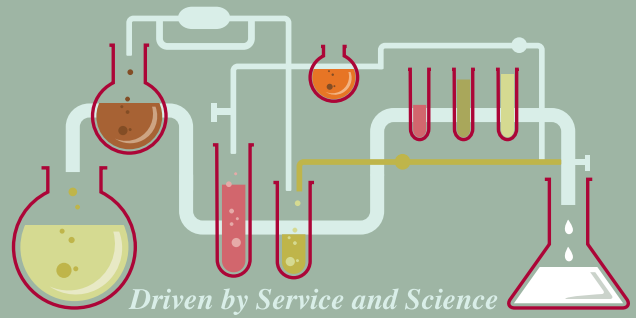


# Maxxam Analytics benchtalk



Holiday 2009

**Québec**

## ceo's note



Season's  
Greetings!

By now you may already know our big news. In mid-October, we acquired Burnaby, B.C.-based CANTEST Ltd., including its laboratory locations in Victoria and Winnipeg. Cantest is British Columbia's largest independent analytical laboratory business, specializing in environmental, food and pharmaceutical laboratory services—it's a wonderful addition to the Maxxam family.

The acquisition represents an obvious and exciting opportunity to strengthen Maxxam's presence in Western Canada and more specifically in the British Columbia marketplace, where we now have over 350 employees. But this is not just about Western Canada. For our customers throughout Canada, we look forward to introducing and extending some of Cantest's specialized services such as ecotoxicology and bioanalytical services.

The acquisition continues Cantest's growth trajectory, while carrying on the work and legacy of one of its founders, Dr. Donald B. Rix, a leader in the British Columbia biotechnology and business communities. Like Maxxam, Cantest has a solid commitment to science, innovation, quality and exceptional customer service. We're pleased to add Cantest's extensive experience and knowledge to our team.

It may be a gross understatement to observe that 2009 has been a challenging year for our industry. For our

part we have felt the impact in reduced volumes and inconsistent, often unpredictable demand. Through it all we have worked hard to ensure that we remain responsive and that we have not cut corners that could impact our ability to deliver on the promise of on time, accurate, defensible data. Ultimately you are the judge of our performance and we always welcome feedback on how to improve our service.

*Like Maxxam, CANTEST has a solid commitment to science, innovation, quality and exceptional customer service.*

*We're pleased to add their extensive experience and knowledge to our team.*

As we turn the page to 2010, I wish everyone all the very best for the holiday season. We are grateful for your support over the past year and we look forward to working with you in the New Year. ☐

*Jon Hantho*

**President & Chief Executive Officer  
Maxxam Analytics International Corporation**



## Contact

[www.maxxamanalytics.com](http://www.maxxamanalytics.com)

Québec Toll-Free: (877) 462-9926

email: [enviro@maxxamanalytics.com](mailto:enviro@maxxamanalytics.com)



## feature

## Polychlorinated Biphenyls Total Aroclors or congeners

Polychlorinated biphenyls (PCBs) are biphenyl molecules with varying degrees of chlorine substitution on the ring structure. The amount of chlorine substitution and the location of the chlorine(s) on the biphenyl ring dictate the chemical and physical properties of the material, and are used to describe the individual molecules. Each possible configuration is referred to as a congener, with 209 possible congeners.

PCB homologues refer to groupings of PCBs having the same molecular weight, i.e., the same number of chlorine atoms on the biphenyl molecule. Hence, homologue groups are described as monochlorobiphenyls (one chlorine – 3 congeners), dichlorobiphenyls (two chlorines – 12 congeners), trichlorobiphenyls (three chlorines – 24 congeners), etc.

Mixtures of PCB congeners having specific chemical and physical characteristics depending on the proportion of each congener in the mix were manufactured and sold in North America by Monsanto Co. under the trade name *Aroclor*. Aroclor mixtures are designated by a four digit code, with the first two numbers representing the type of compound (12 = biphenyl) and the last two digits representing the percent chlorine by weight. Hence, Aroclor 1248 is a chlorinated biphenyl mixture containing 48 per cent chlorine by weight.

Although PCBs are recalcitrant and persistent, they have been shown to degrade under normal environmental conditions, primarily by two main mechanisms: biodegradation and weathering. Therefore the PCB congener patterns in older Aroclor mixtures can be altered. This is important because PCB patterns observed in ambient environmental samples may not match the composition of the original source Aroclor mixture(s).

Industry standards for the determination of PCBs in environmental matrices range from simple low cost, high volume analyses for Aroclor mixtures using gas chromatography coupled with electron capture detection (GC/ECD) to the higher cost, specialized analysis using gas chromatography combined with high resolution mass spectrometry (GC/HRMS).

Each approach offers its own unique advantages and disadvantages depending upon the needs of the project. Table 1 (below) summarizes the more common analytical methods.

**Table 1: Comparison of Analytical Methods for PCBs**

Method	Reference	Relative Cost	Reporting Limits		Application
			Soil (µg/g)	Water (µg/L)	
GC/ECD	EPA Method 8082	Low	0.01	0.05	Aroclors
GC/LRMS	EPA Method 8270	Medium	0.01	0.02	Homologues
HRGC/HRMS	EPA Method 1668	High	0.000003 - 0.000007	0.00005 - 0.0002	Congeners


The analytical approaches presented in Table 1 do not represent an exhaustive list of options. As an example, GC/ECD methods can be used to analyze for PCB congeners, but with some important caveats. Depending on the sample matrix (and potential interferences), these may include lack of specificity for individual compounds (relative to HRGC/HRMS analysis), co-elution of congeners, and elevated reporting limits, although reporting limits can be lowered somewhat by increasing the level of cleanup and concentration of the extract. This comes with an increase in cost and an increased risk of concentrating interfering compounds present in the sample.

So, when planning a sampling and analysis plan, should the focus be on individual PCB congeners or Aroclor mixtures? To properly address this question, a number of factors need to be considered, including site history; data quality objectives (DQOs) for the project; risk assessment and management; cost of analysis (budget); and turnaround time. Table 2 offers some of the pros and cons associated with each of the above-noted analytical approaches.



**Table 2: Pros and Cons of PCB Analytical Methods**

Method	Pros	Cons
GC/ ECD	<ul style="list-style-type: none"><li>• Low cost</li><li>• Faster Turnaround time</li></ul>	<ul style="list-style-type: none"><li>• Interferences may bias results high</li><li>• Quantitation is based on pattern recognition rather than individual compounds which may over- or under estimate the true concentration</li></ul>
GC/ LRMS	<ul style="list-style-type: none"><li>• Summation of homologue groups provides a better representation of "total" PCB concentration</li></ul>	<ul style="list-style-type: none"><li>• Interferences may bias data</li></ul>
HRGC/ HRMS	<ul style="list-style-type: none"><li>• Congener specific analysis provides a "truer" representation of the total PCB concentration in a sample</li><li>• Low risk of interferences biasing results</li><li>• Low limits of detection</li></ul>	<p>Labour/Capital intense analysis leading to:</p> <ul style="list-style-type: none"><li>• High cost</li><li>• Longer turnaround times</li></ul>

A primary advantage to analyzing for PCB congeners over Aroclors is in the area of risk assessment and establishing toxic effect. The World Health Organization has designated a series of twelve individual chlorinated biphenyl congeners as being "dioxin-like" in their potential health effects. These dioxin-like PCB congeners have been shown to exert a number of toxic responses similar to those of 2,3,7,8-tetrachlorodibenzo(p)dioxin (TCDD)—the most toxic dioxin. It is important, for the purpose of establishing risk, to be able to identify and quantify the dioxin-like PCBs at ultra-trace levels. 



*Terry Obal*  
**Ph.D., C.Chem**  
**Manager, Scientific Services**

## PAH: Petrogenic vs. pyrogenic differentiation

**W**ith the day-to-day activities of our society relying largely on combustion as an energy source, it is clear that the abundance of polycyclic aromatic hydrocarbons (PAH) in the environment can be directly correlated to these combustion activities and that PAH concentrations vary from region to region relative to the combustion activities of each respective region.

PAHs are a primary element of environmental contamination. However, since the overall presence of PAHs is due to the contribution of a large variety of industrial and commercial activities, different types and mixes of PAHs are present. In order to correctly determine the source of a PAH contamination for a given site, it is important to be able to differentiate between naturally present PAHs (background) and PAHs contributed from combustion

activities. The analysis of alkylated PAHs enables the potential differentiation of the probable source.

From a chemistry perspective, PAHs are a class of organic compounds composed of two or more fused aromatic rings. Most commonly present in the environment are compounds of two to seven rings and more specifically, naphthalene (composed of two rings) and benzo-a-pyrene (composed of five rings). Like all hydrocarbons, PAHs are composed of carbon and hydrogen atoms. However, certain PAHs compounds contain aliphatic hydrocarbon chains (e.g.: a methyl group - CH<sub>3</sub>) attached to a parent ring. Due to the presence of these chains, these compounds are known as "branched" or "alkylated" PAHs. Considering how the number of chains, their length and location on the aromatic rings varies and how numerous combinations are

*(Continued on page 4)*



## québec

possible, alkylated PAHs are classified according to the number of alkylated carbon atoms they contain. For example, 2-methylnaphtalene becomes a C1-naphtalene and 2-ethylpyrene becomes a C2-pyrene.

Hundreds of PAHs have been identified in nature either as naturally occurring or as a byproduct of human activity with many of the compounds being similar yet differentiable. It is therefore important to understand and consider the different options available for the differentiation of a PAH source in all environmental investigations. The formation of PAHs can be resumed by the following 4 processes:

- 1 Diagenesis** – A rapid transformation (days to years) of organic matter occurring at low temperatures. More precisely, the transformation of compositional organic matter of sediments by biomolecules.
- 2 Petrogenic** – A slow transformation at moderate temperatures resulting in fossil fuels.
- 3 Pyrogenic** – A rapid transformation due to high temperature combustion of organic matter (especially biomass). The combustion is usually incomplete or inefficient due to a lack of oxygen. Can be attributed to both natural sources (forest fires) and human activity (combustion of fossil fuels).
- 4 Phytogetic** – A biosynthesis by plant and animal life forming PAH byproducts.


The principle factor differentiating these four PAH producing processes is the temperature of formation. In the production of PAHs, the degree of alkylation is inversely proportional to the temperature of formation. Furthermore, the degree of alkylation and the distribution of alkyl groups along with the temperature of formation can be used to distinguish the PAH source based on their characteristic properties.

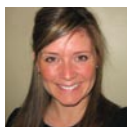
(Continued from page 3)

Also, the nature and complexity of the PAHs are directly related to their temperature of combustion. In other words, the PAHs produced as a byproduct of coal combustion are different from the PAHs produced from the combustion of fuel which are different from those produced in a forest fire.

That being said, it is evident that the best method to distinguish between a pyrogenic and petrogenic source lies in identifying the distribution of PAH compounds and their corresponding family group. Knowing that the degree of alkylation of a PAH compound is inversely proportional to its temperature of formation; it becomes possible to determine homologous characteristic profiles of PAHs and their sources.

These profiles can be used to determine the origins of PAH compounds. In most cases, petrogenic PAHs show a bell-shaped distribution due to the different degrees of alkylation of the PAH compounds ( $C_2 \gg C_3$  and  $C_1 > C_0$  and  $C_4$ ). Contrarily, pyrogenic PAHs show a distribution pattern in which the parent molecule is in the greatest abundance and the concentration of the other compounds drops off with degree of alkylation ( $C_0 \gg C_1 > C_2 > C_3 > C_4$ ).

The determination of PAH profiles is a very specialized tool that may provide legal evidence to identify a potential source of contamination along with quantitative data for all PAH compounds analyzed. Very recently, Maxxam Analytics developed a method for the analysis of alkylated PAHs. For more information regarding this analysis, please contact your respective project manager or sales representative. 



*Geneviève Berthiaume*  
Technical Representative

## Montreal

889 Montée de Liesse,  
Ville St-Laurent, QC H4T 1P5  
Tel : (514) 448-9001  
Fax: (514) 448-9199  
Toll free: 1-877-462-9926

## Saguenay

3780 Rue Panet  
Jonquière, QC G7X 0E5  
Fax: (418) 542-8692  
Toll Free: 1-866-737-8071

## Ste-Foy

2690, Avenue Dalton  
Ste-Foy, QC G1P 3S4  
Tel : (418) 658-5784  
Fax: (418) 658-6594

## All Locations

email: [info@maxxamanalytics.com](mailto:info@maxxamanalytics.com)

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## Holiday Hours



**Important Notice:** During the holiday season, Maxxam will have reduced staffing levels. If you are submitting samples during this time, please speak to your Project Manager to ensure hold and turnaround times can be met.

**Special Notes:** \*No sample receipt available after 12pm in Regional Offices due to hold times. There will be no environmental pick ups or deliveries on Dec 24, 29, 30 and 31, 2009.

	Montreal Environmental & Food		Quebec City	Chicoutimi
	Office Hours	Sample Reception Hours	Office Hours/Sample Reception	Office Hours/Sample Reception
Dec. 23	8:30am-5pm	8am-5pm	8:30am-5pm	8:30am-5pm
Dec. 24	8:30am-12pm	8am-12pm*	8:30am-12pm*	8:30am-12pm*
Dec. 25	CLOSED	CLOSED	CLOSED	CLOSED
Dec. 26	CLOSED	CLOSED	CLOSED	CLOSED
Dec. 27	CLOSED	CLOSED	CLOSED	CLOSED
Dec. 28	CLOSED	CLOSED	CLOSED	CLOSED
Dec. 29	8:30am-5pm	8am-5pm	8:30am-5pm	8:30am-5pm
Dec. 30	8:30am-5pm	8am-5pm	8:30am-5pm	8:30am-5pm
Dec. 31	8:30am-12pm	8am-12pm*	8:30am-12pm*	8:30am-12pm*
Jan. 1	CLOSED	CLOSED	CLOSED	CLOSED
Jan. 2	CLOSED	CLOSED	CLOSED	CLOSED