

# COMPARISON OF CARBORANE AND 5% PHENYL PHASES FOR THE ANALYSIS OF POLYCHLOROBIPHENYL (PCB) CONGENERES

Dan DiFeo Jr. — SGE, Incorporated. 2007 Kramer Lane, Austin, Texas 78758, USA.  
Angus Hibberd, Gerard Sharp — SGE International Pty. Ltd. 7 Argent Place, Ringwood 3134, Australia.

## INTRODUCTION

PolyChlorinated Biphenyl (PCB) compounds have been found to have serious health implications and be extremely persistent in the environment. PCB mixtures called Aroclor mixes were previously used in a variety of applications such as heat transfer fluids, dielectrics (insulators), in transformer cooling liquids, heat-transfer and hydraulic fluids, vacuum pump fluids, lubricants, plasticizers, sealants, pesticide extenders and copy paper. The use of PCB compounds was common place prior to 1970 before their effect on public health came to light. As a result, the use of Aroclor mixtures is very restricted and in some countries banned from use. The PCBs are often analysed as Aroclor samples. Aroclor samples are mixtures of specific PCB congeners and are given a specific number such as Aroclor 1242.

The 209 possible congeners are the subject of strict monitoring procedures within environmental regulating bodies around the world. Monitoring of soil, water and food stuffs for PCBs is common place in environmental laboratories. The standard columns used for the analysis of PCBs in environmental samples are the 5% Phenyl Phase or an SGE HT8 Carborane Phase. The PCB samples are predominantly analyzed by GC-ECD, specific for halogenated compounds or a GC-MS system for identification of the congeners.

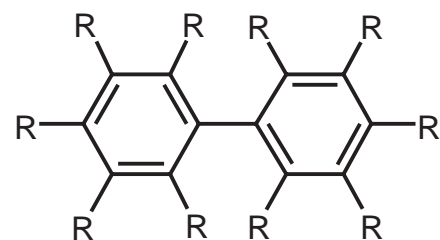


Figure 1. PCB basic structure, any combination of Hydrogen and Chlorine will give 209 different congeners.

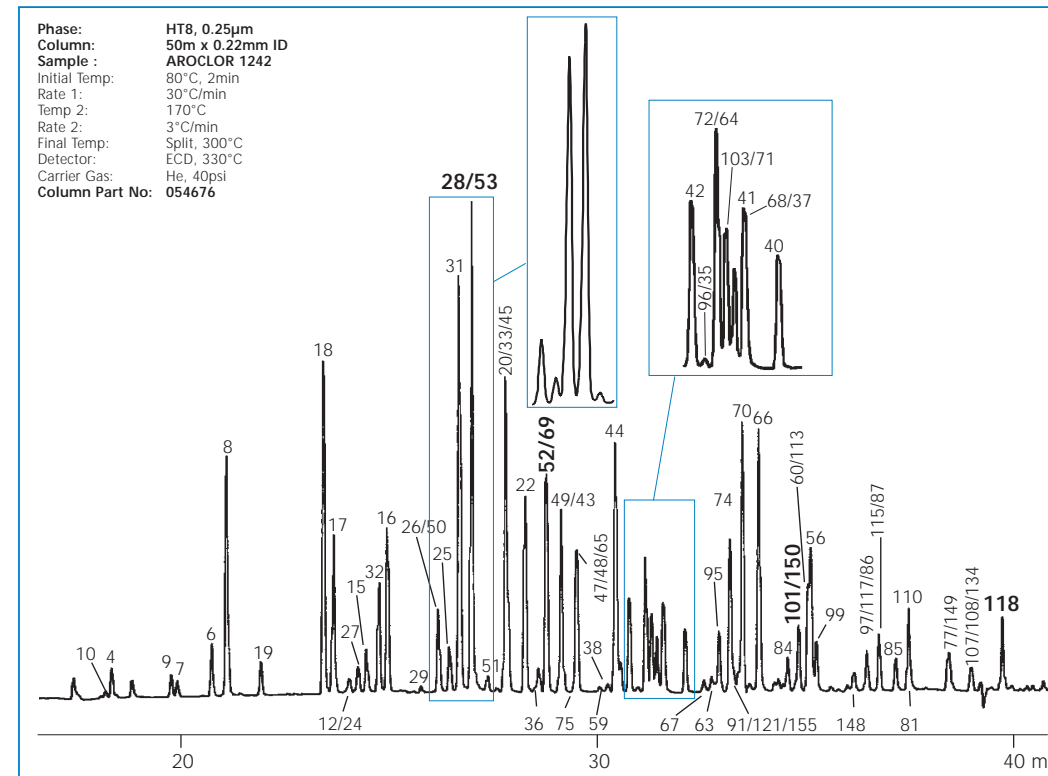


Figure 2. Aroclor 1242 analysed on an HT8 capillary column. Note the separation of the difficult-to-separate congeners, e.g. 28/31. The peak numbers refer to PCB congener numbers.

## ANALYSIS

PCB congeners are non-polar compounds that separate predominantly on boiling point when analysed on a 5% phenyl column. Due to the similar structures of many of the PCBs, the boiling points are very similar and many of the congeners are unable to be separated on non-polar columns. The analysis of Aroclor mixtures using an SGE HT8 capillary column gives unique separation of several difficult-to-resolve congeners. The unique partitioning properties of the HT8 capillary column comes from the Carborane phase incorporated into the polysiloxane backbone. The Carborane phase interacts preferentially with ortho substituted PCBs resulting in separation of these components to a greater extent than given by the conventional 5% phenyl capillary columns. This can be seen in **Figures 2 and 3**, which show chromatograms of the Aroclor 1242

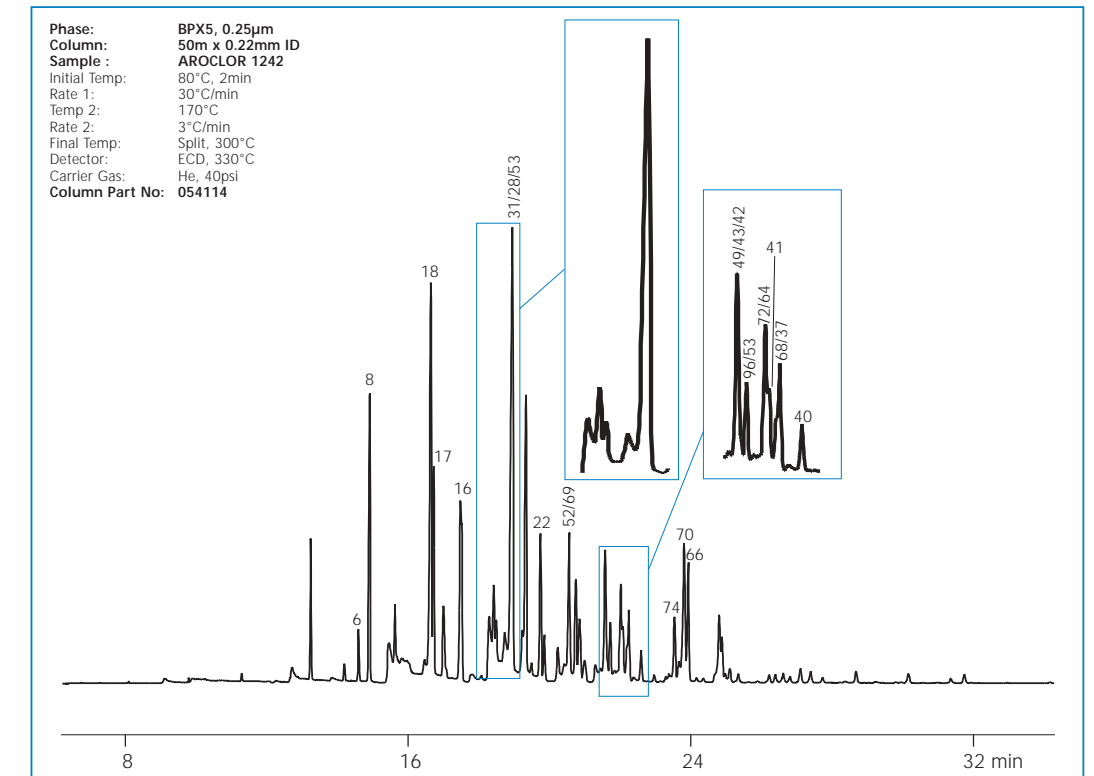


Figure 3. Aroclor 1242 analysed on a standard 5% phenyl column. Excellent for fingerprint pattern analysis. The peak numbers refer to PCB congener numbers.

## SUMMARY

The HT8 capillary column provides highly selective separation of difficult-to-separate PCB congeners unable to be separated on conventional phases such as the 5% phenyl columns. The Carborane phase allows preferential ortho substituted interactions of the PCB congeners with the Carborane phase to give the unique separation of PCB congeners. The 5% phenyl capillary columns are unable to partition the PCB congeners to the same extent and are an excellent choice column for pattern identification of Aroclor groups such as the 1242 shown here.

sample analysed on an HT8 and a 5% Phenyl (BPX5) column respectively. Within this chromatogram, the unique separation can be shown for congeners 31 and 28 on an HT8 column compared to a conventional 5% phenyl column where these isomers are unable to be separated (**Figure 3**). The added advantage of the HT8 column is that with the extra polarity and specific interactions with the PCB congeners there is no sacrifice of thermal stability. The HT8 column has a maximum temperature of 360/370°C, comparable or better than most 5% phenyl columns. Eluting the high boiling PCB congeners on an HT8 column is not a problem.

The BPX5, 5% phenyl column from SGE is a high temperature, inert and robust capillary column ideal for analysis of PCB congeners where elution patterns are all that is needed.



SGE, Incorporated  
2007 Kramer Lane, Austin, Texas 78758, USA  
Toll Free: (800) 945 6154 Tel: (512) 837 7190 Fax: (512) 836 9159  
Email: usa@sge.com Web: www.sge.com