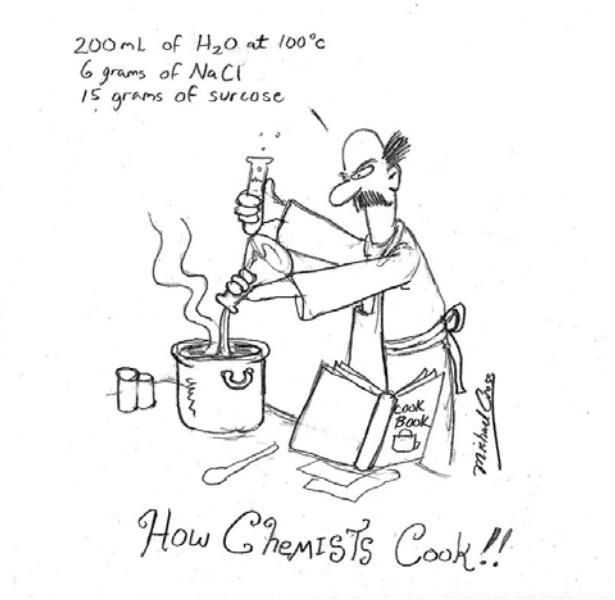
Indiana State Department of Health Laboratories



Cartoon by: Michael Cross

We're on the Web:
www.in.gov/isdh/24567.htm

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as gasoline and kerosene.

The third area is Semi-Volatile Organic Compounds (SVOCs). SVOC analysis, sometimes referred to as acid/base neutral analysis, includes testing for acidic compounds such as phenols, neutral compounds such as chrysene and naphthalene, as well as the heavier petroleum products such as diesel fuel and motor oil. The VOCs and SVOCs areas utilize gas chromatography with detectors called mass spectrometers. A mass spectrometer (MS) is an analytical technique that determines the composition of a molecule.The principle consists of ionizing molecules to generate charged molecules or molecule fragments and then measuring their mass-to-charge ratios. At first, the sample is separated by the GC instrument, and then it goes into the MS where components of the sample are ionized by the MS by impacting them with an electron beam, which results in the formation of charged particles (ions). The ions are then directed into a magnetic field and the mass-to-charge ratio is calculated based on the motions of the ions. The MS is used for both qualitative and quantitative analysis. The Organic Chemistry Laboratory also receives a number of food samples through the Food Chemistry Lab from consumers that ask "What's in this?" due to the fact that something does not taste or smell right. In the past, we have analyzed pizza, soda pop, toaster pastries, chewing gum, and even chicken salad. We have found gasoline in milk, paint thinner in soda pop, and Lysol in cheese. We even found a poison similar to Raid in someone's medications. In October 2008, we investigated a bottled water complaint, and found gasoline components in the water. It was then traced to the plastic cap itself. We reported our findings to the Food Chemistry Lab, they reported back to the Consumer Protection division of the ISDH, and they notified the manufacturer.

Another way our services have been utilized was during the freight train derailment in January 2008, in Indianapolis. Emergency response operations were set up at a nearby library, and the ISDH lab was asked to analyze dozens of surrounding residential water wells for hundreds of parameters to ensure safe drinking water for the nearby residents.

As in these examples, the Organic Chemistry Laboratory plays a vital role in the monitoring and investigation of public health and environmental concerns with the ultimate goal of safekeeping the health of our citizens in the state of Indiana.

Resources Used for this edition of the LAByrinth include:

National Report on Human Exposure to EnvironmentalChemicals, Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Laboratory Sciences, 2005.

http://www.cdc.gov/biomonitoring

Office of the Indiana state Chemist and Seed Commission, ISDH Presentation, February 2009.

Showalter Grant Application, Hugo Ochoa-Acuña, Comparative Pathobiology, Jane R. Frankenberger, Agricultural and Biological Engineering, Leighanne Hahn, Office of the Indiana State Chemist, "Exposure to Atrazine during Pregnancy and its Impact on Infant Health