

TECHNICAL NOTE

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A Problem of Hydrocarbon Profile Modification by Charcoal

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ABSTRACT: A selective modification of mineral turpentine in the presence of charcoal was observed to the extent that the trace resembles evaporated or "weathered" petrol.

KEYWORDS: forensic science, arson, chromatographic analysis, mineral turpentine, petroleum products, petrol, gas chromatography

During a recent in-house quality assurance trial one erroneous result prompted the authors to investigate its cause. The analyst had been given a sample containing 400 μL of mineral turpentine on charcoal in a sealed glass jar. Using a standard procedure the sample was steam distilled and the distillate collected and extracted. However, the flow of water through the condensers of the distillation apparatus had not been checked, and at a late stage in the distillation it was noted that the condensers, although water filled, were hot. The fault was corrected at this stage.

The resultant gas chromatographic-flame ionization detector (GC-FID) trace was misidentified as evaporated or "weathered" petrol.

During a review the authors agreed with the identification of the GC-FID chromatogram. The history of the sample gave an obvious explanation for "weathering" but would not be expected to result in a misidentification of mineral turpentine as petrol.

The distillation was mimicked using a replicate sample with the same result. This prompted the authors to investigate the modifications of mineral turpentine in the presence of charcoal, as well as the criteria for identifying evaporated or "weathered" petroleum distillates.

Method

Two approaches were taken. One sample containing 400 μL of mineral turpentine on 30 g of charcoal was distilled and the distillate collected in fractions.

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TABLE 1—Standard conditions and FID for samples.

Column:	25 m 0.25-mm inside diameter (ID) bonded fused silica open tubular (FSOT) polydiphenyl-dimethylsiloxane	
Program:	40°C for 4 min then 5°C/min to 100°C then 7°C/min to 150°C then 10°C/min to 240°C for 10 min.	
Detector:	260°C	Injector: 260°C
Split/splitless injection:		FID detector.
Carrier gas:	He at 25 cm/s	
Makeup gas:	N ₂ at 30 mL/min	
Septum purge:	He at 1 mL/min	
Fuel gases:	H ₂ at 30 mL/min, Air at 400 mL/min	

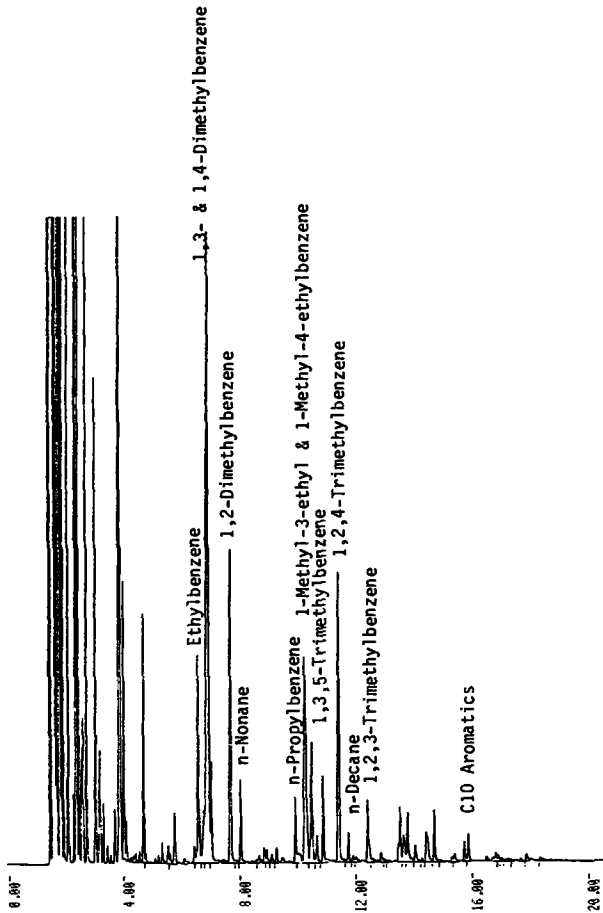


FIG. 1—Petrol chromatogram.

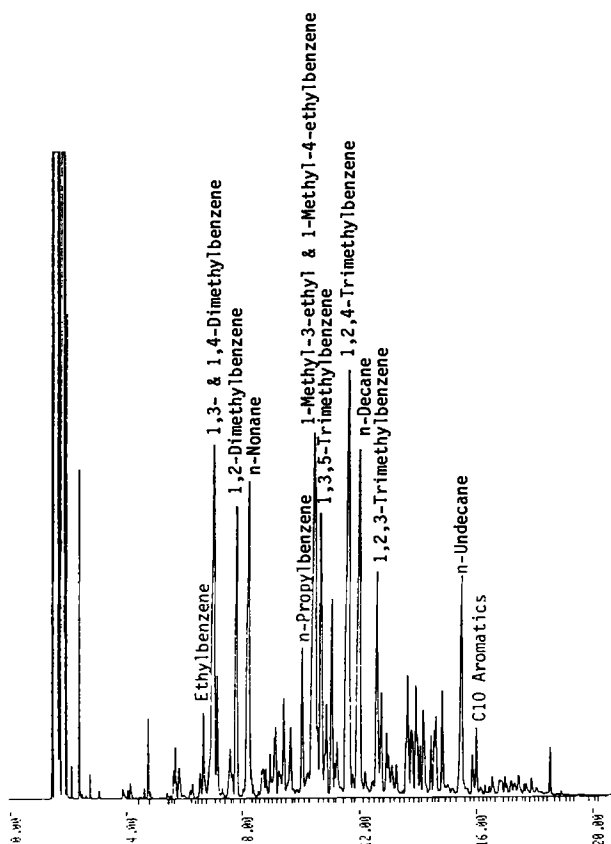


FIG. 2—Mineral turpentine chromatogram.

Secondly, samples of 200 μL of mineral turpentine on 30 g of charcoal were allowed to weather at room temperature for periods between 30 min and 24 h. The samples were subsequently steam distilled, the distillate extracted with methylbutane (5 mL), reduced to 0.3 mL, and chromatographed on a Carlo Erba Mega Series gas chromatograph using standard conditions and FID (see Table 1).

The peaks named on the chromatograms (Figs. 1 to 4) were tentatively identified by retention times and gas chromatography-mass spectroscopy on a Hewlett-Packard 5890 GC with a 5970 series mass selective detector (70-eV electron ionization [EI]).

Results and Discussion

Formerly the criteria used to differentiate mineral turpentine from evaporated or "weathered" petrol in this laboratory were the heights of the peaks for nonane, decane, and undecane relative to C8, C9, and C10 aromatics, respectively. All of these aliphatic peaks were found to be selectively reduced in both the latter fractions of the distillation and in the samples set out for weathering of 8 h or more (see Figs. 1 to 4). This selective reduction was sufficient to cause a confusion between mineral turpentine and evaporated petrol.

We postulate that charcoal has the ability to retain selectively the aromatics at the expense

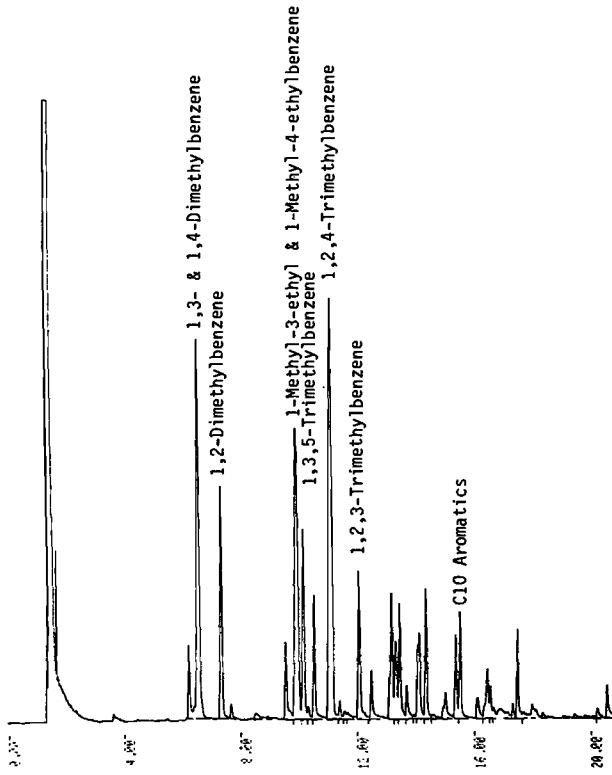


FIG. 3—Evaporated petrol chromatogram.

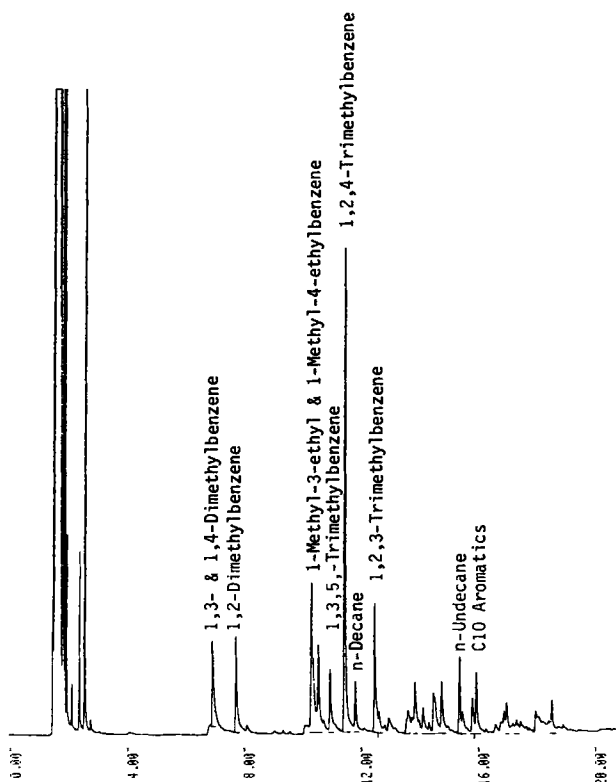


FIG. 4—Chromatogram of mineral turpentine weathered for 16 h on charcoal.

of the aliphatics, and thus the usual weathering pattern based largely on boiling points is modified.

If this is a correct interpretation then clearly the problem could be even worse in casework. A typical casework sample contains a mixture of potentially active and potentially selective solid compounds that could modify the weathering of any hydrocarbon samples present.

Conclusion

A selective modification of mineral turpentine in the presence of charcoal has been observed. This modification reduces the relative levels of the aliphatic components, nonane, decane, and undecane under some conditions, to the extent that the trace resembles evaporated or "weathered" petrol.

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