ZymaX NewZ

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TPH by GC/MS

ZymaX approaches the analysis of TPH from a perspective that sets us apart from the routine environmental laboratory that utilizes the conventional GC/FID method (8015M). We have developed a CA DOHS certified method which allows us to quantify TPH using GC/MS (Gas Chromatograph/ Mass Spectrometer) analysis. Our interest is not solely in quantification of the TPH, but also in the potential for the expanded information gathering from a TPH analysis that GC/MS affords. The benefits of using mass spectral (MS) data on a routine basis seem to increase as a function of the size and the public profile of the project.

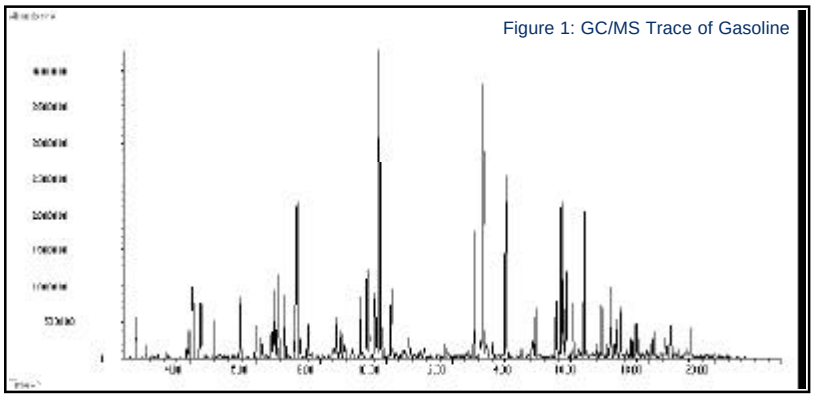

Figure 1: GC/MS Trace of Gasoline

GC/MS can substantially decrease analytical costs when conducting a risk-based assessment (e.g. ASTM-RBCA framework). A quantitative understanding of the site levels and distribution of PAH concentrations and other compounds of concern are as important as assessment of TPH concentrations. Additional information (e.g. PAH's) can be derived from pre-existing TPH MS data, or analysis of PAH's can be performed on contemporaneous sampling by selection of specified samples with positive TPH results.

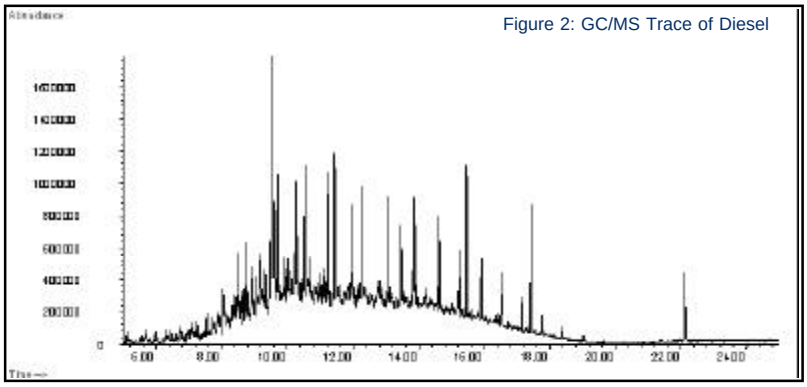

Figure 2: GC/MS Trace of Diesel

GC/MS can be instrumental in source determination. Unique TPH distributions can be critically evaluated using MS analysis to ascertain the nature and potential source of the compounds present in the TPH mixture. This information can be crucial when specific sources and their distributions are unknown.

GC/FID can produce hydrocarbon distributions that are noted as being "unlike the calibration standard." Results indicating the presence of organic material in the sample may not be related to petroleum hydrocarbons at all. TPH quantification by GC/MS inherently contains the tools for correcting the contribution to TPH from naturally occurring compounds that add false positive contributions to the TPH. The availability of the full scan GC/MS data also allows performance of a mass spectral analysis and evaluation of unusual hydrocarbon distributions in terms of unknown and tentatively identified compounds. Further, the availability of GC/MS data coupled with a competent MS analysis can often provide enough information to discern the nature of the organic material in the sample.

Although there are no statistical differences between actual TPH values quantified using GC/MS and those derived from GC/FID, the advantages of the GC/MS method translate to better and more accurate information, decreased long-term analytical costs and increased future options for our clients.

Please refer to our website http://www.zymaxusa.com/technotes/tph-measure.html for the complete paper published by Robert Haddad, Ph.D and John MacMurphey.

PERCHLORATE CONFERENCE

ZymaX recently exhibited at the symposium *"Perchlorate and NDMA in Groundwater: Occurrence, Analysis, and Treatment"* presented by the Professional Environmental Marketing Association. Over 400 people attended the April 17th conference, showcasing many experts from municipal, consulting, and legal backgrounds who discussed occurrence and potential sources of both contaminants. Both perchlorate and NDMA are known to impact drinking water aquifers in California, leading to the closure of numerous municipal water supplies. Fate and transport characteristics, regulatory status, toxicology, chemical detection challenges, and current remediation/ treatment options were discussed, as well as known impacts on California water resources.

table of contents

TPH by GC/MS 1
conference 1
LIMS 2
couriers, couriers, couriers 2
isotope lab 3
radiocarbon age dating 3
employees of the month 3
solving problems 4

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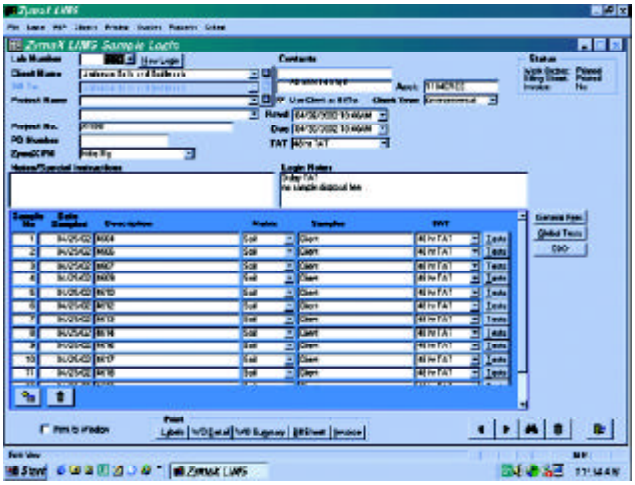
ZymaX LIMS

ZymaX currently utilizes a LIMS (Laboratory Information Mgt System) that is designed to facilitate greater integration of the entire laboratory process from logging in of samples to reporting the results. Once samples have been thoroughly inspected by sample control personnel, they are entered into the LIMS system. The ZymaX LIMS contains a database of current clients, project managers, projects, analysis and pricing. Sample control personnel can update the database as necessary. The descriptions and identifiers on the samples entered into the LIMS by sample control personnel are then carried forward into the laboratory work orders, which are generated from the LIMS. The descriptions and identifiers are also transferred to the final laboratory reports.



ZymaX LIMS: Client page displaying methods and status of project. Sample info is automatically transferred to WIP, where outdating samples and short holds are highlighted.

The ZymaX LIMS automatically transfers the information entered by sample control into the WIP (work-in-progress) database. In the WIP database, personnel from each individual department examine in-house work for preparation and analysis. Outdating samples are highlighted in the WIP. Staff can sort completed samples by time frame, project or sample ID. ZymaX project managers access a master WIP list that includes each sample and analysis for all ZymaX departments, including preparation and analysis dates. Samples in WIP can be sorted by client, project, lab number, matrix, analysis, ZymaX project manager, sample date or due date. The WIP listing can also be filtered to show only forensics projects or only LUFT EDF projects, for example.

ZymaX integrates client quotes and proposals into the LIMS. Once a quote or proposal is generated, pricing is automatically defaulted for that client and project to the new prices. Quotes and proposals are generated from the LIMS database, using current clients, project managers, projects and analysis. New clients, project managers, projects and analysis are added to the database as necessary.

Another benefit of the ZymaX LIMS is internal reporting. Reports can be generated indicating how often an analysis is requested, how many projects are logged in per day and internal turn around times. Turn around time reports can be created showing the relationship between the date samples were received and the date the work orders were printed, between the date the work orders were printed and the date work orders were distributed and between the date a project was due and the date the analysis was completed. The internal reports are continually used to search for ways to increase ZymaX efficiency for the benefit of our clients.

ZymaX FACT: ZymaX provides air monitoring services for perimeter monitoring during construction. Regulatory agencies are concerned with particulate, metals and VOCs. ZymaX performs all these and more!

COURIERS, COURIERS, COURIERS

ZymaX maintains a fleet of courier vehicles and staff of couriers for equipment delivery and sample pick up. We operate this courier service from the Mexican border to the Bay area, including San Joaquin Valley. The clients appreciate our ability to be at the job site when they need us. The time and expense our clients save in shipping, in addition to safe handling of their samples, is an added benefit in our overall commitment to complete customer satisfaction.

Our couriers cover the following areas:

P **Jim White:**
Los Angeles & San Diego

P **John Moore, Bob Rush:**
San Luis Obispo, Santa Barbara & Ventura

P **Ray Chavez:**
Central Coast, Fresno & Bakersfield

P **Wayne Lehman:**
Bay Area & Sacramento

If you need to schedule a pickup, please call Sue or Gracie in our San Luis Obispo office at 805.544.4696.

Dr. Dachun Zhang, Director of the ZymaX Stable Isotopes Department, prepping for radiocarbon isotope samples. Dr. Zhang received his B.S. and M.S. from Peking University and his Ph.D. from University of Chicago. He has contributed to various publications including:

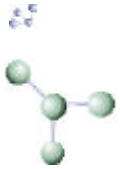
- *"Nitrogen contents and isotopic compositions of some Icelandic basalts."*
- *"Nitrogen abundances and isotopic compositions in MORB and subduction zone rocks."*
- *"Nitrogen isotopes as a tracer in water-rock integration."*
- *"The source of water used by streamed vegetation from Owens Valley in the Sierra Nevada."*

ZymaX Isotope

ZymaX Isotope is a full service isotope laboratory for the measurement of stable isotope ratios of elements that are significant in environmental and geochemical processes. Relevant isotopes and some of the more important applications are listed below.

- D/H and $^{18}O/^{16}O$ for identifying the source of groundwater
- $^{13}C/^{12}C$ and D/H for identifying oil and petroleum fuels
- $^{15}N/^{14}N$ for identifying the source of nitrate in surface and ground water
- $^{34}S/^{32}S$ for identifying crude oil and heavy oils

The laboratory is managed by Dr. Dachun Zhang, who has over 20 years experience in stable isotope analysis. Dr Zhang, along with ZymaX consultants Dr. Ian Kaplan and Dr. Alan Jeffrey, have extensive experience in the interpretation of stable isotope data for the determination of its environmental and geochemical significance.



www.ZymaXisotope.com

Radiocarbon Age Dating

ZymaX Isotope has added a preparative line to allow conversion of carbon containing compounds to graphite for radiocarbon age dating. The ZymaX radiocarbon line was set up in association with scientists from the University of Arizona, one of the few centers performing Accelerator Mass Spectrometry (AMS) analysis. AMS allows analysis of samples with small amounts of carbon, such as landfill gases and fugitive methane, to be dated to help identify their origin. AMS centers normally have a large backlog of samples and turnaround time can be several months. Sample preparation is often the bottleneck. The ZymaX line enables us to eliminate this bottleneck, and offer more timely radiocarbon analysis.

employee of the month

december—Sue Snowdy

Since Fall of 2000, Sue has been the friendly voice you are likely to encounter when you call ZymaX. In addition to receptionist duties, Sue assists with quotes, report generation, and helps keep our office organized. Sue has volunteered in the training of Boy Scout leaders for 15 years. She also enjoys reading, needlecraft, gardening, cooking, and collects unique cookbooks.

january—Lisa Liu

Originally from Southeast China, Lisa has been in the U.S. for 12 years. She has been working in the analytical chemistry field for eight years, including two at ZymaX. Lisa operates the GC and GC/MS in our Semi-Volatiles Lab. Lisa keeps busy chauffeuring her two sons to their sports practices, music lessons, AWANA groups, and helps in their school classrooms. She enjoys traveling and is currently cultivating a garden.

february—Jamie Town

Jamie has been in the ZymaX front office as a report generator for seven years. Knowledgeable about computers, he also provides computer support when needed and is currently performing all of our electronic data delivery reporting. Jamie enjoys riding his motorcycle and reading a wide variety of books. He also has assisted in all aspects of theater production.

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SOLVING PROBLEMS WITH SOPHISTICATION

by Isaac R. Kaplan

The strategy used to litigate contamination or toxic tort dispute can change when the source or timing of contamination is unknown. Often there are several parties that could have caused the contamination in question–either due to several successive owners or several potential sources in close proximity. A plaintiff faced with such uncertainty may try to sue all the entities that might have contributed to the problem.

Increased broad liability for the cleanup of contamination has resulted in sophisticated investigatory techniques to identify sources of contamination. But, however, useful these techniques may be, they do not always provide clear evidence of who and what caused the contamination. In fact, evidence gleaned from these sources may sometimes add to the confusion.

Analytical chemistry provides critical evidence in contamination cases. Laboratories routinely provide information about chemical pollutants present and their concentration. However, EPA approved methods have their limitations. While quick, reliable and inexpensive in providing the kind of information needed for cleanup or disposal decisions, they do not provide detailed information about the exact composition of a complex mixture or time of release of its individual components.

Forensic chemistry analyses of free product and groundwater can help differentiate sources and determine when a gasoline spill occurred. Concentration of total lead and the presence of lead additives, other than tetraethyl lead, indicate the presence of gasoline manufactured before 1985. The presence or absence of MTBE and other oxygenated additives, may provide information about the age of gasoline in groundwater. BTEX hydrocarbons ratios, both in free product and dissolved in groundwater, can also help estimate time of release.

Standard EPA methods generally cannot distinguish between products such as Stoddard solvent, kerosene, Jet A, JP-5, and diesel fuel—all of which may have been stored at a single, or adjacent, bulk storage facility.

Where the pollution may have been caused by adjacent refineries, the use of sophisticated pattern recognition methods, developed in the last two decades by forensic environmental geochemists, using biomarker tracers and stable isotopes, may distinguish between crude oil feed stock blends used for fuel manufacture. Such information is often the only way to distinguish between, or determine the relative contributions of, spills from adjoining refineries.

Cleanup and toxic tort cases may be based on the migration of gaseous hydrocarbons, most commonly methane, which may have several sources, including leaking gas lines, underlying oil or gas fields, domestic landfill sites, or a marsh or swamp in the vicinity. Distinguishing between sources, based on composition, could be difficult to impossible. However, stable isotope measurements on methane and associated gases may identify the sources.

Pre-World War II gas manufacturing from coal or crude oil took place throughout the USA, often leaving in place byproducts of the process, such as "lampblack". Lampblack, coal, and crude oil all contain polynuclear aromatic hydrocarbons (PAH), some of which are "hazardous substances" according to CERCLA. If the PAHs in the soil originated from crude oil, there may be no liability under CERCLA by virtue of the petroleum exclusion in the definition of the term "hazardous substance" [42 U.S.C. §9601(14); *Wilshire Westwood Associates v. Atlantic Richfield Co.*, 881 F.2d 801, 9th cir. 1989]. Using pattern recognition techniques described earlier, it is possible to determine whether the PAHs in lampblack residues came from coal or oil.

Given the widely diverse scenarios that cause environmental contamination, attorneys should be aware that methods exist to help develop evidence used in the prosecution or defense of contamination and toxic tort cases.

Dr. Kaplan is the senior consultant for ZymaX forensics, inc., and Professor Emeritus at UCLA.