

# Dual-Column PCB Congener Analysis

Kory Kelly and Bruce Harder

Phenomenex Inc., Torrance, California

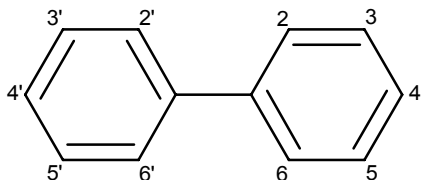
Polychlorinated biphenyls (PCB's) are manmade chemicals that have a wide variety of properties that have made them useful in a variety of industrial applications ranging from paints to oils, with heavy use in electrical transformers. Production of PCB's started in the 1920's by chlorinating one or more sites on a biphenyl molecule, as shown below, resulting in 209 possible varieties of PCB's individually called congeners. Each congener is identified by a number referred to as BZ#, ranging from BZ#1 to BZ#209.

In 1979, the EPA banned the use of PCB's after research showed health hazards associated with PCB use. PCB's have been classified as carcinogens and have been linked to birth defects and developmental abnormalities. Some PCB's have dioxin-like properties and can be fatal to unborn children in very small quantities.

PCB's are very inert chemicals resulting in long lifetimes in the environment. After manufacturing, spills and dumping have resulted in contamination to large areas of the environment. These chemicals can be found in every region on earth due to the long lifetimes and extreme usage/dumping.

Congener analysis is usually performed using a dual column analysis because of the large number of molecules with the same masses and the co-elution which occurs due to the very large number of compounds to be analyzed (up to 209). Dual column analysis allows for more certainty in peak identification and may eliminate the number of compounds that cannot be analyzed because of co-elution.

Structure of Polychlorinated Biphenyl (PCB) Molecule



## Experimental

### Instrumentation:

Analysis was performed using an HP 6890 Gas Chromatograph (Agilent Technologies, Palo Alto, California, USA) with  $\mu$ ECD detection equipped with HP Chemstation software (Version A.09.01) used for data analysis and a G2614A autosampler from Agilent. The GC columns used for analysis were Zebron (Phenomenex, Torrance, CA, USA) ZB-50 30m x 0.32mm x 0.25 $\mu$ m, and a ZB-1701 30m x 0.32mm x 0.25 $\mu$ m. Carrier Gas was UHP grade Helium. Make-up gas for micro ECD was a P-5 mixture, 5% methane

in 95% argon. Standards were received in two mixtures of PCB congeners from Sevens Trent Labs in Pittsburgh, PA. All other chemicals were of HPLC grade.

### Sample Preparation:

Samples were used as received. Solution 1 contained 2,4,5,6-tetrachloro-m-xylene (TCMX), and congeners: BZ #8, 18, 28, 52, 49, 44, 66, 101, 115, 87, 77, 151, 118, 165, 184, 153, 105, 138, 187, 126, 183, 128, 202, 156, 180, 199, 169, 170, 195, 206, and 209. Mix 2 contained: BZ #1, 3, 5, 15, 31, 37, 74, 70, 90, 99, 119, 81, 110, 123, 149, 114, 168, 141, 158, 167, 177, 201, 157, 189, 207, and 194. Concentrations of congeners were 1.25 ng/mL with the exception of TCMX at 2 ng/mL and congeners BZ #1, 2, and 15 at 12.5 ng/mL concentration.

### Chromatographic Conditions:

Oven conditions were the same for all results listed. Temperature started at 130°C and increased to 230°C at 20°C/min, then to 270°C at 4°C/min, then to 300°C at 20°C/min for one minute. 2  $\mu$ L splitless injections were made into a 225°C injector. The detector used was a  $\mu$ ECD detector at 325°C with 40 mL/min of P-5 makeup gas.

### Results:

Chromatograms for both mixes obtained on a ZB-50 are represented in Figure 1 with part a) containing the spectrum for Mix 1 and part b) containing the spectrum for Mix 2. Corresponding spectra are presented in Figure 2 for the same mixes analyzed on a ZB-1701. Congener identifications are labeled within the Figures according to their BZ#'s. Most congeners represented in Mix 1 are resolved in Figure 1a. Congeners that are not fully resolved in Figure 1a are resolved in Figure 2a with the exception of BZ#199 and 169. All congeners in Figure 1b are fully resolved with the exception of BZ#168 and 114, which are resolved in Figure 2b. The resolution of all fully resolved congeners will allow for accurate quantitation using the dual column technique.

## Ordering Information

Order Number	Description
7HM-G006-11	ZB-1701 - 30m x 0.32mm x 0.25 $\mu$ m
7HM-G004-11	ZB-50 - 30m x 0.32mm x 0.25 $\mu$ m



www.phenomenex.com

Phenomenex products are available worldwide. For the distributor in your country, contact Phenomenex USA, International Department by telephone, fax or e-mail: international@phenomenex.com.

**phenomenex**  
...breaking with tradition<sup>VP</sup>

USA  
tel: (310) 212-0555  
fax: (310) 328-7768

Puerto Rico  
(800) 541-HPLC  
(310) 328-7768

Canada  
(800) 543-3681  
(310) 328-7768

United Kingdom  
01625-501367  
01625-501796

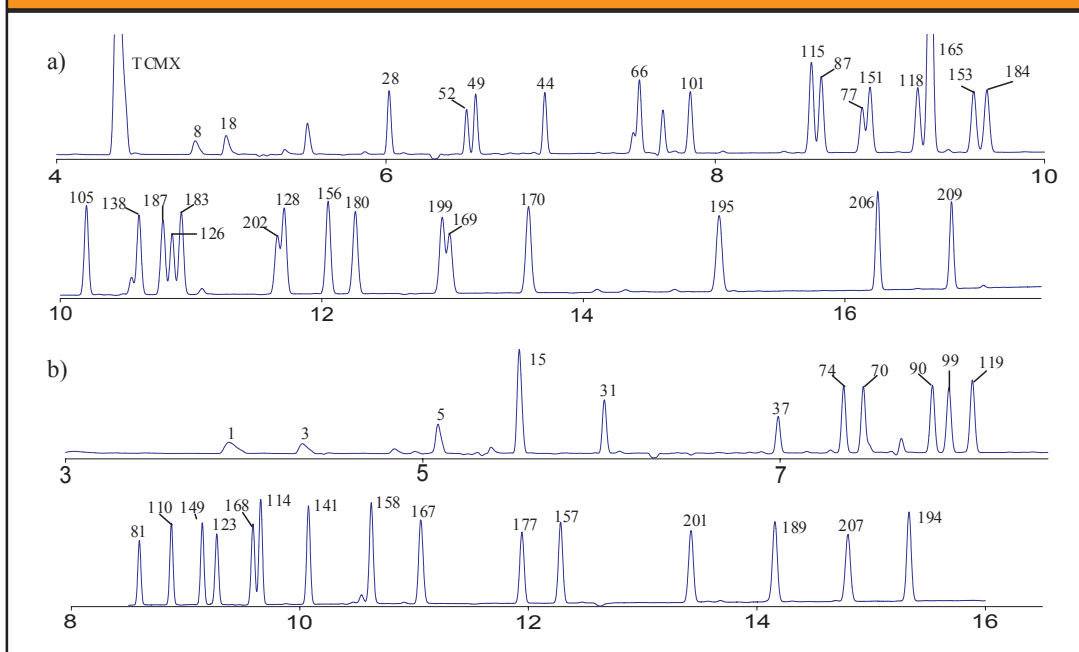
Germany  
06021-58830-0  
06021-58830-11

New Zealand  
09-4780951  
09-4780952

Australia  
1800-553-929  
1800-553-923

## Dual-Column PCB Congener Analysis

**Figure 1.** Spectra for a) Mix 1 and b) Mix 2 solutions of congeners on ZB-50 column.



**Figure 2.** Spectra for a) Mix 1 and b) Mix 2 solutions of congeners on ZB-1701 column.

