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# THE EXTRACTION AND IDENTIFICATION OF SMALL AMOUNTS OF ACCELERANTS FROM ARSON EVIDENCE

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In arson fires where accelerants have been used, it is an essential part of the investigation to recover and identify the flammable material. If the exact type of flammable material is known, the investigators can more reliably determine the source from which it was obtained, or compare it with material that can be connected with the suspected arsonist.

Since most of the accelerant is quickly consumed by the fire, the problem becomes one of recovering and identifying extremely small amounts of sample. The accelerants most often encountered are the petroleum hydrocarbons found in fuel oil, lubricating oil, kerosene, gasoline, and naphtha.

## THE SAMPLE

The samples used in this study were submitted to the Indiana State Police Laboratory by arson investigators during the last three years. In most cases, the suspected material was placed in a sealed container and transported to the laboratory as soon as possible. Several controlled experimental situations were also studied.

## EXTRACTION PROCEDURES

If a low boiling product is suspected, Procedure I for low boiling point hydrocarbons should be followed first, and followed by Procedure II if necessary. If it is known that the flammable material is a high boiling product, Procedure I may be omitted.

### PROCEDURE I

*Gasoline and Naphtha.* Gasoline and naphtha, being much more volatile than oil, cannot be satisfactorily extracted with ordinary solvents due to the equality of their evaporation rates. An aerating system was devised which uses no special apparatus or chemicals. This system is reasonably rapid and provides high recovery rates for very small amounts of gasoline or naphtha impregnated in wood, cotton, etc.

#### *The Method. Apparatus*

1. Mason fruit jar or lard can (containing evidence material)
2. Test tube 15mm. inside diameter
3. Large two hole cork stopper (to fit fruit jar)
4. Small two hole cork stopper (to fit test tube)
5. Glass tubing, inside diameter 5 mm.

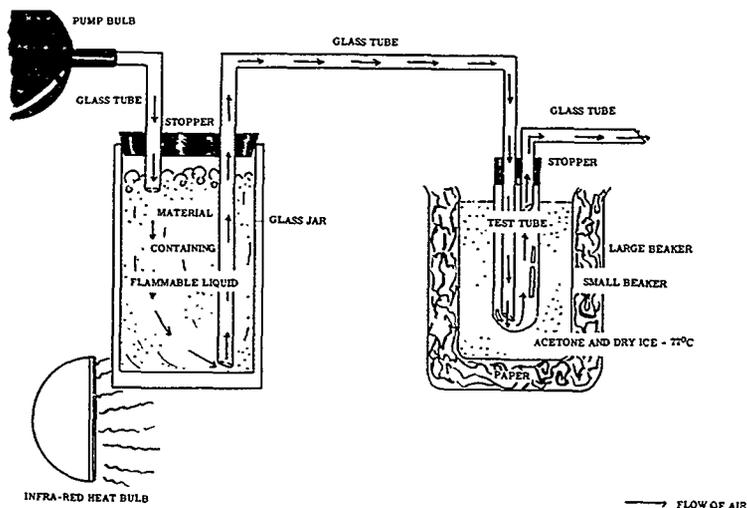


DIAGRAM OF AERATING SYSTEM

6. Atomizer bulb
7. 500 ml. and 250 ml. beakers
8. Newspapers (for insulation)
9. Reflector-flood bulb 300 W. (for heat)

*Reagents*

1. Acetone (about 100 ml.)
2. Dry ice (about 1 lb.)

*Procedure*

1. Place the small beaker inside the larger beaker and pack on all sides with crumpled newspaper. This makes an efficient thermo-container.
2. Place the cork stopper in the fruit jar, and adjust glass tubing as shown in Diagram # 1.
3. Place the cork stopper in the test tube, and insert glass tubing as shown in Diagram # 1. Put the test tube in the small beaker. Fill the beaker  $\frac{2}{3}$  full of acetone. Slowly, and with caution, add dry ice until, upon the addition of more dry ice, the solution does not boil. (Temperature of about  $-77^{\circ}\text{C}$  will then have been reached).
4. Attach the atomizer bulb and connect the two glass tubes.
5. Pump air through the system at the rate of about 20 pumpfuls (1 liter) per minute. It is desirable to dry the air before pumping through the system by passing it through calcium chloride.
6. After pumping has continued for about two to three minutes, the material in the jar may be heated with a 300 W. reflector flood bulb to facilitate the evaporation.
7. Pumping should continue until sufficient sample has been collected or until the sample no longer gives the odor of gasoline. Some of the sample may be recovered as a solid, some as a liquid.

PROCEDURE II

*Lubricating and Fuel oils.* Fuel oil and lubricating oil can be extracted from the impregnated material with carbon tetrachloride as a solvent. The solvent is then

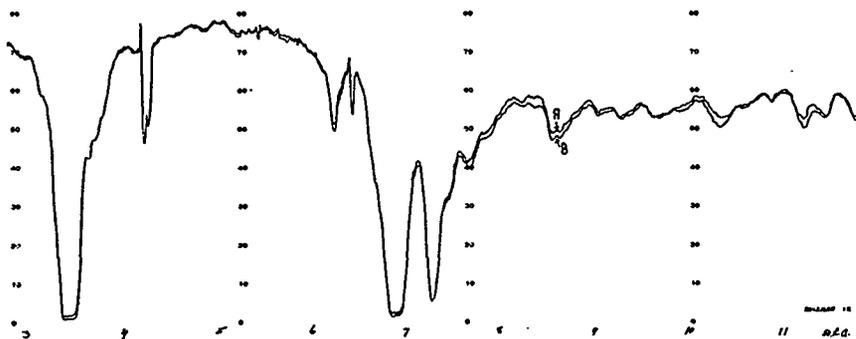


Figure 1

Infrared absorption spectra of a standard kerosene sample (A) and a sample of accelerant recovered from a cleaning mop (B). Recovery of the sample from the mop was accomplished by procedure II, and 2 ml. of the sample were obtained.

evaporated at room temperature, the oil remaining in the evaporating dish. Several washings, with as small amounts of carbon tetrachloride as practical for the size of sample, has proven most successful. In experimental situations where hydrocarbons were added to cotton, recoveries were reported of more than 75% in all cases.

#### IDENTIFICATION OF THE RECOVERED LIQUID

The amount of sample which may be recovered from an arson fire is often of the magnitude of from  $\frac{1}{3}$  ml. to 2 ml. For this reason, usual chemical identification procedures are not always practical. The heat of the fire often drives off the lighter fractions; this changes such properties as refractive index, specific gravity, and boiling range to such an extent that positive identification by ordinary procedures is not possible. Some cracking of the hydrocarbons may have taken place. Successful identifications of recovered samples of fuel oil, gasoline, and naphtha have been accomplished in over twenty cases in the last three years using an infrared spectrophotometer.<sup>1</sup> Successful identification of recovered samples of oil, gasoline, and naphtha was experienced in all experimental situations using an infrared spectrophotometer.

<sup>1</sup> Almost all materials composed of molecules of three or more atoms have an infrared spectrum. Although infrared is commonly thought of in terms of photography or heating, it is much more. The infrared is that region of the electromagnetic wave spectrum just beyond the red in the visible spectrum about 0.78 microns to about 300 microns. The range used in normal infrared spectrophotometry extends from about 2.5 to 50 microns. The technique of infrared spectroscopy takes advantage of the fact that molecules have mechanical motions, that is, they vibrate at various frequencies. The frequencies at which they vibrate depends upon the characteristics of: 1. atomic mass, 2. the type of chemical bond, 3. the geometry of the molecule.

If infrared energy of successive frequencies is shone on the sample, the light will be absorbed if its frequency is identical to one of the characteristic vibrational frequencies of the molecules in the sample. When an infrared spectrum has been "run" the end result is a spectrogram with bands or peaks which represent the points of absorbed energy. The bands or peaks are characteristic of the sample under investigation not only in position, but also their intensity is directly proportional to the material causing the absorption. It has been shown that while similar compounds will have similar spectra, it is highly unlikely that two compounds which are not identical would have identical spectra. An identification is accomplished by comparing the spectra obtained from the unknown to those of various known compounds until a comparable spectrum is found.

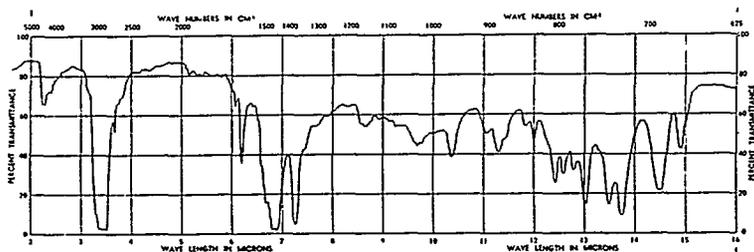


Figure 2

Infrared absorption spectrum of a sample of gasoline recovered from cotton taken from a sofa near the center of a fire. Comparison with known infrared absorption spectrum of gasoline permitted identification of the accelerant. The recovery was accomplished by procedure I, and  $\frac{1}{3}$  ml. of the sample was recovered.

In Figure 1 the spectrum of a fluid recovered from a cleaning mop is recorded. The mop was found near the scene of a fire which was suspected to be arson. The mop was subjected to Procedure I for about twenty minutes without results. The mop was then treated according to Procedure II, and two ml. of a liquid sample was recovered. The spectrum which was recorded in Figure 1 (B) was compared to the spectra of standard kerosene and gasoline. The spectrum in Figure 1 (B) closely resembles the spectrum of kerosene. A spectrum of a standard kerosene (A) was then recorded on the same sheet to show the comparison.

In Figure 2 the spectrum of a fluid recovered from cotton taken from a sofa near the center of a fire is recorded. The cotton was subjected to Procedure I and  $\frac{1}{3}$  ml. of liquid sample was recovered in 30 minutes. The spectrum was found to compare favorably to the spectrum of gasoline.

#### ACKNOWLEDGEMENT

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