

Detection of Acetaldehyde and Formaldehyde in Cigarette Smoke by Thermal Desorption

Application Note

Tobacco
Environment

Author:

C. Zawodny

Cigarette smoke contains a complex mixture of chemical compounds. There may be as many as four thousand compounds present in cigarette smoke, with many being potentially toxic and some that are suspected carcinogens. Included among these are BTX compounds. Figure 2, below is a chromatogram of cigarette smoke. Note the peaks for benzene, toluene and xylene, as well as very prominent limonene and nicotine peaks.

There is much interest in the detection of the volatile gases such as acetaldehyde and formaldehyde, but these have classically been done by HPLC analysis. Their carbonyl functionality lends them well to hydrazone derivatization, and 2,4-DNPH derivatization is performed for HPLC. Pentafluorophenyl hydrazine (PFPH) derivatization has been developed for GC applications and was evaluated in this paper.



Figure 1. X-1067 Sampler set up to collect cigarette smoke

A solution of PFPH (1000 ppm) was prepared in hexane, and a thermal desorption tube packed with Tenax, Carboxen 1000, and Carbosieve was placed on the spiking station of a Tube Conditioner with the tube frit toward the inside. A flow of 75ml-100ml of helium was set, and a syringe containing 100 μ l of the PFPH was injected into the spiking station port. (Figure 3, following page). After about 30 seconds, the tube was removed, and attached to the port of a Model 1067 air sampler. Added to the external end of the tube was a small glass funnel with a flare of about 1.5 inches. The flow rate was adjusted to 100 ml/min for 20-30 seconds. A lighted cigarette was placed close to the funnel flare and the air sampler was started (Figure 1, left). After 20 seconds of sampling, the sample tube was thermally desorbed at 150°C for 15 minutes. Figure 4 on the following page shows the PFPH hydrazones of formaldehyde and acetaldehyde respectively. A suitable internal standard like 4-fluoro benzaldehyde would permit quantitation of these volatiles. PFPH hydrazones are sensitive and corroborative for acetaldehyde and formaldehyde.

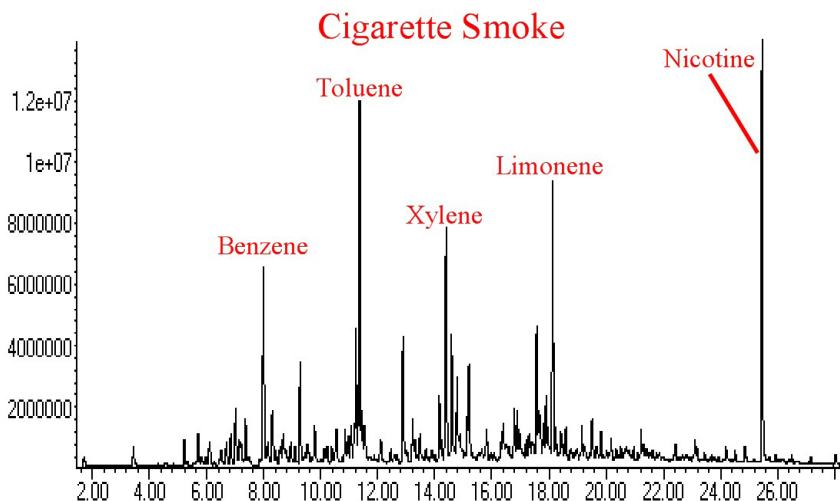


Figure 2. Straight cigarette smoke.

CDS Autosampler Dynatherm 9300

Valve Oven: 275°C
Transfer Line: 250°C
Tube Heat: 150°C 15.00 minutes
Trap Heat: 275°C 5.00 minutes

GC/MS

Column: Varian 624
Carrier: Helium, 50:1 split
Injector: 350°C
Program: 40°C for 2 min
7°C/min to 100°C
8°C/min to 250°C hold 2 min



Figure 3. PFPH being spiked on a 3-bed sorbent tube using a CDS Tube Conditioner

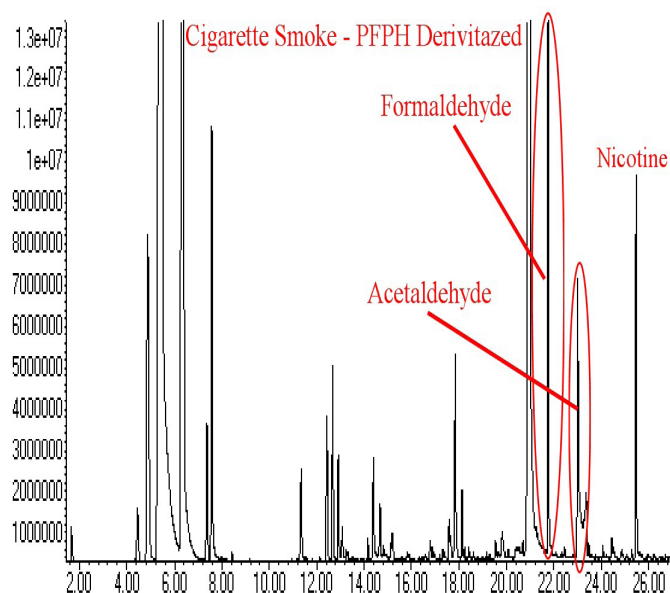


Figure 4. PFPH derivatized cigarette smoke.

FOR MORE INFORMATION CONCERNING THIS APPLICATION, WE RECOMMEND THE FOLLOWING READING:

Ho and Yu, Environ. Sci. Technol.
2004, 38, 862-870