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Arson Evidence Container Evaluation: II. "New Generation" Kapak Bags

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ABSTRACT: Packaging for arson evidence must be convenient to transport to and from the scene, available in a range of sizes, water resistant, easy to seal, and effective at providing containment of accelerant vapors. Traditional containers have several limitations for use in the field and the laboratory. A polyester-polyolefin composite film bag was an attractive candidate but had been largely abandoned because of a contamination problem. Similar bags made with film from a modified process designed to eliminate the contaminant were studied to assess their suitability as containers for routine use by arson investigators. This study showed the "new generation" bags to be free of the prior contaminant and sufficiently retentive for packaging and storage of arson evidence.

KEYWORDS: criminalistics, arson, physical evidence, packaging, containers, flammable liquid, hydrocarbon contamination, collection

At the scene of a suspicious fire, when physical evidence is collected for laboratory examination, the containers used must meet several requirements. They must be initially clean and free of materials resembling those to be analyzed or materials that will increase the instrumental backgrounds. Containers must be easily sealed to maintain the chain of custody and sufficiently retentive to permit transportation of the evidence to the laboratory and conduct of the laboratory examination. Retentiveness is also essential to lessen potential sample-to-sample cross-contamination by the volatile hydrocarbons typical of flammable liquids used as accelerants. Water resistance and longer-term retention of residual accelerant materials are desirable to meet legal requirements that a portion of the evidence be available for later examination by the opposing party. Essential to retention is resistance to puncture or cutting by sharp edges on the evidentiary material. Because the physical evidence at a fire scene varies widely in material type and size, containers must be available in a range of sizes. From the perspective of the investigator, it is desirable that empty containers be compact, so that a number of them can be routinely carried as part of the investigative equipment package. Traditionally, jars and cans have been used for packaging of arson evidence. While providing good retention of vapors and freedom from cross-contamination, both of these have limitations for use in the field and for convenience of analysis in the laboratory.

Glass jars with screw-on or Mason-type lids have long been recommended and used as arson evidence containers but suffer from limitations of fragility and their inability to

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accommodate oversize samples. One advantage of glass jars is their visibility, which allows a preliminary examination of the evidence without opening the container. Metal containers such as new paint cans are retentive, rugged, and easily sealed at the scene without the need of special equipment. Cans and screw-cap jars are convenient for removal of the analytical samples and are unaffected by moderate heating when heated headspace or absorption/elution techniques are used. Significant disadvantages of both jars and cans are their bulk, which may limit the number available to the investigator at the scene and their rigidity, which makes them unable to handle awkward sample shapes or sizes. Cans do not permit preliminary visual examination of the evidence and, with the wet materials typical of arson samples, tend to rust on long-term storage.

A sample container with a number of potential advantages for arson evidence collection is a suitable plastic bag. These are unaffected by water, flexible, available in a range of materials, sizes, and shapes and occupy little space in the investigator's evidence collection package. In the laboratory, these bags need not be opened for removal of the analytical sample. They are easily punctured for static or dynamic headspace sampling and simply resealed after sample removal. Polyethylene film of the type used for sandwich or garbage bags is essentially worthless, being neither rugged nor effective in retaining volatile liquids. Bags made from films such as Mylar [*1*] and Tedlar [*2*] have been used for field collection of hydrocarbons but have not been widely accepted for evidence packaging. Nylon bags have been used for packaging of arson evidence but have proven difficult to seal in the field. Kapak,[2] a polyester-polyolefin composite bag, widely used as a container for a variety of types of evidence, is sealable with an ordinary heat sealer, useful in ensuring the chain of custody, and reasonably rugged. It is transparent and has limited permeability to hydrocarbons of the type commonly encountered as accelerants. In one study, samples in Kapak bags were stored for several months before significant diffusion from the bag was observed [*3*]. Because the bag is suitable for heated headspace sampling, direct heating of the bag in a microwave oven was proposed to expedite sample processing. A more recent work encountered problems with microwave heating of arson evidence in plastic bags and suggested that other approaches be used [*4*]. In that study, although several limitations to using Kapak bags as evidence containers were noted, the bags were found to be competitive with jars and cans for use with arson evidence. Because of the availability and convenience of bags for use in the field, in the late 1970s, a number of agencies adopted Kapak bags for routine packaging of evidence from fire and arson investigations.

As early as 1984, questions were raised concerning potential contamination problems with Kapak bags. Film from two bags, cut up and sealed in a can, was heated at 100°C for several hours. Absorption/elution was used to collect a vapor sample, and significant gas chromatography peaks were observed in the paint thinner/diesel fuel range [*5*]. In early 1988, several investigators reported observation of traces of a medium distillate in Kapak bags produced after 1985. After using absorption/elution analysis with a charcoal wire or a carbon disulfide (CS_2) rinse of a bag after heating [*6*] and both heated headspace and absorption/elution tests [*7,8*], a material resembling a Wizard or Gulf-Lite charcoal starter was observed. The problem was traced to the producer of the film used in the bag, the 3M Company, which had made changes in the production process since the initial manufacture and distribution of the bags. Although present only at low levels, any potential contaminant in evidence containers is unacceptable. As a result, many laboratories advised against the use of the bags for arson evidence.

In mid-1989, the authors were advised by the vendor of the Kapak bag that the production process for the film had been modified to eliminate the medium-range distillate contamination. Our laboratory had previously evaluated several types of containers for

[2]Kapak is a registered trademark of Kapak Corporation.

arson evidence and, because of the flexibility and convenience offered by plastic bags, we undertook an evaluation of this "new generation" of Kapak bags. To evaluate the bags, two objectives were identified: (1) verification that the medium-range distillate contaminant was no longer present in the new bags and (2) demonstration of hydrocarbon containment suitable for accelerant retention. If accelerants are effectively retained, there will be no bag-to-bag cross-contamination prior to analysis.

Experimental Procedure

Twelve new-generation bags—six 14 by 19 in. (35.6 by 48.3 cm) with 100-gage film thickness, and six 8 by 12 in. (20.3 by 30.5 cm) with 300-gage film thickness—were selected at random from approximately 25 provided by the manufacturer for this study.

Two approaches, solvent extraction and adsorption/elution, were used to examine the bags for contamination. To detect potential contamination, inside or outside, the bags were placed in beakers, covered with 100 mL of CS_2 and agitated for 15 min. The solvent was decanted and permitted to evaporate at room temperature to a volume of about 1 mL. Analyses were conducted using a Perkin-Elmer Sigma 1B gas chromatograph equipped with a 15-m fused silica capillary column (J & W Scientific DB1-15N) and flame ionization detectors. The data were captured on a Nelson Analytical 900 series interface and uploaded to a Wyse AT compatible for processing using Nelson 2600 chromatography software, Version 5.0. Adsorption/elution testing of the bags was conducted by placing three bags in clean 1-gal (3.8-L) paint cans. The cans were heated to 90°C and held at this temperature for 1 h. Emitted vapors were collected using the purge and trap charcoal tube technique [9] regularly used in our laboratory. Absorbed material was eluted from the charcoal tube with CS_2 and examined using the gas chromatography system previously described.

Containment effectiveness of the new-generation bags was tested using products of varying volatility. A 3-mL sample of either Zippo brand lighter fluid, gasoline, or kerosene was placed into a bag. Three test samples of each accelerant type were prepared for a total of nine bags. These bags had been previously examined and found to be clean.

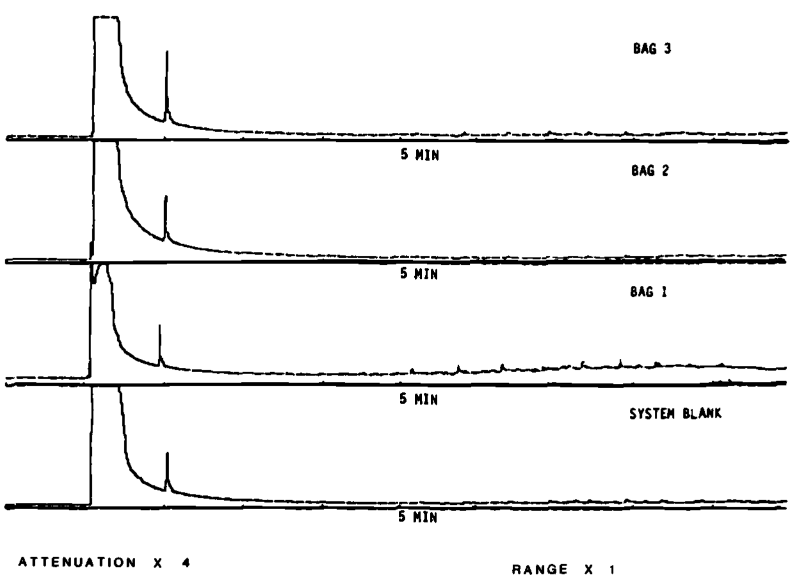

FIG. 1—*Solvent extraction (empty bags).*

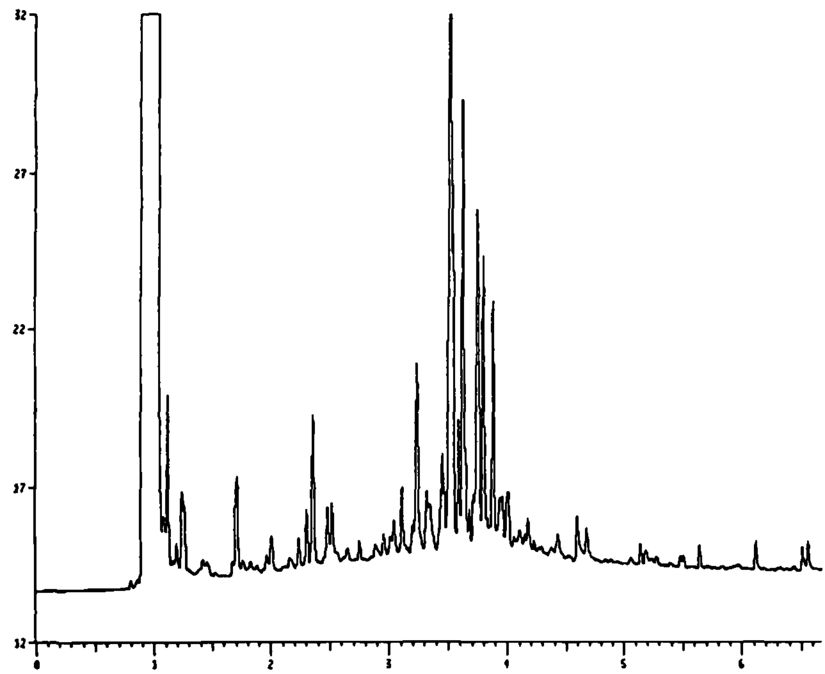

FIG. 2—*Potts's K-Pak contaminated bag data No. 2.*

Each bag was heat sealed and put into a clean 1-gal (3.8-L) paint can, and the can was sealed with its own lid. The cans were maintained at room temperature for periods of 10, 40, and 60 days. Vapor samples were obtained by heating the cans and collecting the vapor, using the purge and trap technique.

Results and Discussion

Chromatograms from the solvent wash of the empty bags are shown in Fig. 1. For comparison, Fig. 2 is a chromatogram obtained by Potts using a solvent wash of the pre-1986 bags [*6*]. Figure 3 is a known charcoal lighter (Gulf-Lite) examined in our laboratory. Resulting chromatograms from the absorption/elution tests on the empty bags are shown in Fig. 4. Prior published results using a charcoal wire absorption technique on the older bags [*6*] are shown in Fig. 5 for comparison. Figures 6, 7, and 8 show the chromatograms from three different types of samples maintained in cans for 10, 40, and 60 days, respectively.

As can be seen in the chromatograms of the solvent wash and adsorption/elution tests, no significant levels of hydrocarbons were present in the new-generation bags. The modifications made to the film production process appear to have been effective in removing the medium-range distillate contamination.

The new bags also have excellent containment qualities for the materials tested, as is evident from the minimal accelerant vapor detected in the headspace from within the can and outside the bag even after storage for 60 days. It appears that, if intact and well sealed, Kapak bags will hold traces of accelerant for a sufficient time to permit laboratory analysis of arson evidence. Although our results suggest that the newer bags are free of contaminants, it is our recommendation that, prior to their use as evidence containers,

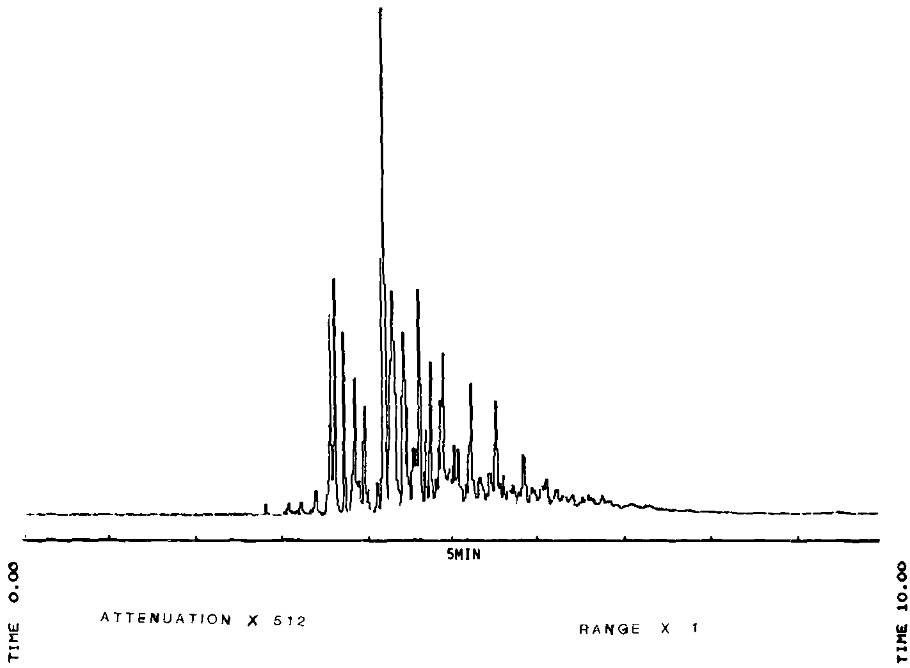

FIG. 3—*Gulf-Lite charcoal starter standard.*

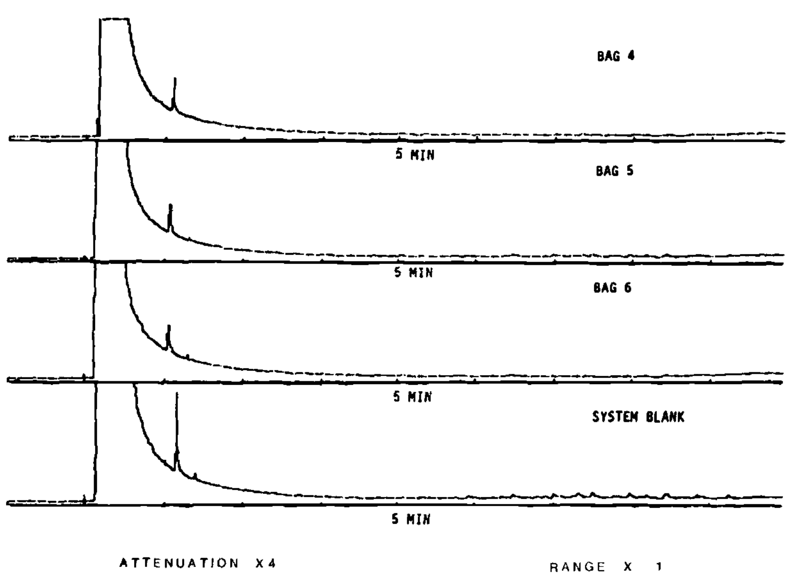

FIG. 4—*Heated headspace with charcoal tube (absorption/elution) analysis of empty bags.*

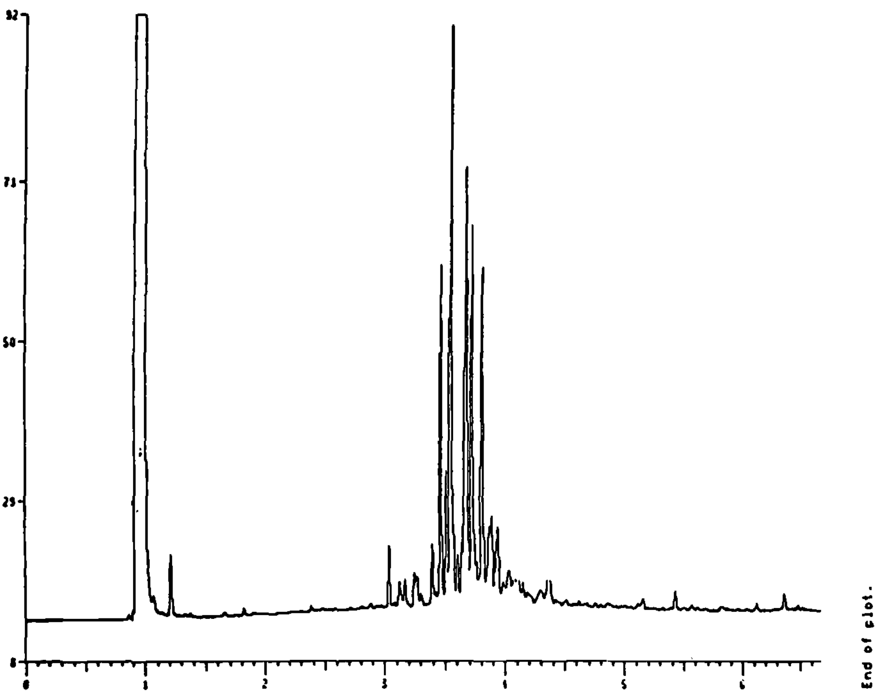

FIG. 5—*Potts's K-Pak contaminated bag data No. 19.*

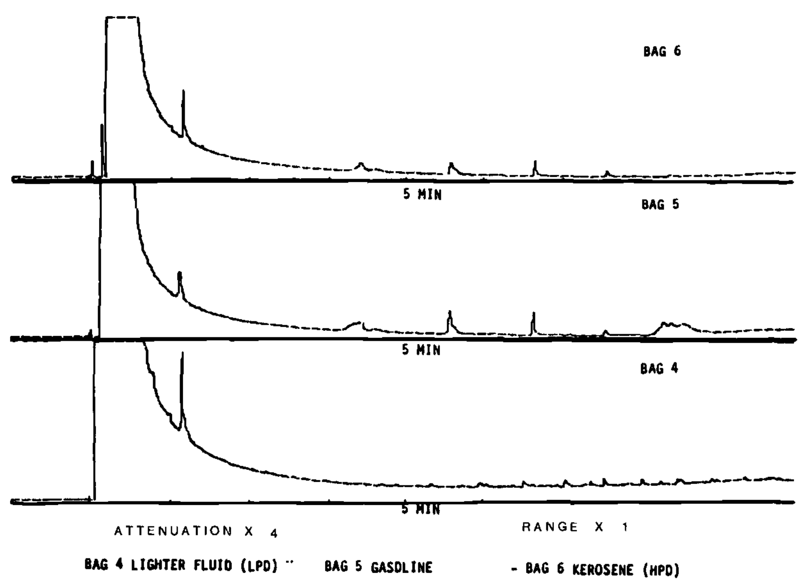

FIG. 6—*Cold headspace with charcoal tube (absorption/elution) accelerant containment results after 10 days.*

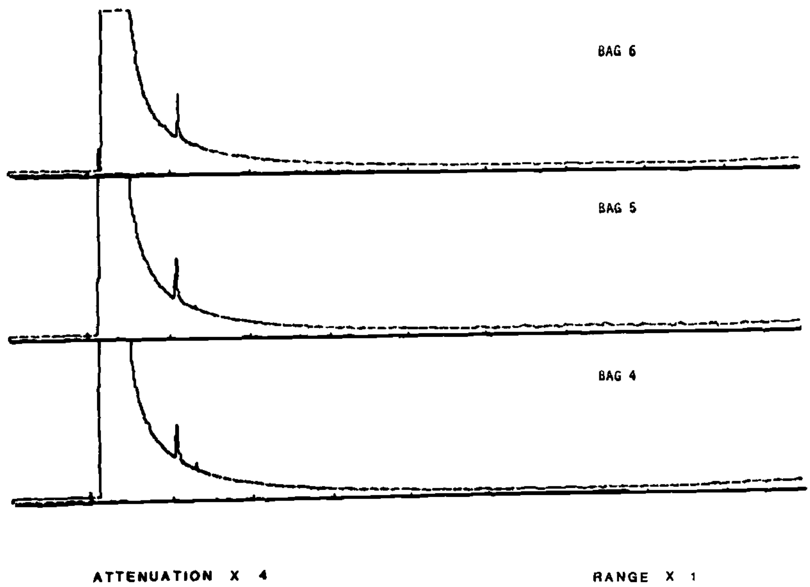

FIG. 7—*Heated headspace with charcoal tube (absorption/elution) accelerant containment results after 40 days.*

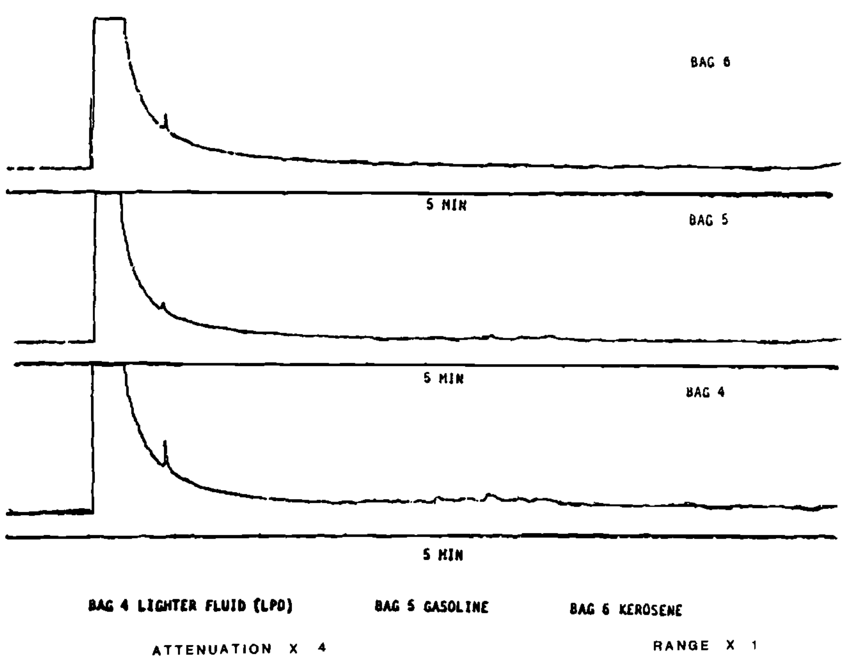

FIG. 8—*Heated headspace with charcoal tube (absorption/elution) accelerant containment results after 60 days.*

a representative sample of the bags be tested in the laboratory. Only after verification of the cleanliness of the bags should they be released to field investigators for arson evidence collection.

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