

Lecture Chromo-3:
Gas Chromatography

CHEM 5181 Fall 2004
Mass Spectrometry & Chromatography

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Outline

- Introduction
- Instrument overview
 - Carrier gas
 - Sample injection
 - Columns & stationary phase
 - Packed columns
 - Capillary (open) columns
 - Operating conditions
- Practical ways to select and compare columns

Review and References on GC

- Historical Basis (Review)
 - 1952; [Martin and James](#): Packed columns
 - 1954; Commercialization
 - 1957; [Golay](#): Open tubular (capillary) columns
 - 1980; Wide spread use of capillary GC
- GC replaced distillation as the preferred method for separating volatile materials.
 - GC separations depend upon many variables making it a powerful separation technique.

Author	Publisher	Title	\$ on Amazon	Comments
McNair & Miller	Wiley	Basic Gas Chromatography, 1998 <i>(QD79.C46)(425)</i>	\$37	Good short reference book, read it if you use GC a lot
Grant	Wiley	Capillary Gas Chromatography, 1995 <i>(QD79.C46973)</i>	\$185	Detailed reference

Example of Separating Power of GC

Peppermint Oil

From McNair

Column: DB[®]-WAX
 80 m x 0.25 mm ID, 0.25 µm
 150-1800
 Carrier: Helium at 100 cm/min (0.25 ml/min)
 Oven: 70°C for 5 min
 75-200°C at 4°C/min
 200°C for 5 min
 Injection: Split 1:50, 0.1 µl
 1 µl, neat
 Detector: FID, 250°C
 Nitrogen make-up gas at 30 mL/min

- | | |
|---------------------|---------------------|
| 1. n-Pentane | 15. Menthofuran |
| 2. n-Pentane | 17. d-Camphorone |
| 3. Hexane | 18. β-Citronellol |
| 4. Heptane | 19. Linalool |
| 5. p-Terpinene | 20. α-Terpinolene |
| 6. l-Limonene | 21. Cineole |
| 7. l-α-Cineole | 22. Terpinolene |
| 8. α-Camphor | 23. p-Caryophyllene |
| 9. p-Terpinene | 24. Menthyl |
| 10. p-terpinene | 25. l-Menthyl |
| 11. Terpinolene | 26. α-Terpinolene |
| 12. β-Citronellol | 27. Camphorone-D |
| 13. α-Citronellol | 28. Menthone |
| 14. Linalyl acetate | 29. Menthyl |
| 15. Menthofuran | |

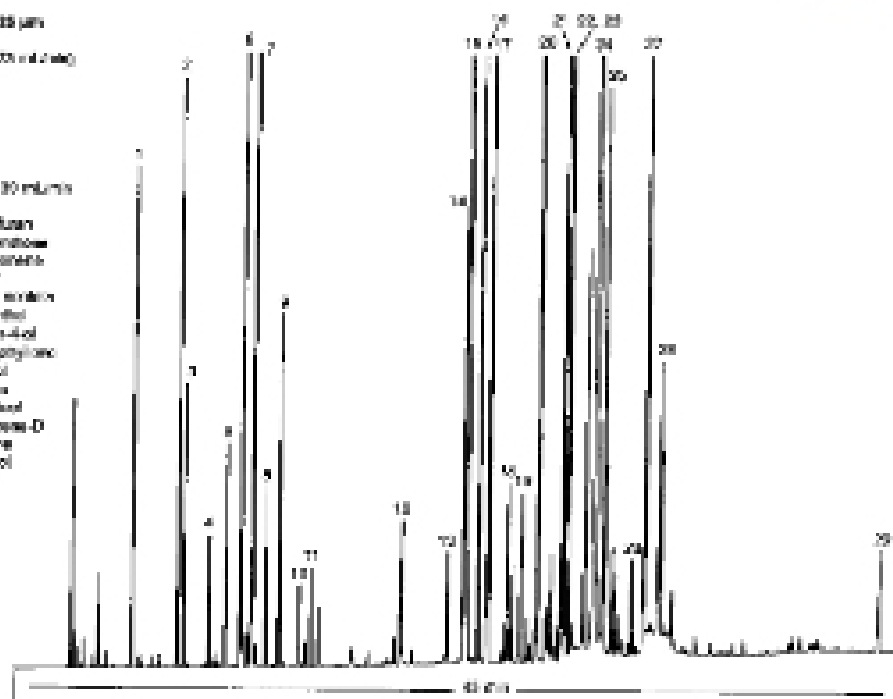


Fig. 1.1. Typical gas chromatographic separation showing the high efficiency of this method. Courtesy of J & W Scientific, Inc.

Introduction

- GC is most widely used analytical technique in the world
 - Over 50 years in development
 - 2,000 instruments / yr
 - 25,000 in use
 - Worldwide market > \$1billion
- GC is premier technique for separation and analysis of volatile compounds
 - Gases, liquids, dissolved solids
 - Organic and inorganic materials
 - MW from 2 to > 1,000 Daltons

Advantages of GC

- Fast analysis
 - Typically minutes (even sec.)
 - Can be automated
- Small samples (μl or μg needed)
- High resolution
 - Record: $N \sim 1.3 \times 10^6$
- Reliable, relatively simple and cheap (~ \$20,000)
- Non-destructive
 - Allows on-line coupling, e.g. to MS
- Sensitive detectors (easy ppm, often ppb)
- Highly accurate quantification (1-5% RSD)