

TECHNICAL NOTE

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Persistence of Floor Coating Solvents

REFERENCE: Lentini JJ. Persistence of floor coating solvents. *J Forensic Sci* 2001;46(6):1470–1473.

ABSTRACT: Using passive headspace concentration as described in ASTM E 1412 and gas chromatographic/mass spectrometric (GC/MS) analysis as described in ASTM E 1618, the author has studied the persistence of solvents in floor coating materials. Both oak and pine flooring boards were tested using stain, stain with polyurethane varnish, and oil finish after a period of ten months and 24 months. The solvents from all three floor-coating substances were easily detectable after 24 months, and showed no signs of diminution when compared with the samples tested earlier. These results point out the need for the submission of comparison samples whenever wood flooring samples are submitted for fire debris analysis in suspected arson cases.

KEYWORDS: forensic science, criminalistics, fire debris, gas chromatographic analysis, mass spectrometry, petroleum solvents, flooring, comparison samples

Flooring samples are among the most common submitted to forensic laboratories in cases of suspected arson. When the top surface of the flooring is coated wood, the possibility that the substance used to coat the wood left behind detectable quantities of petroleum solvents is one that the analyst cannot lightly dismiss.

After a recent case was resolved in which solvents from floor coatings were believed to have persisted for over 20 years, the author undertook a controlled experiment to test the persistence of solvents in samples whose history was well known. A previous study (1) reveals that floor coatings were among the many types of building materials and common substrate materials that might contain petroleum products. In that study, Lentini, Dolan, and Cherry reported that unsealed stained solvents could be easily detected six months after application.

This paper describes the continuation of that part of the background substrate study. The solvents are still easily detectable after 24 months, and there is no reason to believe that these solvents are not detectable indefinitely.

For this reason, a finding of medium petroleum distillate (MPD) on any sample of finished wood flooring must be interpreted with great caution, particularly in the absence of a negative comparison sample.

Materials and Methods

Sample Preparation

Samples of 2 by 9 cm pine and 2 by 6 cm oak flooring boards were obtained from a local building supply store and finished. A 1 m length of each species was coated with Minwax[®] stain. A 1 m length of each species was coated with Minwax[®] stain and then sealed with Minwax[®] polyurethane sealer, and a 1 m length of each species was coated with two coats of Carver Tripp[®] oil finish. All of the prepared samples were dry by Dec. 6, 1998. The samples were kept in the laboratory office area at room temperature (21°C ± 5°C) during the aging period. On October 6, 1999 and again on November 29, 2000, samples measuring approximately 150 cm² were cut from each of the six test boards, and placed in clean, one quart polyester-lined paint cans, which had been previously baked at 90°C for 16 h. One-third (approximately 7 × 10 mm) of a Pro-Tek strip (Albrayco Laboratories, Inc., Cromwell, CT) was suspended in each can, and the temperature was raised to 80°C for a period of 16 h. The strips were then removed and placed in autosampler vials and extracted with 0.5 mL of diethyl ether, which had been spiked to a level of 100 ppm with tetrachloroethylene. The ether solutions were then analyzed by GC/MS.

GC/MS Operating Parameters

All samples were run on a Hewlett-Packard (HP) 5890 Series II gas chromatograph connected to an HP Model 5971A mass selective detector. Data analysis was accomplished using HP ChemStation software. The column was a 25 m HP 1, 0.2 mm I.D., 0.5 micron film thickness, operated at an initial temperature of 60°C for 6 min, ramped at 20°C per minute to 280°C, and held at 280°C for 4 min. One microliter samples were injected splitless, using an HP Model 7671 Automatic Liquid Sampling System. Ions were scanned from 33 to 300 AMU.

Results

Figure 1 shows the total ion chromatogram of two samples of stained, unvarnished oak at 10 months and 24 months. The medium petroleum distillate solvent from the Minwax[®] stain is clearly visible and is present at concentrations that might be misinterpreted as sufficiently high to the result of the application of a foreign ignitable liquid.

The results of the testing of the pine board that was both stained and sealed are shown in Fig. 2. The pinenes and limonene are clearly visible at concentrations slightly higher than the mineral spirits solvent from the coating materials, and an initial review of

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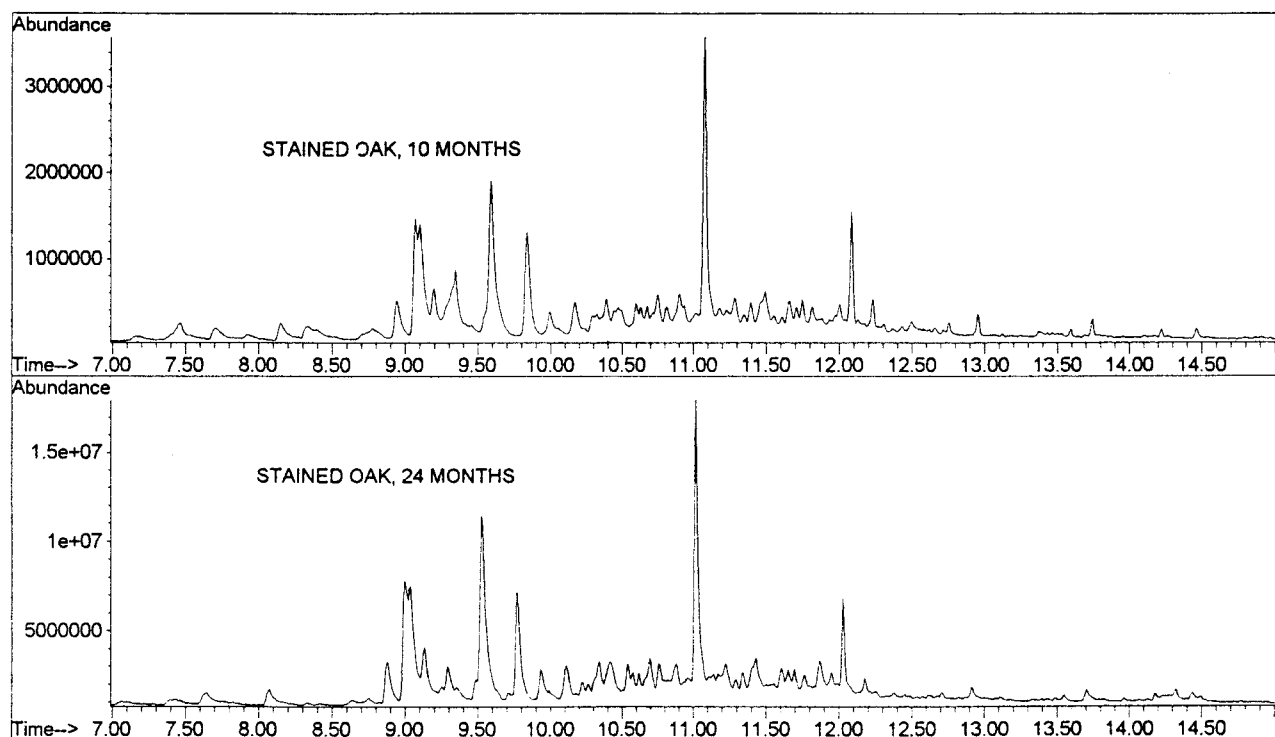


FIG. 1—Total ion chromatogram of volatile components from a stained, unvarnished oak board 10 months and 24 months after the stain was applied.

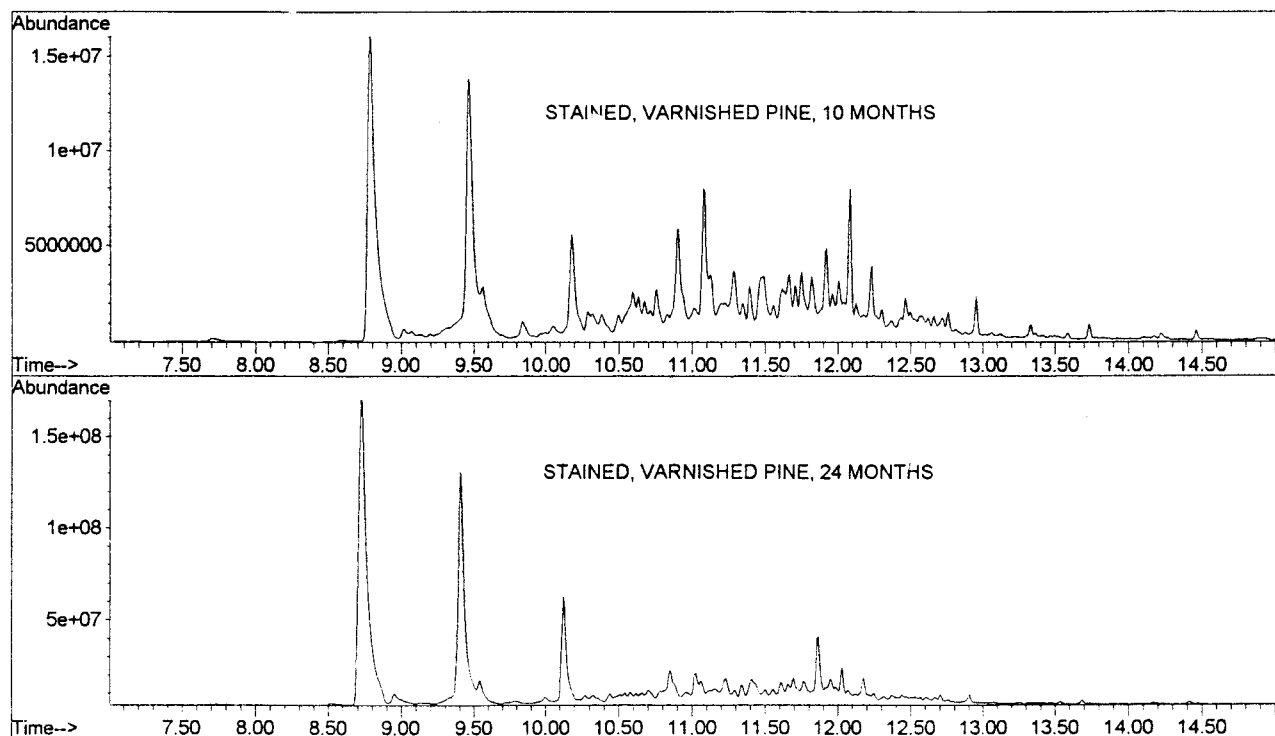


FIG. 2—Total ion chromatogram of volatile components from a stained, varnished pine board 10 months and 24 months after the stain was applied.

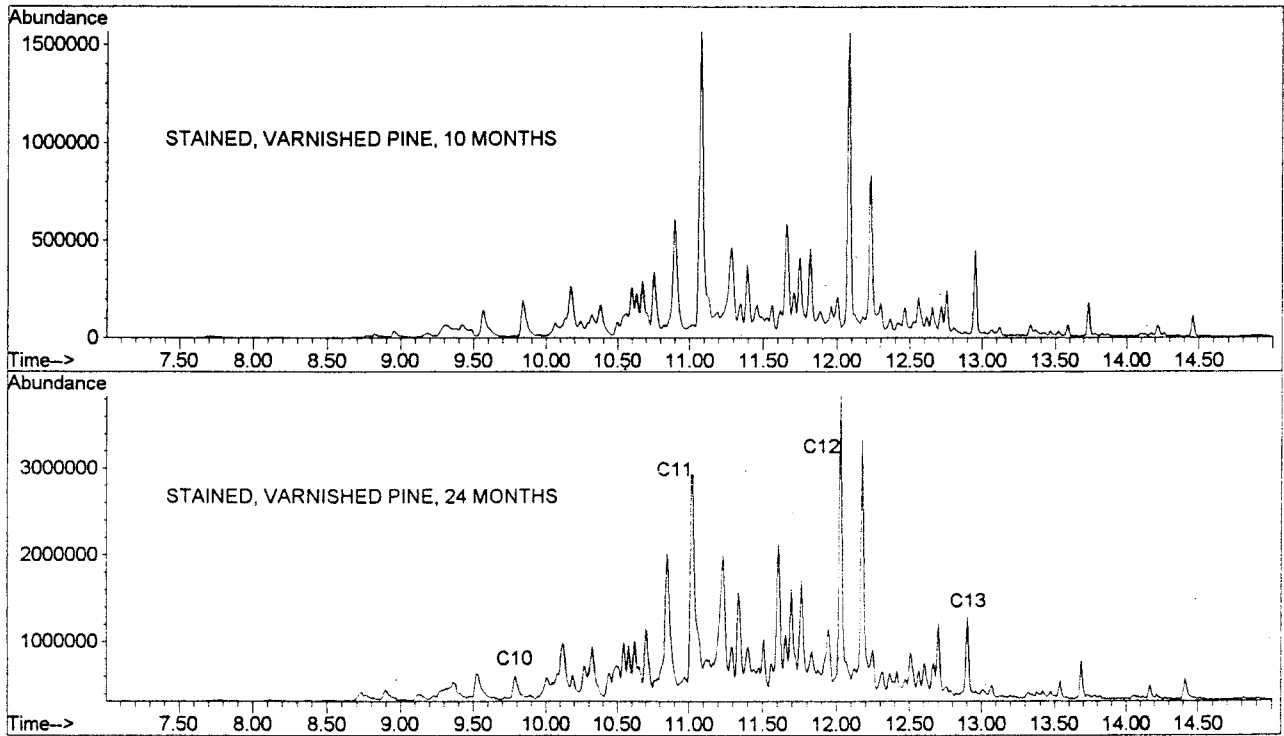


FIG. 3—Ion 57 profile of stained, varnished pine board shown in Fig. 2.

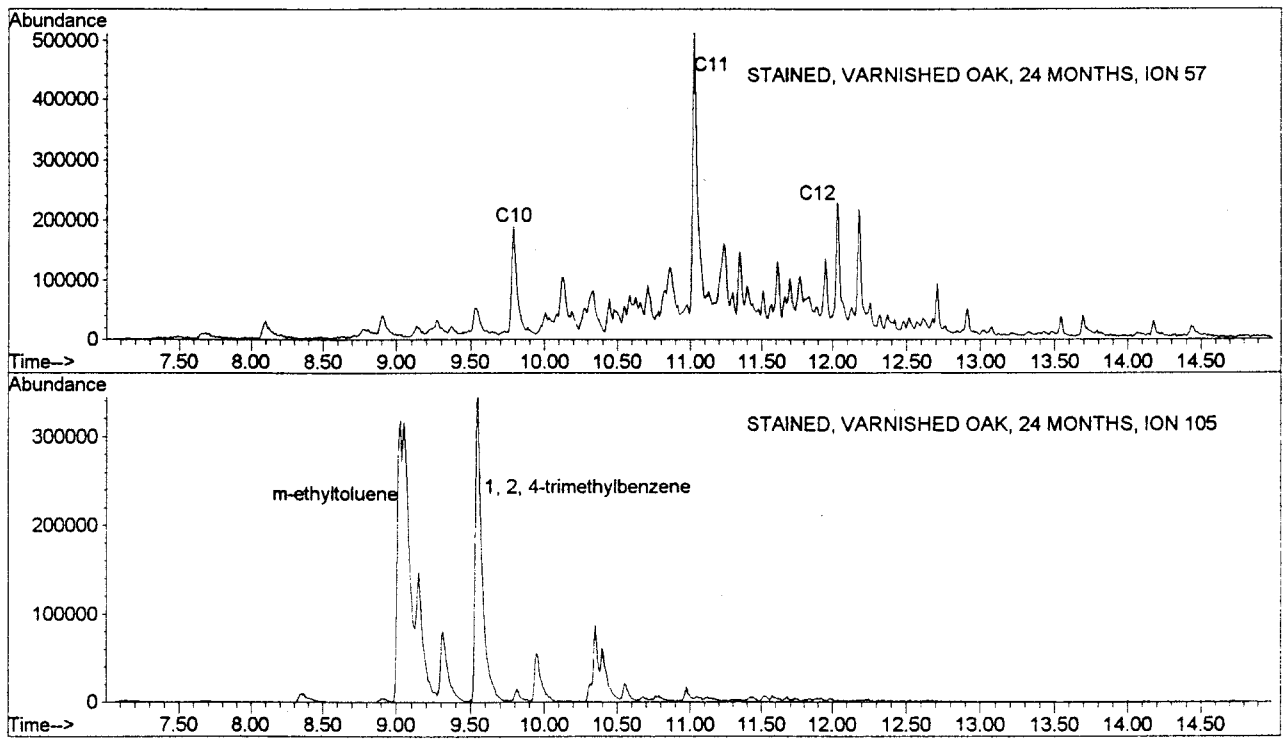


FIG. 4—Ion 57 and ion 105 profiles of stained varnished oak board after 24 months.

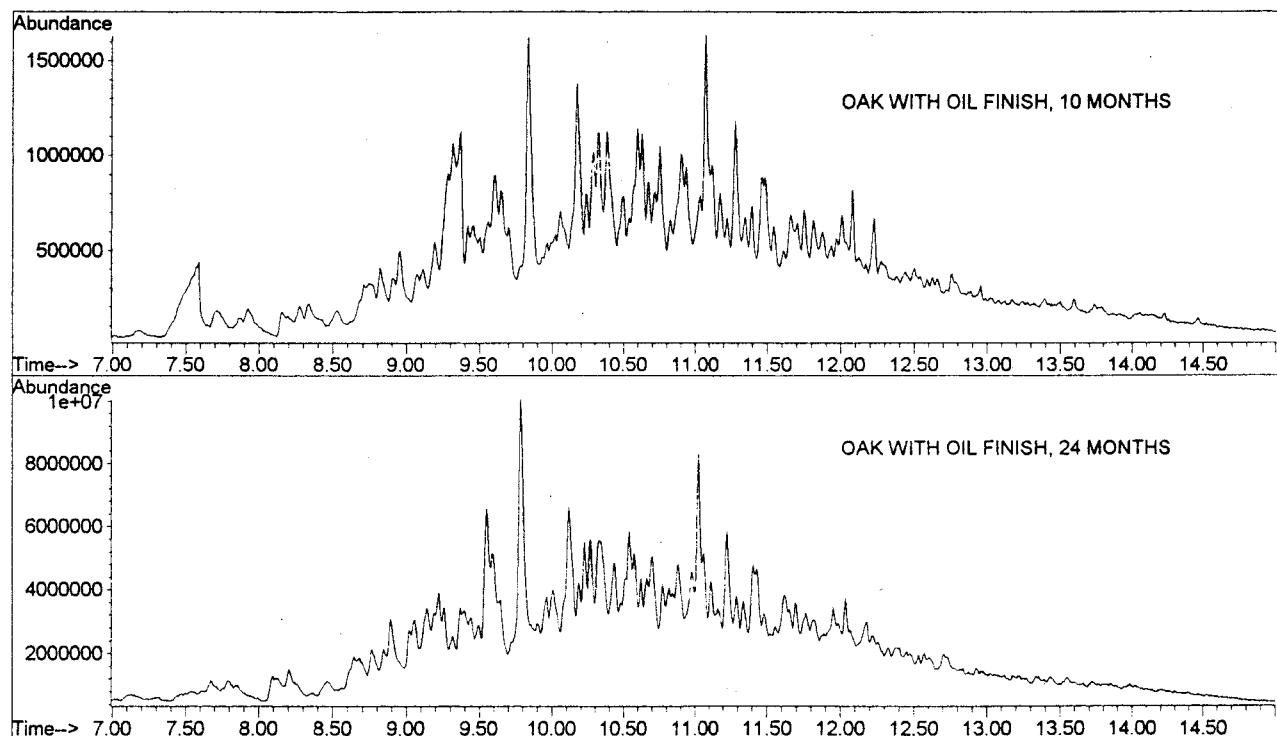


FIG. 5—Total ion chromatogram of oak finished with Carver Tripp[®] oil finish after 10 months and 24 months.

the TIC data suggests some diminution of the petroleum product relative to the terpenes. Examination of the Ion 57 profile, however, reveals that the terpenes do not make a good “internal standard” as their concentration varies along the length of the wood. The concentration of alkanes present in the wood did not change significantly from 10 months to 24 months.

We also found the aromatic content of the floor coating did not change significantly. Figure 3 shows the results of testing of the oak board that was stained and sealed. The medium petroleum distillate profile as well as the characteristic C₃ alkylbenzene profile of mineral spirits is shown in Fig. 4.

The profile of the total ion chromatogram of a sample of oak finished with an oil finish is shown in Fig. 5. The medium petroleum distillate present in this drying oil finish appears to be as persistent as those in the samples finished with stain and/or varnish.

Discussion

This study has shown that medium petroleum distillates, which are designed to evaporate, become part of the wood substrate

long after the bulk of the solvent is gone. Because finished wood flooring samples represent a significant percentage of the samples submitted for forensic analysis of fire debris to detect the presence of foreign ignitable liquids, it would appear that in the absence of a comparison sample that exhibits no petroleum hydrocarbons, the interpretation of medium petroleum distillate in a sample of finished wood flooring requires considerable caution.

Our laboratory will add a cautionary statement regarding interpretation to our reports when MPD's are detected in wood flooring samples.

Reference

1. Lentini JJ, Dolan JA, Cherry C. The petroleum-laced background. *J Forensic Sci* 2000;45(5):968–89.

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