Training Guidelines for the Fire Debris Analyst

Lesson Plan (Module) 11

Date: November 2006  
Instructor: Qualified Instructor

Subject: Gas Chromatography  
Total Time: 10 hours

Learning Objectives

- Understand the theoretical aspects of chromatography.
- Understand the theoretical aspects of gas chromatography.
- Understand the advantages and disadvantages of gas chromatography.
- Demonstrate familiarity with gas chromatography terminology.
- Demonstrate familiarity with instrumentation.
- Demonstrate how to properly interpret gas chromatographic data.

Suggested Reading

Introduction
This lesson covers the theoretical basis of gas chromatography and its application to the analysis of ignitable liquids and other materials.

Outline

1. Theoretical aspects
   a. History of chromatography
   b. Introduction to the various chromatographic methods
   c. Gas/liquid phase equilibrium
   d. Van Deemter curves
   e. Cross contamination
   f. Temperature vs. retention behavior

2. Chromatographic columns
   a. Liquid
   b. Packed
   c. Polar/non-polar
   d. Column efficiency
   e. Resolution

3. Carrier Gas
   a. Gas selection
   b. Flow rate
   c. Troubleshooting

4. Detectors
   a. Thermal
   b. Flame ionization
   c. Photoionization
   d. Mass Spectrometry
   e. Other

5. Quantitative evaluation
   a. Triangulation
   b. Correlation of area and quantity
   c. Peak characteristics

6. Qualitative evaluation
   a. Peak pattern comparison (with standards)
   b. Instrument Coupling
Teaching Aids

1. Provide actual GC runs of various volatile components. Demonstrate actual events of contamination, overload, improper oven temperatures and other factors that have an affect on interpretation.
2. Practical exercises involving various gas chromatographic parameters.
3. Practical exercises involving interpretation of gas chromatographic data.
4. PowerPoint presentation
5. Attend a course from an instrument manufacturer.

Summary

After completion of this module, the student should be able to determine correct sample preparation per sample attributes, how to obtain the best signal, the required instrumentation parameters per the specifics of each sample and be able to interpret a chromatographic chart.

Test Questions

1. Which of the following gases provides the best chromatographic separation over the widest temperature range?
   a. air
   b. hydrogen
   b. helium
   c. nitrogen

2. The temperature of the injection port should be:
   a. hotter than the final oven temperature
   b. room temperature
   c. optimized for the desired results
   c. 250ºC

3. Tailing of the peak can be an indication of:
   a. weak sample
   b. active sites in the GC system
   b. empty carrier gas
   c. faulty injection port septum
4. Inadequate resolution of two or more components could yield a chromatographic profile exhibiting:
   a. fronting
   b. **shouldering**
   b. tailing
   c. ghost peaks

5. What is the function of makeup gas?
   a. **to optimize the flame**
   a. to burn residue
   b. clean the detector
   c. provide fuel for the flame

6. Retention time can be affected by:
   a. carrier gas leakage
   b. insufficient carrier gas pressure
   c. overloaded sample
   d. deviation from the oven temperature program
   e. **all of the above**

7. Which of the following is a non-polar stationary phase?
   a. phenethylpolysiloxane
   b. cyanopropylpolysiloxane
   c. Tenax
   d. **dimethylpolysiloxane**

8. Single column gas chromatographic results are a means of positive identification for a single component. True or False

9. What physical properties affect the elution order of components on a non-polar column?
   a. vapor pressure
   b. molecular weight
   c. polarity
   d. unsaturation
   e. **all of the above**

10. A gas chromatograph calibration can be used as a check of:
    a. deviation in retention time
    b. reduced detection limits
    c. proper instrument functioning
    d. injection technique
    e. **all of the above**

11. A blank chromatogram can be the result of:
    a. a faulty septum
b. a blank sample

c. plugged column

d. flame is out in the FID

e. all of the above