APPLICATION NOTE

Gas Chromatography

Using Thermal Desorption–Gas Chromatography for the Detection of Fire Accelerants in Arson Residues

Introduction

When fires occur under suspicious circumstances, forensic scientists will normally examine the fire residue for the presence of flammable fluids that would indicate the deliberate creation of that fire.

Liquids like gasoline comprise a mixture of hundreds of hydrocarbon components. Gas chromatography of these complex mixtures produces highly detailed chromatograms that are characteristic of a particular sample. Although many of the volatile components will be lost during the fire, sufficient less-volatile components may have been left in partially burned wood or other materials to enable the detection and identification of the fire accelerant from its chromatographic "fingerprint".

The extraction and concentration of the residual fire accelerant components from fire residue and their introduction into a gas chromatograph may be performed in a number of ways but normally using liquid or thermal desorption. In this note, a method is described that uses thermal desorption – gas chromatographic (TD-GC) instrumentation to perform the extraction and analysis automatically.

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Sample Preparation

A piece of seasoned pinewood was cut up into pieces approximately 2 cm x 2 cm x 20 cm. Five of these were placed in a metal tray and 10 mL of fire accelerant was poured over them. The wet wood was allowed to stand for 5 minutes and was then ignited with a burning match. When the excess liquid had burned or evaporated and the wood was partially charred, the fire was quenched by placing a metal sheet over the tray to seal out the air.

The wood was allowed to cool. The charred sections of wood surface were scraped off and a sharp knife was used to shave off small thin pieces of the intact wood beneath. Fifty to sixty mg of these shavings were placed in a glass thermal desorption tube and were retained with glass wool plugs at each end as shown in Figure 1.

Two wood samples were prepared in this way using a different fire accelerant sample for each:

- 87-octane lead-free gasoline
- Kerosene

Analytical conditions

The wood sample in each tube was analyzed using TD-GC under the conditions listed in Table 1.

For reference 0.2 µL of each of the original fire accelerants was injected by syringe into a stainless steel thermal desorption tube packed with Tenax TA. Each tube was analyzed using the conditions in Table 1, except that a desorption temperature of 280 °C was applied.

Results and Discussion

Figures 2 and 3 show the chromatography obtained from the two burnt wood samples and Figures 4 and 5 show the chromatography of the original fire accelerants. Figures 6 and 7 show overlaid sections of the chromatograms to enable better comparison between the wood samples and the accelerants.

Although the early-eluting components have largely disappeared, the presence of the appropriate accelerant in each burnt wood sample is easy to detect. The background profile from the wood matrix is low because of the relatively low (120 °C) tube desorption temperatures and because the heat from the fire will have expelled most of the volatile content from the wood.

Table 1. **Conditions used for the determination of residual fire accelerants in wood.**

Chromatograph	PerkinElmer AutoSystem XL™ Gas Chromatograph
Column	30 m x 0.32 mm x 0.25 µm PE-1 (dimethylpolysiloxane)
Oven	40 °C for 1 min, then 5 °C/min to 240 °C, then 20 °C/min to 300 °C and hold for 5 min
Detector	Flame Ionization at 300 °C Air = 450 mL/min H2 = 45 mL/min Range x1 Attenuation x64
Thermal Desorber	PerkinElmer TurboMatrix™ Thermal Desorber
Trap	Tenax TA and Carbopack C in series 50:50
Carrier Gas	Helium at 7.5 psig
Tube Purge	1 min
Tube Desorb	20 mL/min at 120 °C for 10 min
Trap Low	-30 °C
Trap High	280 °C for 5 min
Inlet Split	None
Outlet Split	30 mL/min
Valve	250 °C
Transfer Line	250 °C
Data Handling System	PerkinElmer TotalChrom™

Conclusions

Although this work is by no means an exhaustive study, it does demonstrate the potential of using TD-GC in arson investigations. Good informative chromatography is produced with a minimum of effort on the part of the user.

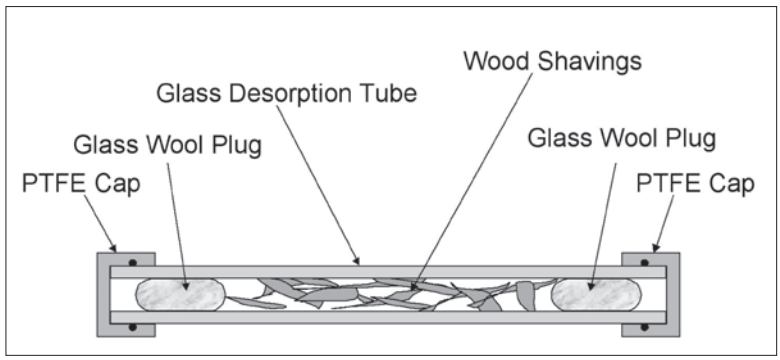

Figure 1. Glass thermal desorption tube packed with wood shavings ready for analysis.

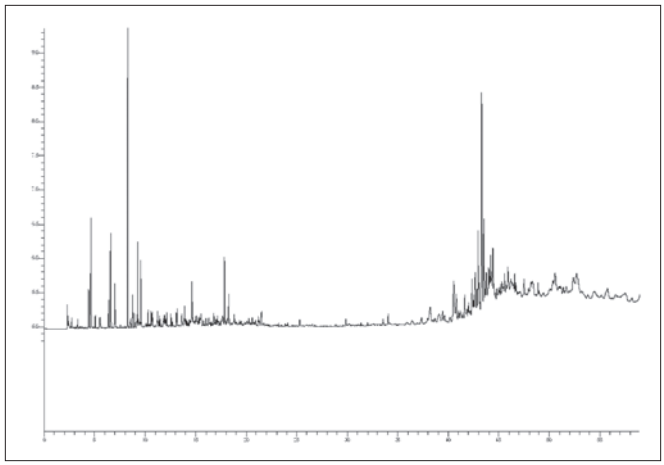

Figure 2. Chromatogram produced from wood burnt with gasoline.

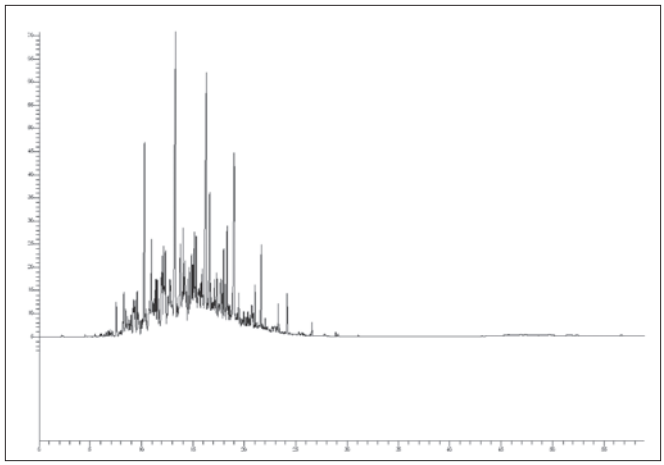

Figure 3. Chromatogram produced from wood burnt with kerosene.

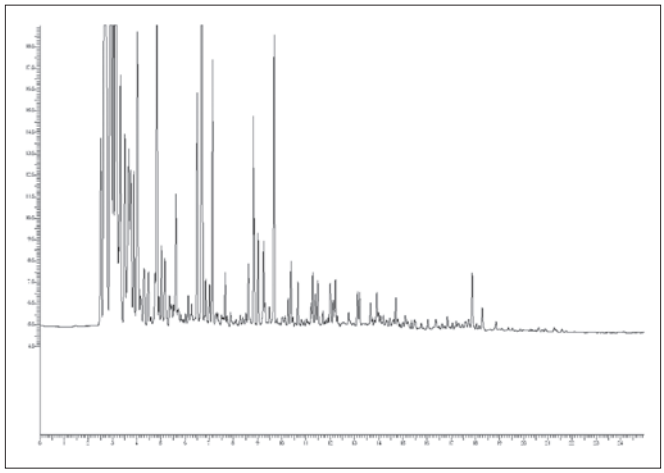

Figure 4. Chromatogram of original gasoline.

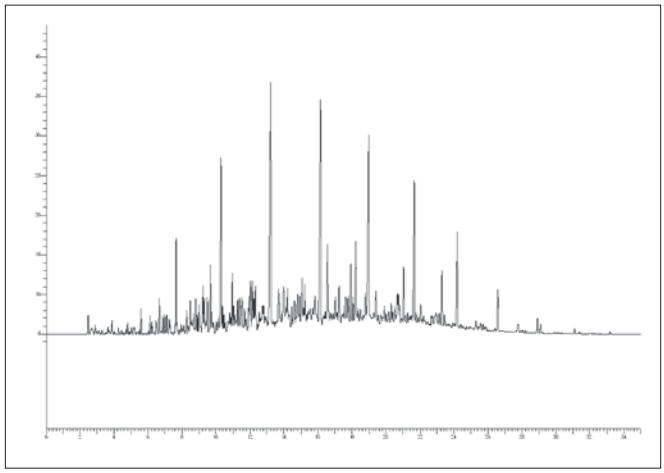

Figure 5. Chromatogram of original kerosene.

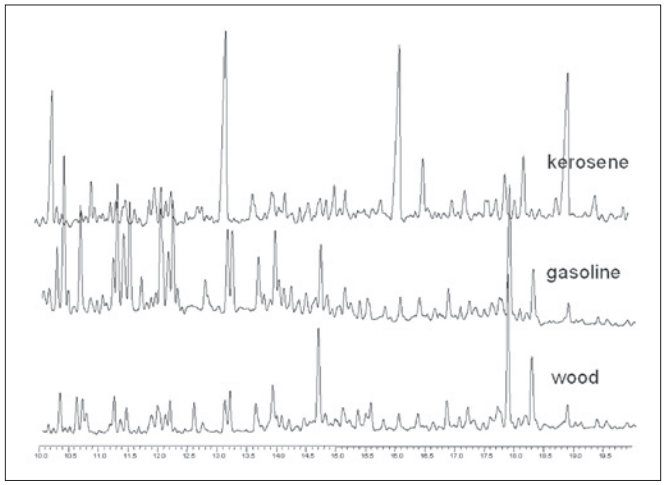

Figure 6. Comparison of section of burnt wood with the two accelerants confirming the presence of gasoline.

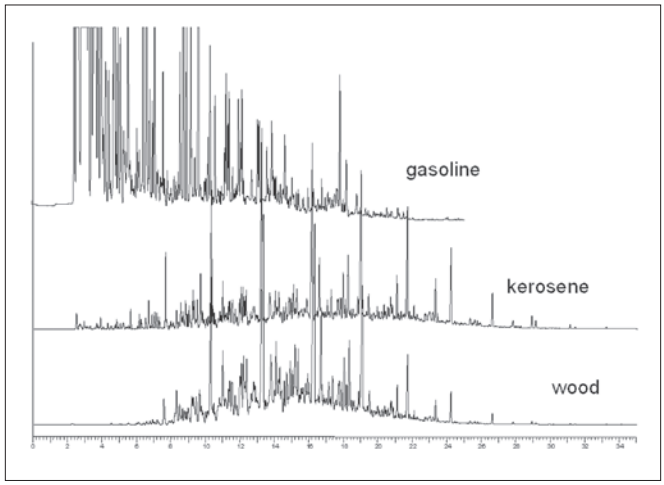

Figure 7. Comparison of section of burnt wood with the two accelerants confirming the presence of kerosene.

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