

## Application Note 158

### Analysis of 209 PCB Congeners on the SPB-Octyl and MDN-5S Columns

**Current methods for analyzing the 209 PCB congeners use two different columns because a single column cannot separate all isomers. Supelco recommends SPB-Octyl and MDN-5S columns for the analysis.**

#### Key Words:

● congener ● coplanar ● PCB

The determination of individual PCB congeners rather than Aroclor mixtures as a whole is becoming increasingly important. Research studies have linked specific PCB congeners to potential toxic effects in the body. Congeners that are coplanar and lack chlorine substituted in the ortho position act similarly in the body to polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) (1). There are 209 possible PCB congeners.

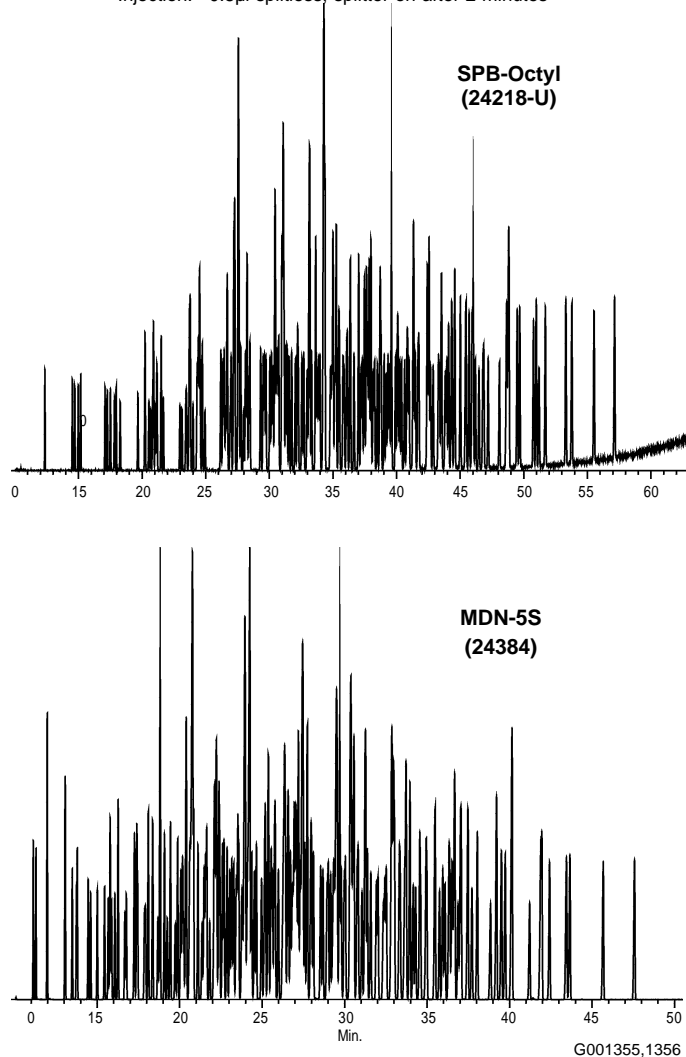
Current methods for analyzing the 209 PCB congeners use two different columns because a single column cannot separate all isomers. Supelco recommends SPB-Octyl and MDN-5S columns for the analysis (Figure A). The unique selectivity of the SPB-Octyl yields separations not possible on other columns and the stability and low bleed of the MDN-5S make it ideal for GC/MS work.

Separations were completed on 30m x 0.25mm ID, 0.25µm columns. Column lengths of 30 meters were chosen to keep the run time to 1 hour. Also, a final temperature of 290°C was used on the Octyl column in order to elute IUPAC #209 within the one-hour time window. Although the recommended operating temperature range for the SPB-Octyl column is -60°C to 280°C (isothermal), with additional conditioning, the column can be used up to 290°C in a temperature programmed run. However, expect increased bleed and a shorter lifetime due to loss of phase.

Table 1 summarizes the elution order of the congeners on both the SPB-Octyl and MDN-5S. The thirteen coplanar or toxic congeners of current interest are listed in red boldface. These congeners have been identified as having the potential to bind to chlorinated dioxin receptors. From this, it is possible to estimate dioxin-like toxic equivalencies for these compounds.(2). GC/MS analysis allows congeners of differing degrees of chlorination to be resolved by mass, and when used in combination with the SPB-Octyl, provides unique resolution of all thirteen of the specified congeners except numbers 156 and 157. This pair is resolved from all other congeners on the SPB-Octyl, and in many cases the two are reported together. If the two must be reported separately, data from the MDN-5S (which does resolve the two) can be used.

**Figure A. TICs of All 209 PCB Congeners on the SPB-Octyl and MDN-5S**

Column Dimensions: 30m x 0.25mm ID, 0.25µm  
 Cat. Nos.: 24384, 24218-U  
 Oven: 75°C, hold 2 min, 15°C/min to 150°C, 2.5°C/min to 290°C, no hold  
 Flow: He, 37 cm/sec, set at 200°C  
 Injector Temp.: 270°C  
 MSD interface Temp.: 280°C  
 Det.: MS, scan range 100-550 amu, 1.7 scans/sec.  
 Injection: 0.5µl splitless, splitter on after 2 minutes



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**Table 1. Comparison of elution order for all 209 PCB congeners on the SPB-Octyl and MDN-5S**

| Peak # | SPB-Octyl      | MDN-5S         | Peak # | SPB-Octyl            | MDN-5S             | Peak # | SPB-Octyl   | MDN-5S      |
|--------|----------------|----------------|--------|----------------------|--------------------|--------|-------------|-------------|
| 1      | 1              | 1              | 51     | 94                   | 100                | 100    | 179         | 179         |
| 2      | 2              | 2              | 52     | 57                   | 67                 | 101    | 165         | 141         |
| 3      | 3              | 3              | 53     | 95                   | 58                 | 102    | 105         | 137         |
| 4      | 4              | 4,10           | 54     | 58                   | 94                 | 103    | 146         | 176         |
| 5      | 10             | 7,9            | 55     | 67,93,100            | 63                 | 104    | 161,184     | 130         |
| 6      | 9              | 6              | 56     | 102                  | 61                 | 105    | 176         | 160,163,164 |
| 7      | 7              | 5,8            | 57     | 98                   | 74                 | 106    | 153,168     | 138,158,186 |
| 8      | 6              | 14             | 58     | 63                   | 76,98,102          | 107    | 141         | 129,178     |
| 9      | 5              | 19             | 59     | 61,88                | 93,70,96,66,121,88 | 108    | 186         | 126         |
| 10     | 8              | 30             | 60     | 70,74,76,91          | 80                 | 109    | 103         | 166,175     |
| 11     | 19             | 11             | 61     | 84                   | 91                 | 110    | 127,137     | 182,187     |
| 12     | 14             | 12             | 62     | 66                   | 55                 | 111    | 164         | 159         |
| 13     | 18,30          | 13,18          | 63     | 55                   | 155                | 112    | 129,138,163 | 183         |
| 14     | 11             | 17             | 64     | 89                   | 56,60              | 113    | 160         | 128,162     |
| 15     | 17             | 15             | 65     | 56                   | 84,92              | 114    | 158,178     | 167,185     |
| 16     | 13             | 24,27          | 66     | 121,60               | 89                 | 115    | 126,175     | 174,181     |
| 17     | 12,27          | 16             | 67     | 92                   | 90                 | 116    | 128,166     | 177         |
| 18     | 24             | 32             | 68     | 80                   | 101,113            | 117    | 187         | 202         |
| 19     | 15,16          | 23,34          | 69     | 155                  | 99                 | 118    | 182         | 171         |
| 20     | 54             | 54             | 70     | 90,101,113,152       | 79,119,150,112     | 119    | 183,185     | 156,173     |
| 21     | 32             | 29             | 71     | 150                  | 108,83             | 120    | 159,174     | 201         |
| 22     | 34             | 26,25          | 72     | 83,136               | 152                | 121    | 162         | 157,204     |
| 23     | 23             | 50             | 73     | 99                   | 78                 | 122    | 177         | 192         |
| 24     | 26,29          | 28,31          | 74     | 112                  | 97                 | 123    | 202         | 172,197     |
| 25     | 25,53          | 21             | 75     | 145                  | 86,125             | 124    | 167,181     | 180,193     |
| 26     | 50             | 20,33,53       | 76     | 79,86,97,109,119,125 | 116,117,145        | 125    | 173,171     | 191         |
| 27     | 31             | 51             | 77     | 87                   | 111                | 126    | 201         | 200         |
| 28     | 28,20          | 22             | 78     | 78                   | 115,87,148,81      | 127    | 156,157     | 169         |
| 29     | 45             | 45             | 79     | 117                  | 85                 | 128    | 204         | 170,190     |
| 30     | 21,33,51       | 36             | 80     | 85,116               | 120,136            | 129    | 197         | 198         |
| 31     | 46             | 46             | 81     | 110                  | 110,154            | 130    | 200         | 199         |
| 32     | 22             | 69             | 82     | 81,115               | 77                 | 131    | 172         | 196,203     |
| 33     | 52             | 73             | 83     | 82,148               | 82                 | 132    | 192         | 189         |
| 34     | 73             | 39             | 84     | 77                   | 151                | 133    | 180,193     | 208         |
| 35     | 43             | 43,52          | 85     | 111                  | 135,144            | 134    | 191         | 195         |
| 36     | 36             | 49             | 86     | 135,151              | 147                | 135    | 170         | 207         |
| 37     | 49,69          | 38,48,47,75,65 | 87     | 120,154              | 107,124            | 136    | 169,190     | 194         |
| 38     | 39             | 62             | 88     | 144                  | 109,123,139,149    | 137    | 198,199     | 205         |
| 39     | 48             | 104            | 89     | 147,149              | 106,140            | 138    | 196         | 206         |
| 40     | 44,47,65,104   | 35             | 90     | 134                  | 118                | 139    | 203         | 209         |
| 41     | 38,59,62,75,96 | 44             | 91     | 143                  | 143                | 140    | 208         |             |
| 42     | 42             | 59             | 92     | 108,124              | 134                | 141    | 195         |             |
| 43     | 35             | 42             | 93     | 107,139,140          | 114,131,133,142    | 142    | 189         |             |
| 44     | 41             | 37             | 94     | 123,131              | 122,165,188        | 143    | 207         |             |
| 45     | 40,71          | 71,72,41       | 95     | 106,142              | 146,161            | 144    | 194         |             |
| 46     | 37             | 64             | 96     | 118                  | 184                | 145    | 205         |             |
| 47     | 64             | 68,96          | 97     | 132                  | 132,153,168        | 146    | 206         |             |
| 48     | 72             | 40             | 98     | 122                  | 105                | 147    | 209         |             |
| 49     | 103            | 103            | 99     | 114,133,188          | 127                |        |             |             |
| 50     | 68             | 57             |        |                      |                    |        |             |             |

**References**

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- Frame, G.; Anal. Chem. News & Features, August 1, 1997, 468A-475A.

**Trademarks**

SPB – Sigma-Aldrich Co.  
MDN – Sigma-Aldrich Co.

Fused silica columns manufactured under HP US Pat. No. 4,293,415.

**Ordering Information:**

| Description   | Cat. No.       |
|---|----------------|
| <b>SPB-Octyl Capillary Column</b><br>30m x 0.25mm ID, 0.25µm film | <b>24218-U</b> |
| <b>MDN-5S Capillary Column</b><br>30m x 0.25mm ID, 0.25µm film    | <b>24384</b>   |

*Note 158*

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