

TECHNICAL NOTE

Richard E. Tontarski, Jr.,¹ M.F.S.

Evaluation of Polyethylene Containers Used to Collect Evidence for Accelerant Detection

REFERENCE: Tontarski, R. E., Jr., "Evaluation of Polyethylene Containers Used to Collect Evidence for Accelerant Detection," *Journal of Forensic Sciences*, JFSCA, Vol. 28, No. 2, April 1983, pp. 440-445.

ABSTRACT: Polyethylene containers are demonstrated to be unsuitable packaging for accelerant evidence collection. Polyethylene's permeability to hydrocarbons makes sample loss and possible contamination significant problems.

KEY WORDS: criminalistics, arson, polyethylene, accelerants, evidence packaging

Containers used to collect accelerant evidence should be as vapor tight as possible to prevent sample loss and contamination. Textbooks recommend clean metal paint cans with friction lids [1] and glass jars [2] as suitable containers. De Haan and Skalsky evaluated polyester/polyolefin [3] and nylon [4] bags for arson evidence packaging. This author was asked to evaluate the polyethylene containers (Fig. 1) that have been used for several years by some agencies to package arson evidence. Investigators have demonstrated polyethylene's permeability to dynamite vapors [5]. Arson analysts are aware of polyethylene's permeability to hydrocarbons [6, 7], but no evaluation of polyethylene evidence containers has been made. Three tests were conducted to compare the performance of these polyethylene containers to that of a metal paint can.

Experimental Procedure

The first two experiments were structured to demonstrate the amount of evaporation that might normally be encountered between the time a debris sample is collected and the time it is examined in the laboratory. In the first experiment 25 mL of gasoline was placed in both the plastic container and a 0.96-L (1-qt) paint can and the lids were sealed. In the second experiment, 30 μ L of gasoline was placed in both a 3.79-L (1-gal) paint can and a plastic container. The containers were set aside for 15 days.

The volume of liquid remaining in the first set of containers was then measured by pouring it into a graduated cylinder. A comparison of chromatograms using a heated-headspace (HHS) technique was made on the second set of containers to measure the relative amounts

Received for publication 13 July 1982; accepted for publication 3 Sept. 1982.

¹Forensic chemist, U.S. Treasury Department, Bureau of Alcohol, Tobacco and Firearms, National Laboratory Center, Rockville, MD.



FIG. 1—The containers are 19.05 mm (7/2 in.) tall, 146.05 mm (5¾ in.) wide at the mouth, and 120.65 (4¾ in.) wide at the base. They have a snap top lid. The top is low density polyethylene and approximately 0.81 mm (32 mil) thick. The body of the container is high density polyethylene and approximately 1.27 mm (50 mil) thick. They are from Reb Plastics, Inc., Avon Lake, OH.

of gasoline remaining. The HHS analysis of the plastic container was performed after heating the container for 30 min in an oven set at 70°C. The optimum temperature for HHS is 100°C [9] but heating the plastic containers above approximately 70°C resulted in splitting the top of the container (Fig. 2). The 3.79-L (1-gal) can was heated to 100°C for 30 min.

The third experiment was designed to simulate the type of contamination problems evidence containers may encounter (for example, riding in the trunk of a car or cross-contamination of samples). One plastic container and an open beaker of gasoline were placed side by side in an empty letter-size file drawer for 15 days. The body of the container was then examined using the charcoal sorption/carbon disulfide (CS₂) technique [8,9]. The polyethylene container was placed in a can jacketed by a heating mantle. The material was heated to 100°C while air was drawn through the can. This air was passed through a 50-200 mesh activated coconut charcoal trap to concentrate the accelerant vapors. This trap was then rinsed with approximately 0.5 mL of CS₂ to produce a liquid sample for chromatographic analysis.

All of the chromatograms were obtained on a Perkin-Elmer Sigma 1 gas chromatograph with a 3.175-mm by 6.1-m (1/8-in. by 20-ft) stainless steel, 3% SP-2100, 80-100 mesh Supelcoport column. For each run, the column was held at 50°C for 6 min, then ramped to 280°C at 12°/min with a final hold of 6 min.

Results and Discussion

Only 7 mL of gasoline was recovered from the polyethylene container after 15 days. From the metal paint can 24½ mL were recovered. A yellowish stain was noted from the bottom of the plastic container up to the original fill height of the gasoline. This can be attributed to the gasoline being absorbed by the polyethylene.

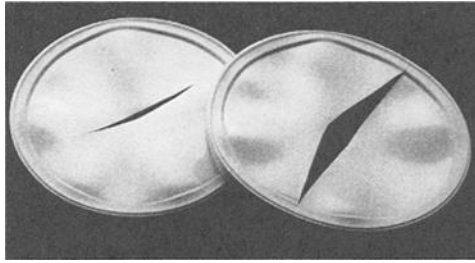


FIG. 2—The lids split upon heating above 70°C.

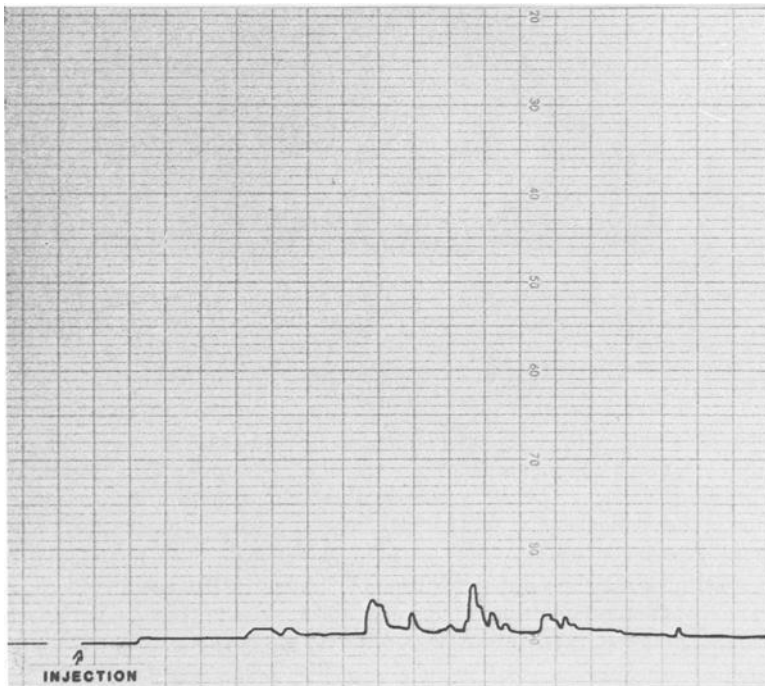


FIG. 3—Thirty microlitres of gasoline stored in polyethylene container for 15 days. The sample was heated for 30 min at 70°C. A heated-headspace sample of 3 mL was injected at a range of 10 and attenuation of 4.

A comparison of gasoline remaining in the plastic container versus the paint can can be seen in Figs. 3 and 4. Both are chromatograms of 3 mL of heated vapor run at the same sensitivity. Note that the gasoline remaining in the plastic container is only a small fraction of that remaining in the can.

After 15-days storage, the plastic container in the file drawer was unstained and odor free. Figure 5 is a chromatogram run on the vapor extracted from the walls of the container. It has almost all the chromatographic characteristics of a liquid sample of gasoline (Fig. 6) except for the more volatile components. Since upon heating polyethylene breaks down, this decomposition could also interfere with chromatogram interpretation. This interference can be seen in Fig. 5.

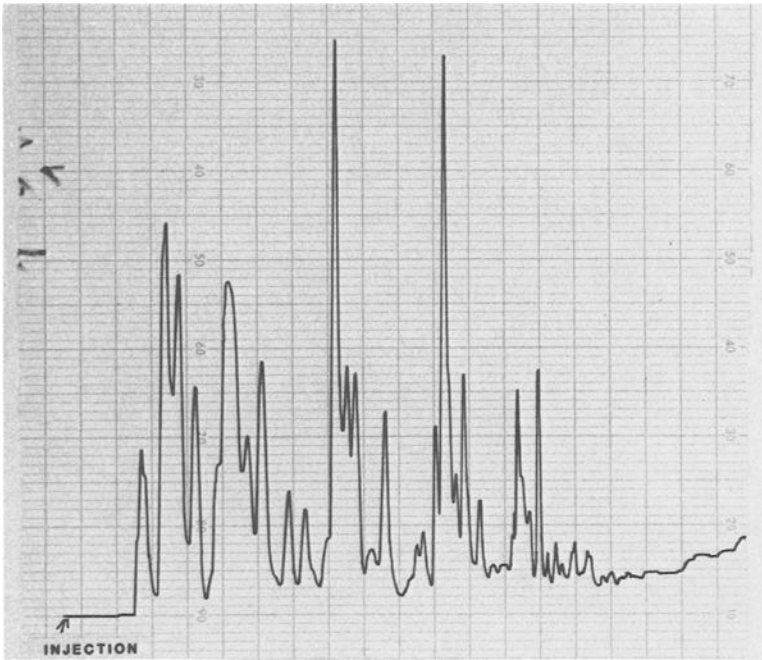


FIG. 4—Thirty microlitres of gasoline stored in a 3.79-L (1-gal) can for 15 days. The sample was heated for 30 min at 100°C. A heated-headspace sample of 3 mL was injected at a range of 10 and attenuation of 4.

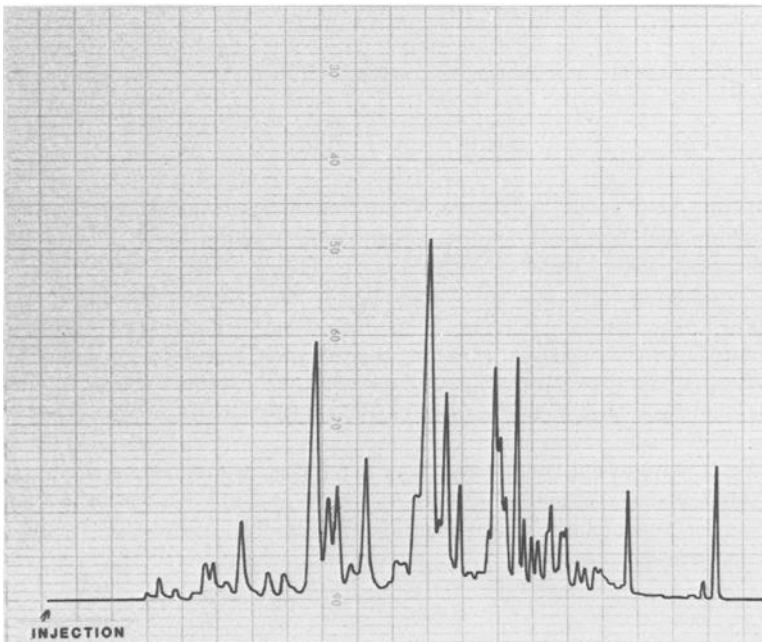


FIG. 5—This illustrates the contamination that can occur with polyethylene containers. The charcoal sorption/carbon disulfide elution technique recovered gasoline from an "empty" container. Five microlitres of the CS₂ rinse were injected at a range of 1000 and attenuation of 16. The two large peaks at the right of the chromatogram are decomposition from the polyethylene.

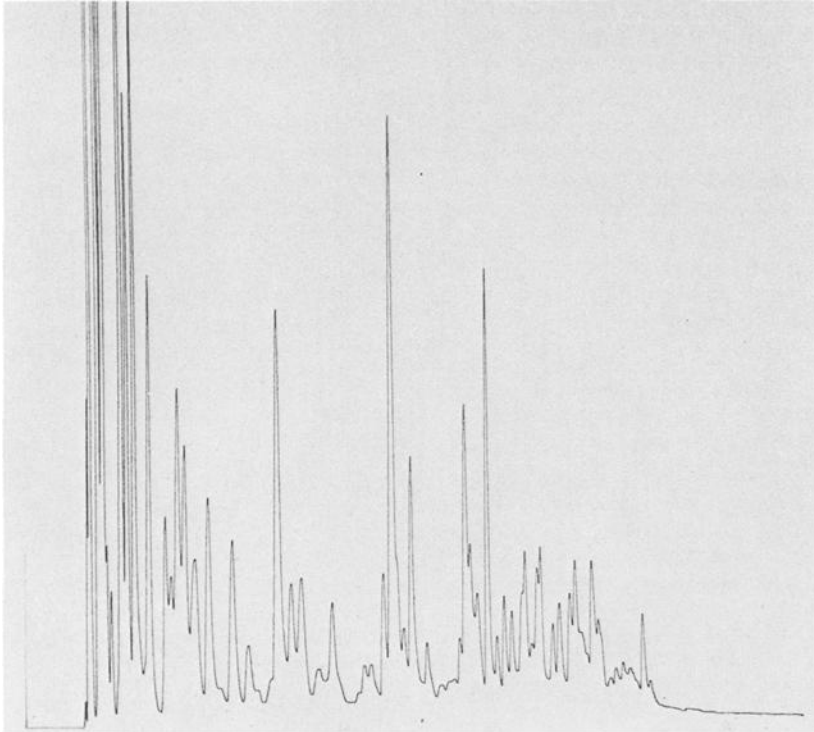


FIG. 6—Chromatogram of fresh liquid gasoline. One microlitre was injected at a range of 1000 and attenuation of 16.

These three tests demonstrate some of the serious shortcomings of a polyethylene container. More than two thirds of the liquid sample was lost in 15 days because of the permeability of polyethylene to hydrocarbons. The problem of sample loss was also demonstrated in the HHS analysis. The plastic container also precluded heating the debris to its optimum analysis temperature. The most significant limitation of using polyethylene as an arson evidence container, in the author's opinion, was demonstrated in the third experiment. A large quantity of accelerant was absorbed by the polyethylene without direct contact with the liquid gasoline. In normal storage and transportation, such contamination could occur and there is no way to detect it. Casework has shown that accelerants trapped within the plastic of polyethylene containers, such as milk jugs, will remain for weeks and possibly longer. Atmospheric contamination is not the only problem. Cross-contamination from one sample with a large quantity of accelerant to a sample with no accelerant could also occur with the polyethylene container.

Conclusion

Polyethylene containers should be avoided as evidence collection containers in arson cases. Significant accelerant loss and the possibility of sample contamination cannot be avoided with polyethylene containers.

References

- [1] Midkiff, C. R., "Arson and Explosive Investigation," in *Forensic Science Handbook*, R. Saferstein, Ed., Prentice-Hall, Inc., Englewood Cliffs, NJ, 1982, pp. 223-266.
- [2] Krishnan, S. S., *An Introduction to Modern Criminal Investigation*, Charles C Thomas, Springfield, IL, 1978.
- [3] De Haan, J. D. and Skalsky, F. A., "Evaluation of Kapak Plastic Pouches," *Arson Analysis Newsletter*, Vol. 5, No. 1, Jan. 1981, pp. 6-11.
- [4] De Haan, J. D., "Arson Evidence Packaging," *Arson Analysis Newsletter*, Vol. 2, No. 3, June 1978, pp. 9-13.
- [5] Washington, W. D. and Midkiff, C. R., "Systematic Approach to the Detection of Explosive Residues. II. Trace Vapor Analysis," *Journal of Official Analytical Chemists*, Vol. 56, No. 5, Sept. 1973, pp. 1239-1245.
- [6] Simril, V. L. and Hershberger, A. in *Modern Plastics*, Vol. 27, No. 10, 1950, p. 97.
- [7] Golding, B., *Polymers and Resins, Their Chemistry and Engineering*, Van Nostrand Reinhold Co., New York, 1959, pp. 379-380.
- [8] Chrostowski, J. E. and Holmes, R. N., "Collection and Determination of Accelerant Vapors from Arson Debris," *Arson Analysis Newsletter*, Vol. 3, No. 5, Dec. 1979, pp. 1-17.
- [9] Wineman, P. L., Strobel, R. A., Tontarski, R. E., and Stewart, L. F., "Detection of Volatile Accelerants in Fire Debris. I. A Comparative Evaluation," Abstract No. 9 of the 32nd Annual Meeting of the American Academy of Forensic Sciences, New Orleans, 1980.

Address requests for reprints or additional information to
Richard E. Tontarski
U.S. Treasury Department
Bureau of Alcohol, Tobacco and Firearms
National Laboratory Center
Rockville, MD 20850