

## Thermal Desorption Applications Guide for Model 890/891 Thermal Desorption Unit and Dynamic Thermal Stripper

When you use a Supelco Thermal Desorption Unit in combination with a Supelco Dynamic Thermal Stripper, your samples can exist in any physical state—solid, liquid, or gas. Applications in this guide show how each type of sample (foods, petroleum products, polymers, environmental samples, and others) can be analyzed using the Model 890/891 Thermal Desorption Unit. Supelco offers stock and custom-designed thermal desorption tubes for a wide range of applications.

### Key Words:

- thermal desorption
- dynamic thermal stripper
- adsorbent

Thermal desorption ensures versatility and analytical sensitivity. In thermal desorption, organic compounds trapped on an adsorbent are desorbed into a carrier gas stream and delivered onto a gas chromatography column simply by rapidly heating the adsorbent. Components of a solid sample (food, polymer, etc.) can be thermally extracted from the sample into a carrier gas stream, delivered onto an adsorbent, and subsequently desorbed and delivered to the analytical column. Because the sample is not diluted with solvents, sensitivity is greatly en-

hanced. Thermal desorption techniques also save sample preparation time and, because the adsorbent tubes usually can be reused many times, adsorbent tube costs are lower over the long run.

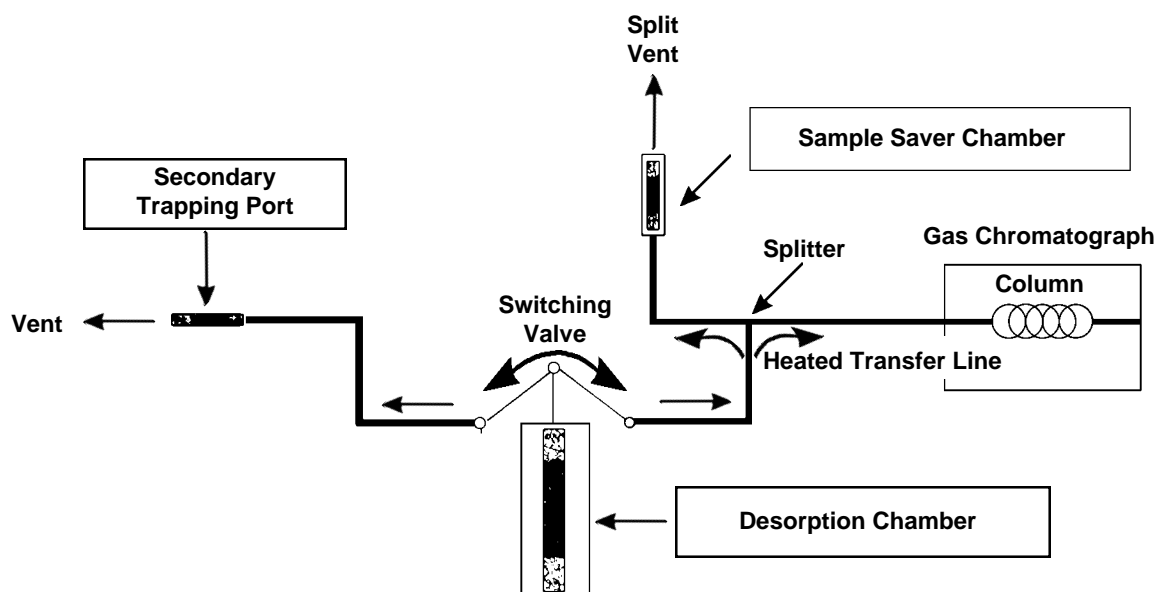
### Supelco™ Thermal Desorption Unit (Model 890/891)\*

The Model 890/891 Thermal Desorption Unit has features which make it useful for analyzing many types of samples (Figure A):

*Dual flow pathways* – The left pathway in Figure A is used to desorb a sample from a large ID adsorbent tube to a narrow ID tube in the trapping port, for more efficient delivery, subsequently, to the GC column. This flow pathway also can be used to thermally extract components of a solid sample and deliver them to an adsorbent tube in the trapping port. The right pathway delivers samples that are ready for analysis to the chromatography column.

*Accurate, ballistic heating* – Samples are rapidly (e.g., 30°C to 400°C in 26 seconds) and reproducibly delivered to the analytical column, for sharp, symmetrical peaks. Highly accurate temperature control allows reliable thermal fractionation analyses of polymers, etc.

**Figure A. Thermal Desorption Unit Flow Pathways**



\*Manufactured by Dynatherm, Inc.

795-0722

*Trapping port* – Install an adsorbent tube here to trap components that have been thermally extracted from a sample. Focus compounds from a wide bore adsorbent tube to a narrow bore tube for better chromatography *without cryogenic focusing*.

*Sample saving chamber* – Save part of a sample for a second analysis.

*Inert flow pathways* – A heated nickel transfer line prevents sample adsorption or condensation during transfer to the analytical column. The line will be custom prepared for your instrument make and model. Optional fused silica transfer lines and a Hastelloy® valve also are available.

*Remote start signal* – You can automatically start the analytical and integrating systems of your chromatograph.

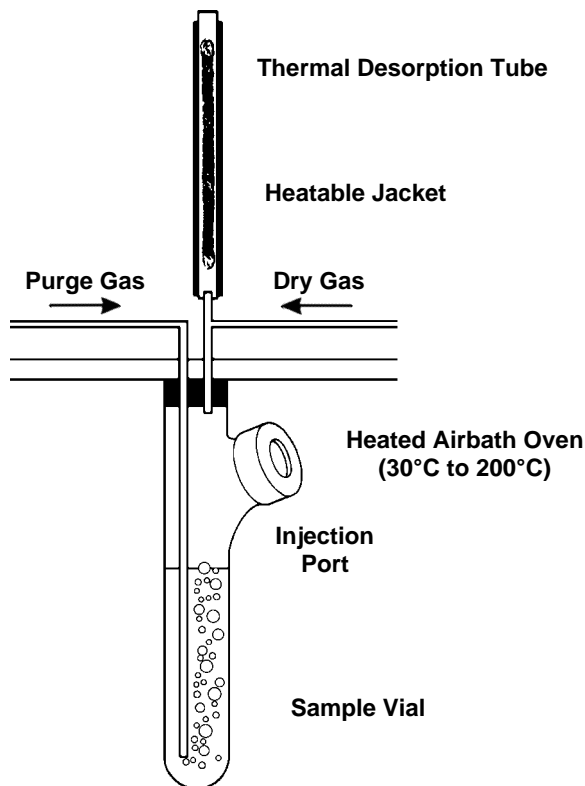
### Supelco™ Dynamic Thermal Stripper\*

- Eliminates solvent use and reduces extraction time, while ensuring efficient recovery of compounds of interest.
- Time and temperature parameters are easy to set and monitor.
- Accommodates one, two, or three 10-100mL sample vials. Accommodates larger samples one or two at a time.
- A separate dry gas line and heated jacket around the adsorbent tube prevent water condensation in the adsorbent, ensuring high trapping efficiency.

The Supelco Dynamic Thermal Stripper thermally strips (purges) volatile, semivolatile, and weakly volatile compounds from troublesome sample matrices, eliminating tedious, inefficient, and wasteful liquid-liquid extractions (Figure B). Organic materials in aqueous samples, for example, can be efficiently transferred to the adsorbent tube at temperatures well below their boiling points. Dry samples also can be purged for dynamic headspace analyses.

We offer a wide range of adsorbent tubes to efficiently trap the purged compounds, then efficiently transfer them to your chromatographic column. Please refer to the Ordering Information at the end of this bulletin.

**Figure B. Flow Pathways in Sample Stripping**



\*Manufactured by Dynatherm, Inc.

## Petroleum/Chemical Applications

**Saturated and Unsaturated C2-C6 Hydrocarbons in Air**  
Carbotrap™ 200 tubes effectively retain ethane and propane, as well as larger molecules (up to C14). Desorption efficiency is approximately 100%. When the tube is used in conjunction with a Carbo-pack™ B packed GC column, many difficult-to-separate isomers can be resolved, such as the C4 isomers in Figures C and D.

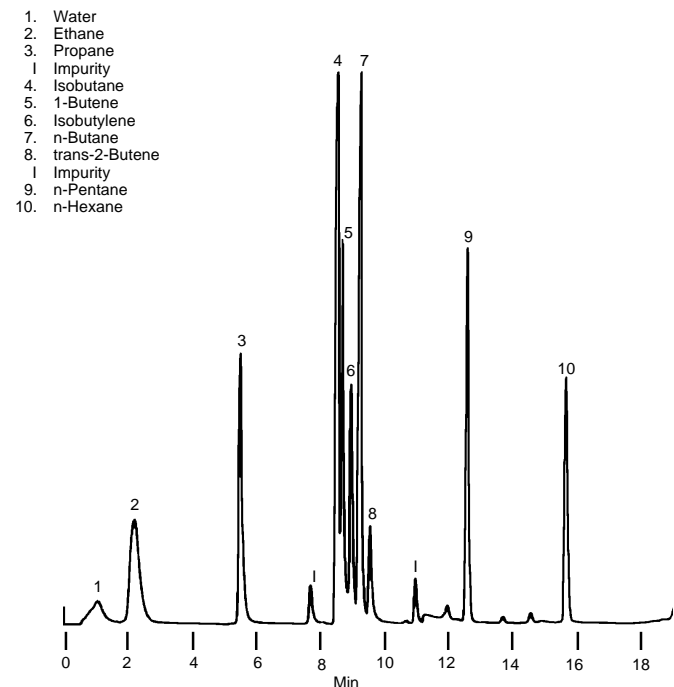
For maximum resolution of C2 hydrocarbons, collect the sample in a 4mm ID tube and focus it by transfer to a 2mm ID tube, then to the GC column (Figure E). Model 890/891 Thermal Desorption Unit enables you to make the transfer without reducing desorption or analytical efficiency for the C3-C6 compounds.

For additional information about these analyses, request Bulletin 850 (T100850). For packed columns, please refer to our general catalog.

### Figure C. Use Thermal Desorption to Monitor C2-C6 Hydrocarbons

**Thermal Desorption**  
Sampling Tube: Carbotrap 200, 6mm OD x 4mm ID x 11.5cm  
Cat. No.: 20242  
Tube Desorption Temp.: 330°C, 4 min  
Flow: helium, 20mL  
Valve Compartment Temp.: 225°C  
Transfer Line Temp.: 225°C

**Chromatography**  
Column: 60/80 Carbo-pack B, 6' x 1/8" SS  
Cat. No.: 20273  
Oven: 35°C (2 min) to 260°C at 16°C/min  
Carrier: helium, 20mL/min  
Det.: FID  
Sample: C2-C6 hydrocarbons, 8ppb in 1L air

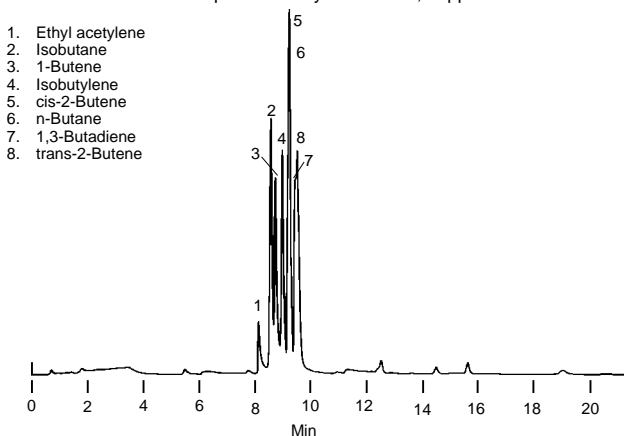


795-0724

### Figure D. Thermal Desorption/GC Effectively Traps, Releases, and Resolves C4 Isomers

**Thermal Desorption**  
Sampling Tube: Carbotrap 200, 6mm OD x 4mm ID x 11.5cm  
Cat. No.: 20242  
Tube Desorption Temp.: 330°C, 4 min  
Flow: helium, 20mL  
Valve Compartment Temp.: 225°C  
Transfer Line Temp.: 225°C

**Chromatography**  
Column: 60/80 Carbo-pack B, 6' x 1/8" SS  
Cat. No.: 20273  
Oven: 35°C (2 min) to 260°C at 16°C/min  
Carrier: helium, 20mL/min  
Det.: FID  
Sample: C4 hydrocarbons, 20ppb in 1L air



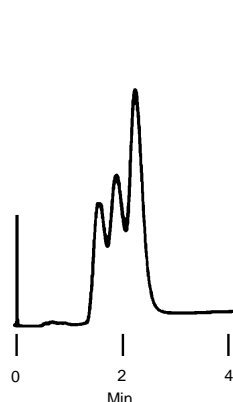
795-0725

### Figure E. Sample Transfer Improves C2 Hydrocarbons Resolution

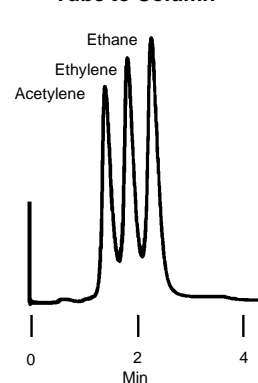
**Thermal Desorption**  
Sampling Tube: Carbotrap 200, 6mm OD x 4mm ID x 11.5cm  
Cat. No.: 20242  
Focusing Tube: Carbotrap 200, 6mm OD x 2mm ID x 11.5cm  
Cat. No.: 20244  
Sample Focus: 330°C, 5mL/min, 4 min  
Tube Desorption Temp.: 330°C, 4 min  
Valve Compartment Temp.: 225°C  
Transfer Line Temp.: 225°C

**Chromatography**  
Column: 60/80 Carbo-pack B, 6' x 1/8" SS  
Cat. No.: 20273  
Oven: 35°C (2 min) to 260°C at 16°C/min  
Carrier: helium, 20mL/min  
Det.: FID  
Sample: C2 hydrocarbons, 20ppb in 1L air

4mm ID Tube to Column



4mm ID Tube to 2mm ID Tube to Column



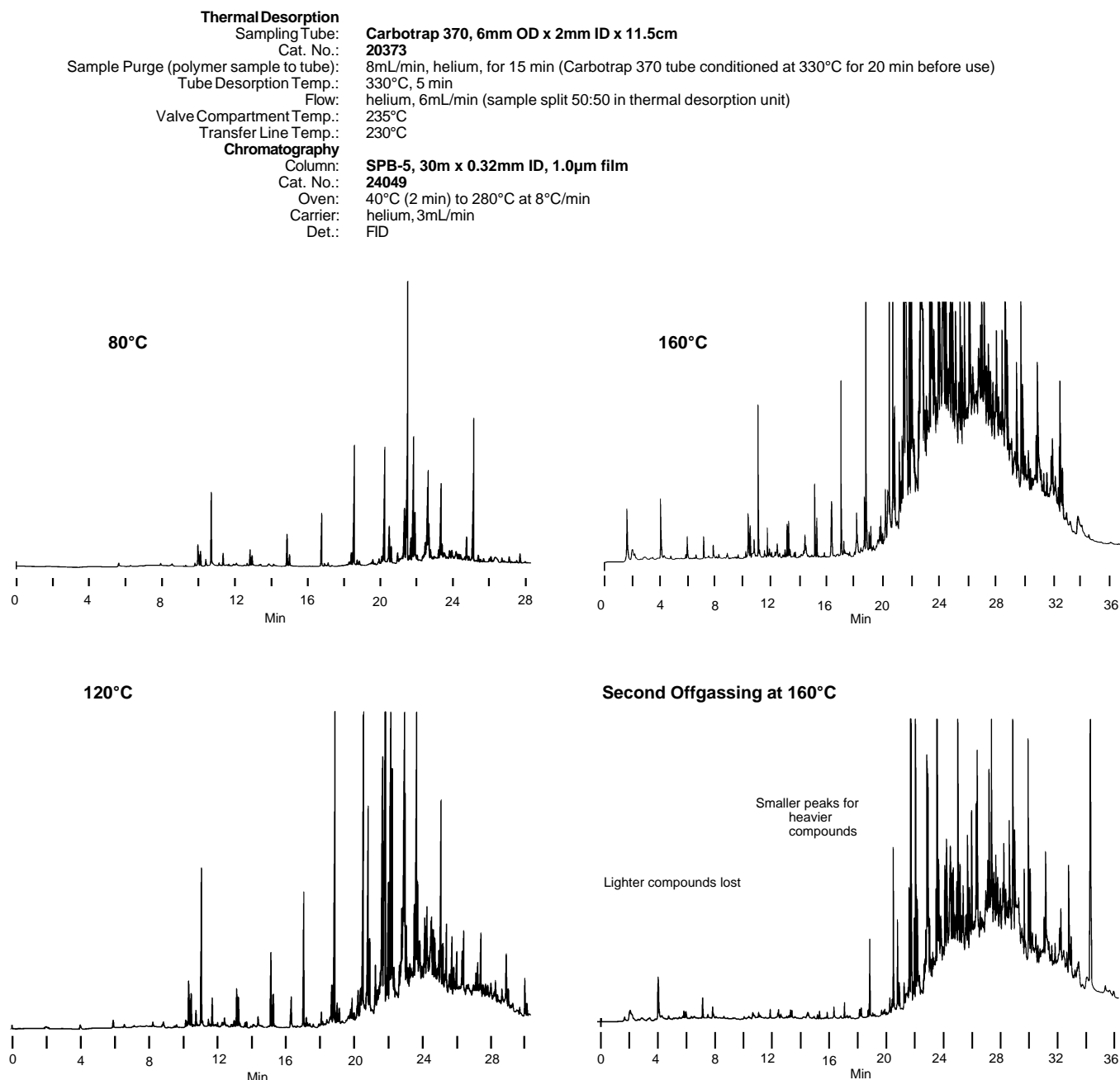
795-0726

## Petroleum/Chemical Applications

### C5-C30 Compounds in Polymers

By using a system composed of a Carbotrap 370 thermal desorption tube, a Model 890/891 Thermal Desorption Unit, and an SPB™-5 capillary column, you can quickly and efficiently extract C5-C30 components from polymer products, trap them on an adsorbent, and analyze them to characterize the products. Highly reliable temperature control in the thermal desorption unit enables you to obtain consistent profiles at specific temperatures (Figure F). Information and chromatograms for other samples are provided in Bulletin 866 (T194866).

**Figure F. Effect of Sample Chamber Temperature on Offgas from a Sample of Polyethylene Beads**



795-0727, 0728, 0729, 0730

## Environmental Applications

### Hazardous Compounds in Air

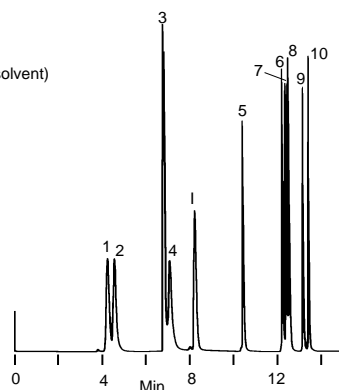
Efficiently adsorb and release all aliphatic, aromatic, and chlorinated hydrocarbons listed in US Environmental Protection Agency TO-1, TO-2, and TO-3 methodology (1), whether present individually or in mixtures, by using a Model 890/891 Thermal Desorption Unit, a Carbotrap 300 thermal desorption tube, a 0.75mm ID SUPELCO<sup>TM</sup> 10 capillary column, and a Carbopack B or Carbopack C packed GC column.

### Figure G. Thermally Desorbed TO-1 Hydrocarbons

<b>Thermal Desorption</b>	
Sampling Tube:	<b>Carbotrap 300, 6mm OD x 4mm ID x 11.5cm</b>
Cat. No.:	<b>20379</b>
Tube Desorption Temp.:	330°C, 4 min
Flow:	helium, 10mL (for capillary column) helium, 20mL (for packed column)
Valve Compartment Temp.:	220°C
Transfer Line Temp.:	220°C
<b>Chromatography</b>	
Capillary Column:	<b>SUPELCO<sup>TM</sup> 10, 60m x 0.75mm ID, 1.0µm film</b>
Cat. No.:	<b>23723</b>
Oven:	35°C (4 min) to 220°C at 8°C/min
Carrier:	helium, 10mL/min
Det.:	FID
Sample:	TO-1 hydrocarbons, 2ng each
<b>Packed Column:</b>	
	<b>80/100 Carbopack C/0.1% SP<sup>TM</sup>-1000, 6' x 1/8" SS</b>
Cat. No.:	<b>11820</b>
Oven:	35°C to 220°C at 16°C/min
Carrier:	helium, 20mL/min
Det.:	FID
Sample:	TO-1 hydrocarbons, 2ng each

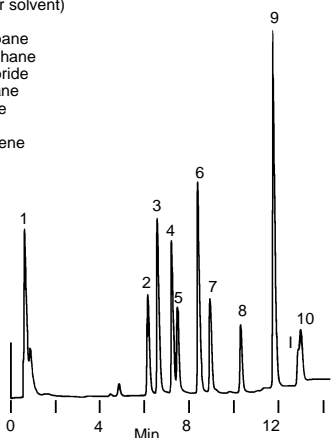
#### Use a capillary column for nonhalogenated hydrocarbons

1. n-Heptane
2. 1-Heptene
3. Methanol (carrier solvent)
4. Benzene
5. Impurity
6. Toluene
7. Ethylbenzene
8. p-Xylene
9. m-Xylene
10. Cumene (Isopropylbenzene)
11. o-Xylene



#### Use a packed column for chlorinated hydrocarbons

1. Methanol (carrier solvent)
2. Chloroform
3. 1,2-Dichloropropane
4. 1,1,1-Trichloroethane
5. Carbon tetrachloride
6. 1,2-Dichloroethane
7. Trichloroethylene
8. Bromoform
9. Tetrachloroethylene
10. Impurity
11. Chlorobenzene



In Figure G, the capillary column separates TO-1 compounds that coelute on the Carbopack C packed column (n-heptane and toluene, o-xylene and cumene). Use the packed column to monitor TO-1 compounds that coelute on the capillary column (carbon tetrachloride and 1,1,1-trichloroethane, chloroform, and tetrachloroethylene).

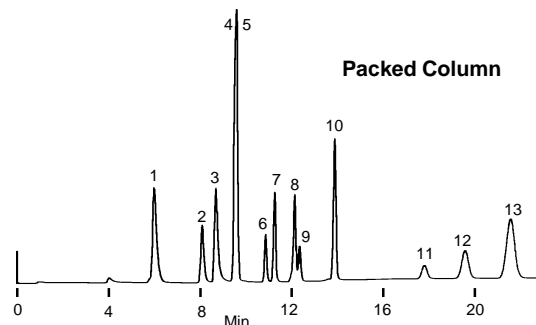
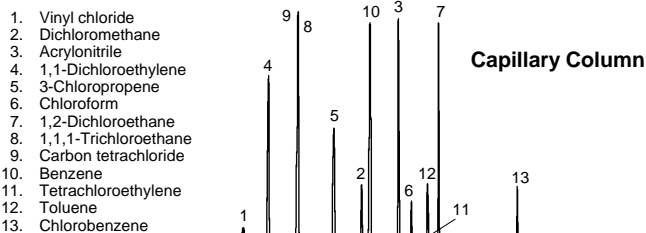
To analyze TO-2 and TO-3 compounds, use either the SUPELCO<sup>TM</sup> 10 capillary column (Figure H) or an 8' column containing the Carbopack B packing. For the sharpest vinyl chloride peak, trap the sample on a 4mm ID tube and, using the thermal desorption unit, transfer it to a 2mm ID tube, then to the column.

Additional information is presented in Bulletin 849 (T100849). For packed columns, refer to our general catalog.

1. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. US EPA Document No. 600/4-84-041 (April 1984).

### Figure H. Thermally Desorbed TO-2 & TO-3 Compounds

<b>Thermal Desorption</b>	
Sampling Tube:	<b>Carbotrap 300, 6mm OD x 4mm ID x 11.5cm</b>
Cat. No.:	<b>20379</b>
Focusing Tube:	<b>Carbotrap 300, 6mm OD x 2mm ID x 11.5cm</b>
Cat. No.:	<b>20382</b>
Sample Focus:	330°C, 5mL/min, 4 min
Tube Desorption Temp.:	330°C, 4 min
Flow:	helium, 8L (for capillary column) helium, 20mL (for packed column)
Valve Compartment Temp.:	220°C
Transfer Line Temp.:	220°C
<b>Chromatography</b>	
Capillary Column:	<b>SUPELCO<sup>TM</sup> 10, 60m x 0.75mm ID, 1.0µm film</b>
Cat. No.:	<b>23723</b>
Oven:	35°C (4 min) to 160°C at 8°C/min
Carrier:	helium, 8mL/min
Det.:	FID
Sample:	TO-2, TO-3 compounds, 105ng each
<b>Packed Column:</b>	
	<b>80/100 Carbopack B/0.1% SP-1000, 8' x 1/8" SS</b>
Cat. No.:	<b>11815</b>
Oven:	35°C (2 min) to 220°C at 16°C/min
Carrier:	helium, 20mL/min
Det.:	FID
Sample:	TO-2, TO-3 compounds, 105ng each



795-0731, 0732

795-0733, 0734

## Environmental Applications

### Volatile Compounds

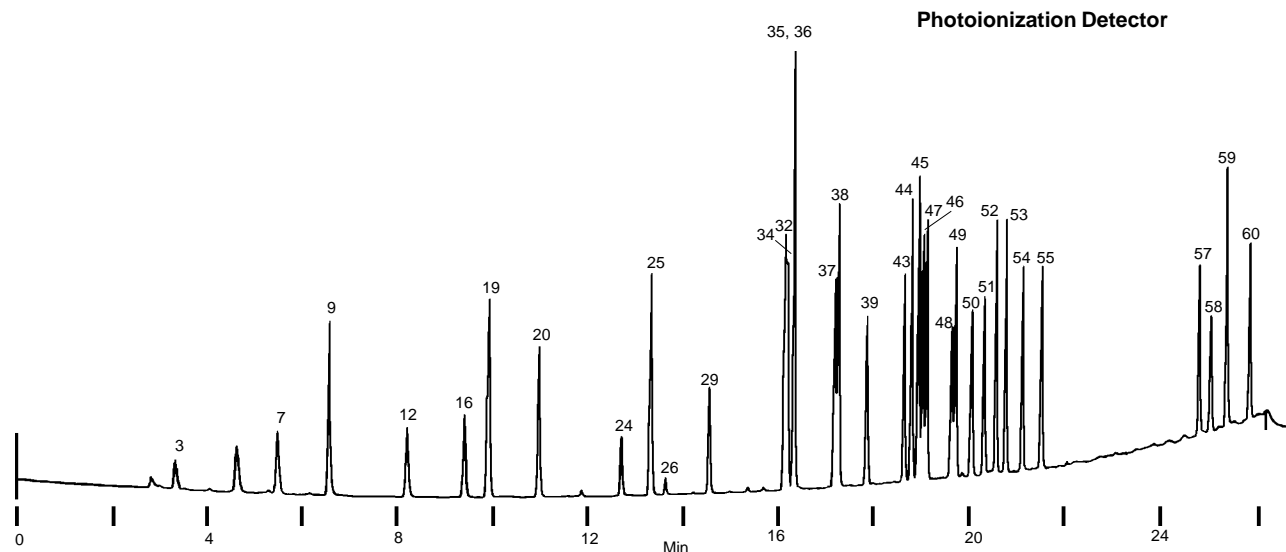
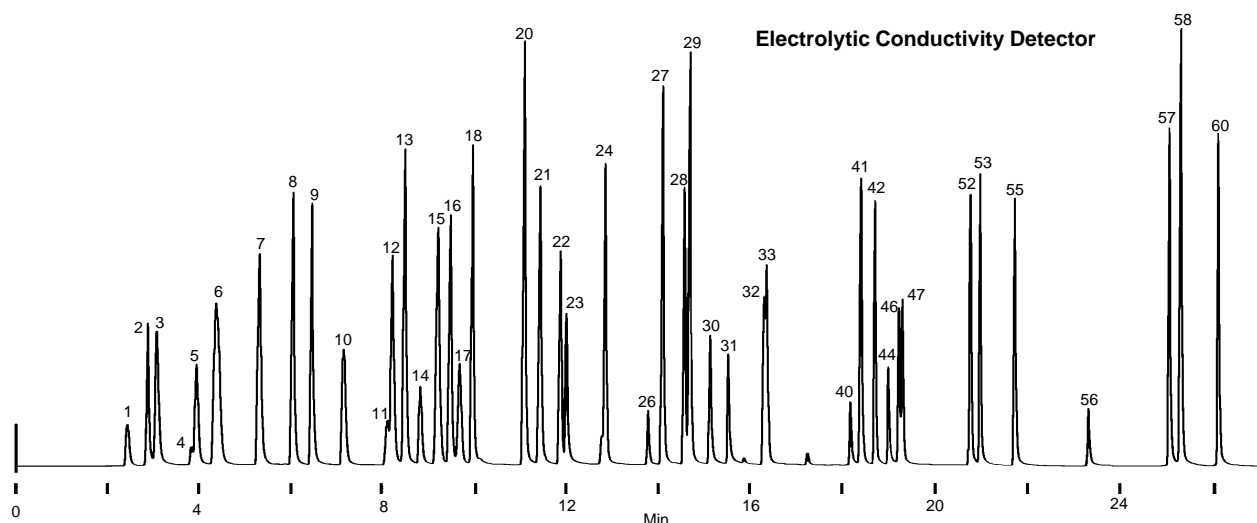
Using a Supelco Dynamic Thermal Stripper, volatile compounds such as those listed in US EPA wastewater analyses can be purged — at ambient temperature — from water samples and trapped on an adsorbent tube. For best chromatography, trap the com-

pounds on a 4mm ID adsorbent tube and use the Model 890/891 Thermal Desorption Unit to focus them onto a 1mm ID tube. Sample focusing, followed by ballistic thermal desorption in the thermal desorption unit, eliminates the need for cryofocusing the compounds. Gaseous compounds are resolved well on a VOCOL™ capillary column (Figure I).

**Figure I. Volatile Organic Compounds in Water**

<b>Thermal Stripping</b>				
Oven Temp.:	ambient			
Adsorp. Tube Heater Temp.:	60°C			
Spurge Gas:	nitrogen, 40mL/min, 10 min			
Dry Gas:	20mL/min, 4 min			
<b>Thermal Desorption</b>				
Sampling Tube:	<b>Carbotrap 302, 6mm OD x 4mm ID x 11.5cm</b>			
Cat. No.:	<b>20356</b>			
Focusing Tube:	<b>Carbotrap 201, 1mm ID</b>			
Cat. No.:	<b>20361</b>			
Sample Focus:	300°C, 2mL/min, 5 min			
Tube Desorption Temp.:	350°C, 5 min			
Valve Compartment Temp.:	235°C			
Transfer Line Temp.:	235°C			
<b>Chromatography</b>				
Column:	<b>VOCOL, 60m x 0.32mm ID, 3.0µm film</b>			
Cat. No.:	<b>24157</b>			
Oven:	35°C (8 min) to 230°C at 4°C/min, hold 4 min			
Carrier:	helium, 3mL/min			
Sample:	8µg/liter each compound in 5mL water			

- |                               |                               |                                 |
|-------------------------------|-------------------------------|---------------------------------|
| 1. Dichlorodifluoromethane    | 21. 1,2-Dichloropropane       | 41. 1,1,2,2-Tetrachloroethane   |
| 2. Chloromethane              | 22. Bromodichloromethane      | 42. 1,2,3-Trichloropropane      |
| 3. Vinyl chloride             | 23. Dibromomethane            | 43. n-Propylbenzene             |
| 4. Bromomethane               | 24. cis-1,3-Dichloropropene   | 44. Bromobenzene                |
| 5. Chloroethane               | 25. Toluene                   | 45. 1,3,5-Trimethylbenzene      |
| 6. Trichlorofluoromethane     | 26. trans-1,3-Dichloropropene | 46. 2-Chlorotoluene             |
| 7. 1,1-Dichloroethene         | 27. 1,1,2-Trichloroethane     | 47. 4-Chlorotoluene             |
| 8. Methylene chloride         | 28. 1,3-Dichloropropane       | 48. tert-Butylbenzene           |
| 9. trans-1,2-Dichloroethylene | 29. Tetrachloroethylene       | 49. 1,2,4-Trimethylbenzene      |
| 10. 1,1-Dichloroethane        | 30. Dibromochloromethane      | 50. sec-Butylbenzene            |
| 11. 2,2-Dichloropropane       | 31. 1,2-Dibromoethane         | 51. p-Isopropyltoluene          |
| 12. cis-1,2-Dichloroethylene  | 32. Chlorobenzene             | 52. 1,3-Dichlorobenzene         |
| 13. Chloroform                | 33. 1,1,1,2-Tetrachloroethane | 53. 1,4-Dichlorobenzene         |
| 14. Bromochloromethane        | 34. Ethylbenzene              | 54. n-Butylbenzene              |
| 15. 1,1,1-Trichloroethane     | 35. m-Xylene                  | 55. 1,2-Dichlorobenzene         |
| 16. 1,1-Dichloropropene       | 36. p-Xylene                  | 56. 1,2-Dibromo-3-chloropropane |
| 17. Carbon tetrachloride      | 37. o-Xylene                  | 57. 1,2,4-Trichlorobenzene      |
| 18. 1,2-Dichloroethane        | 38. Styrene                   | 58. Hexachlorobutadiene         |
| 19. Benzene                   | 39. Isopropylbenzene          | 59. Naphthalene                 |
| 20. Trichloroethylene         | 40. Bromoform                 | 60. 1,2,3-Trichlorobenzene      |



795-0735, 0736

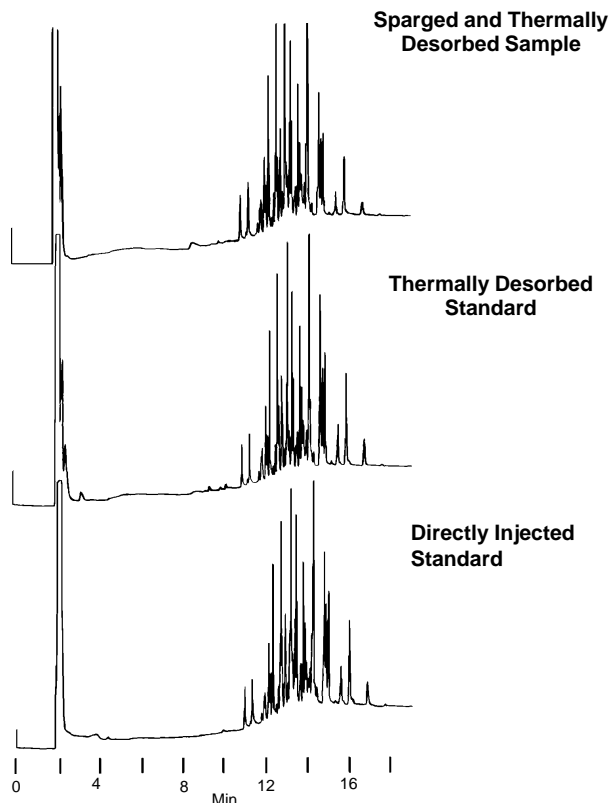
## Environmental Applications

### Semivolatile/Nonvolatile Compounds

Compounds that are semivolatile or nonvolatile at room temperature, such as polychlorinated biphenyls, can be monitored in various liquid matrices, using a Supelco Dynamic Thermal Stripper and a Model 890/891 Thermal Desorption Unit. Compared to standards injected directly onto the capillary column, recovery rates for sparged, thermally desorbed PCBs are nearly 100% (Figures J and K). For additional information, request Bulletin 861 (T109861).

**Figure J. PCBs Recovered from Water**

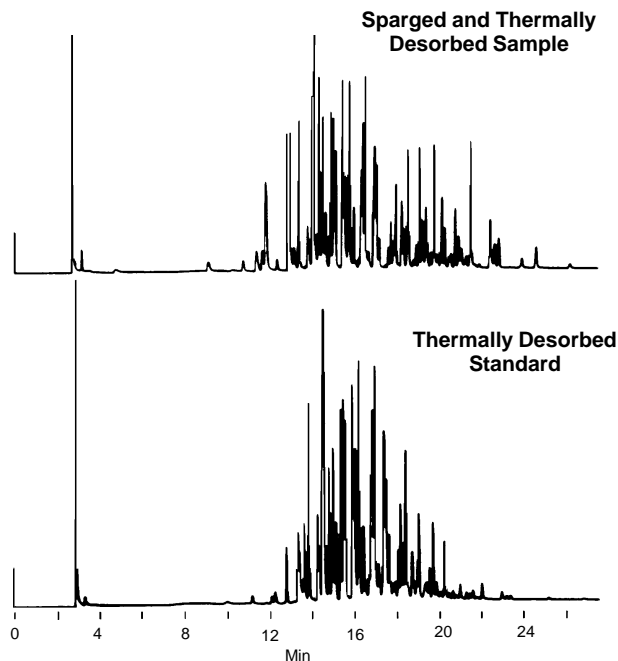
<b>Thermal Stripping</b>	
Oven Temp.:	110°C
Block Temp.:	150°C
Adsorp. Tube Heater Temp.:	80°C
Spurge Gas:	helium, 100mL/min, 40 min
Dry Gas:	helium, 50mL/min
Dry Purge Time:	10 min
<b>Thermal Desorption</b>	
Sampling Tube:	Carbotrap 150, 6mm OD x 4mm ID x 11.5cm
Cat. No.:	20381
Tube Desorption Temp.:	350°C, 4 min
Valve Compartment Temp.:	235°C
Transfer Line Temp.:	235°C
<b>Chromatography</b>	
Column:	SPB-5, 60m x 0.75mm ID, 1.0µm film
Cat. No.:	23721
Oven:	150°C (2 min) to 290°C at 8°C/min, hold 10 min
Carrier:	helium, 10mL/min
Det.:	ECD (water: 16 x 10-10, sediment: 128 x 10-10, oil: 8 x 10-10 AFS)
Sample:	Aroclor® 1260, 1ppb in 10mL water



**Figure K. PCBs Recovered from Sediment and Transformer Oil**

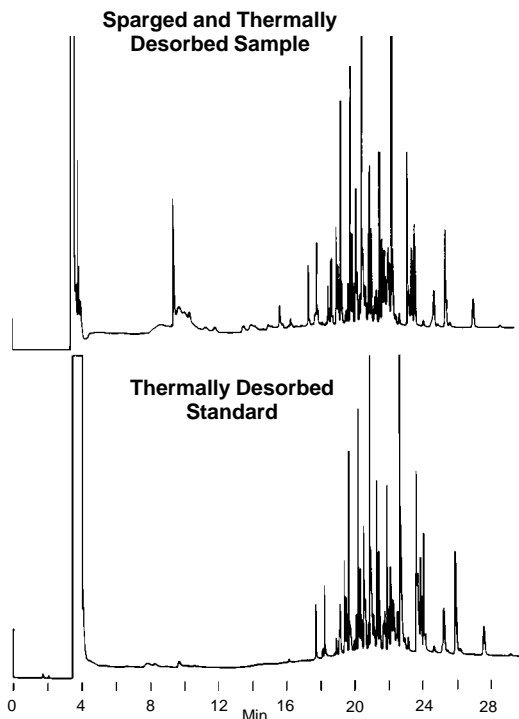
### Hudson River Sediment

Conditions: see Figure J  
Sample: 30mg sediment/10mL water



### Transformer Oil

Conditions: see Figure J  
Sample: 1mL transformer oil/10mL water



## Environmental Applications

### Hydrocarbons Associated with Leaking Underground Fuel Tanks

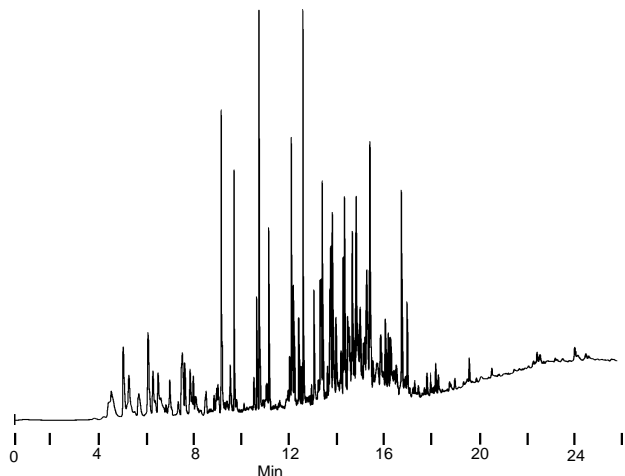
Soil and water samples typically are analyzed for hydrocarbons from leaking underground tanks by ambient temperature purge and trap or liquid/liquid extraction methods that require large quantities of solvents. Steam distillation, using a Supelco Dynamic Thermal Stripper and a Model 890/891 Thermal Desorption

Unit, allows analyses of complex mixtures of C6-C14 hydrocarbons at ppb concentrations, without cryogenic focusing (Figure L). Samples are sparged and collected on a Carbotrap 400 tube, then focused on a Carbotrap 301 tube.

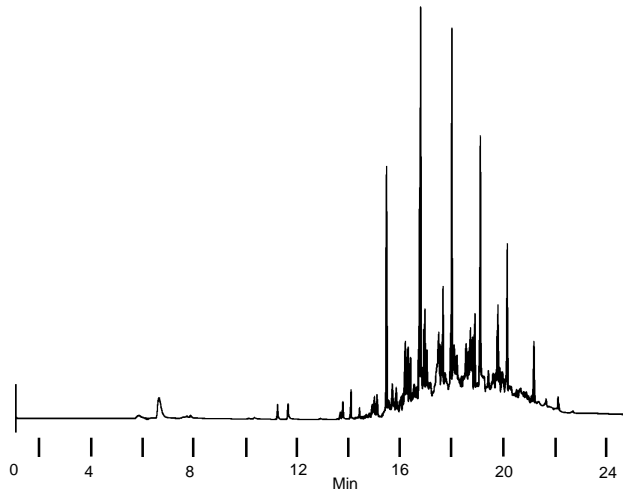
**Figure L. Hydrocarbon Mixtures Sparged from Soil**

<b>Thermal Stripping</b>		<b>Chromatography</b>	
Oven Temp.:	90°C	Column:	SPB-5, 60m x 0.32mm ID, 1.0µm film
Block Temp.:	120°C	Cat. No.:	24051
Adsorp. Tube Heater Temp.:	70°C	Oven:	35°C (2 min) to 300°C at 12°C/min, hold 2 min
Spurge Gas:	nitrogen, 50mL/min, 12 min	Carrier:	helium, 2mL/min
Dry Gas:	250mL/min, 5 min	Det.:	FID
<b>Thermal Desorption</b>		Sample:	10ng hydrocarbons in 1g soil
Sampling Tube:	Carbotrap 301, 6mm OD x 1mm ID x 11.5cm		
Cat. No.:	20354		
Tube Desorption Temp.:	330°C, 5 min		
Flow:	helium, 4mL, split 50:50		
Valve Compartment Temp.:	230°C		
Transfer Line Temp.:	230°C		

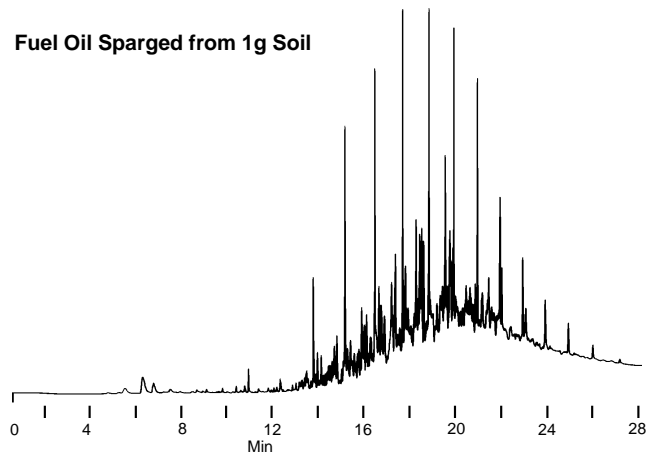
**Gasoline Sparged from 1g Soil**



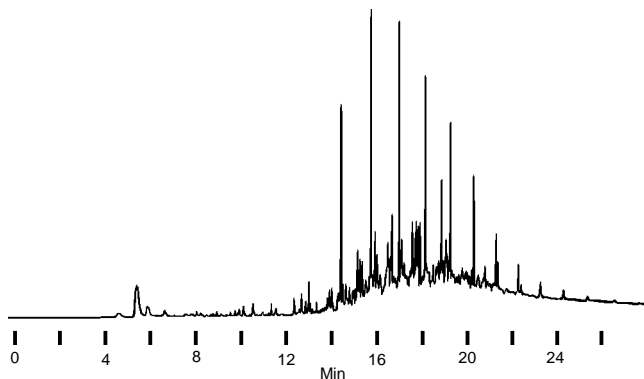
**Kersoene Sparged from 1g Soil**



**Fuel Oil Sparged from 1g Soil**



**Diesel Fuel Sparged from 1g Soil**





## Environmental Applications

### Qualitative Analyses

Thermal stripping/thermal desorption techniques can be used as a *qualitative* tool, in screening soil, water, or air samples for low levels of difficult-to-monitor compounds, such as chlorinated

pesticides (Figure M), which often break down during an analysis, or polynuclear aromatic hydrocarbons (Figure N) that are weakly volatile.

Samples are collected on a four-bed Carbotrap 400 tube and thermally desorbed directly to a capillary column.

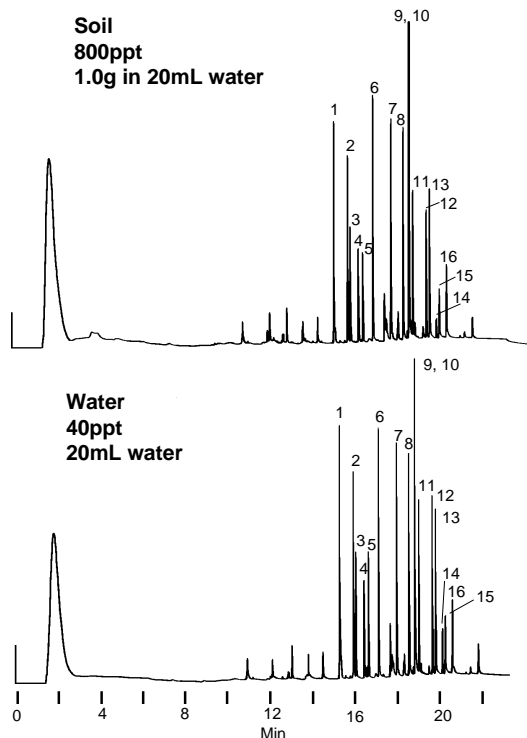
**Figure M. Pesticides in Picogram Quantities Extracted from Soil and Water**

**Thermal Stripping**  
 Oven Temp.: 110°C  
 Block Temp.: 180°C  
 Adsorp. Tube Heater Temp.: 75°C  
 Sparge Gas: nitrogen, 100mL/min, 30 min  
 Dry Gas: 50mL/min, 2 min

**Thermal Desorption**  
 Sampling Tube: Carbotrap 400, 6mm OD x 4mm ID x 11.5cm  
 Cat. No.: 20359  
 Tube Desorption Temp.: 350°C, 5 min  
 Flow: helium, 4mL, split 50:50  
 Valve Compartment Temp.: 240°C  
 Transfer Line Temp.: 240°C (optional Hastelloy valve and fused silica transfer line used)

**Chromatography**  
 Column: SPB-608, 30m x 0.25mm ID, 0.25µm film  
 Cat. No.: 24103-U  
 Oven: 40°C (2 min) to 290°C at 12°C/min  
 Carrier: helium, 2mL/min  
 Det.: ECD  
 Sample: see figure

1. α-BHC
2. γ-BHC
3. β-BHC
4. Heptachlor
5. δ-BHC
6. Aldrin
7. Heptachlor epoxide
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. 4,4'-DDT
15. Endrin aldehyde
16. Endosulfan sulfate



795-0741

**Figure N. Polynuclear Aromatic Hydrocarbons in Water**

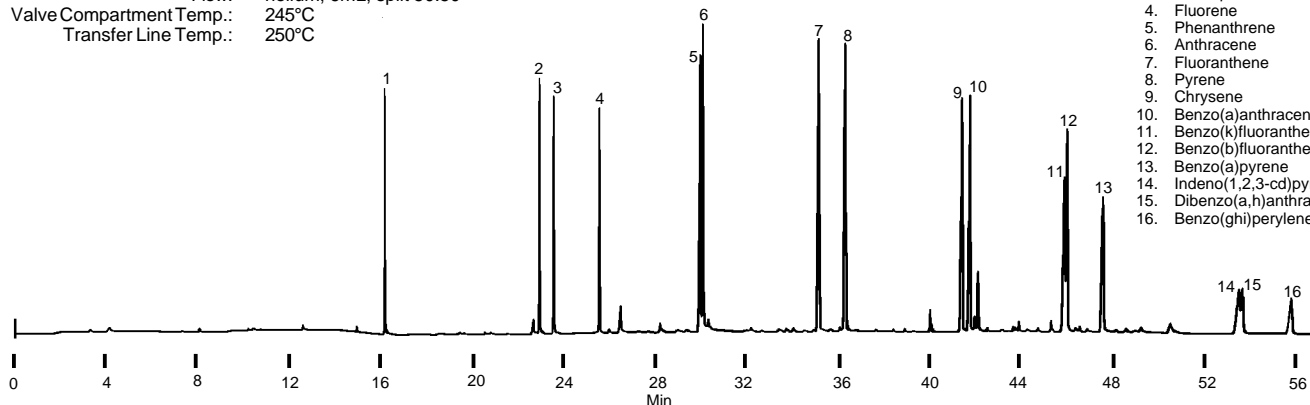
**Thermal Stripping**  
 Oven Temp.: 120°C  
 Block Temp.: 180°C  
 Adsorp. Tube Heater Temp.: 80°C  
 Sparge Gas: nitrogen, 300mL/min, 60 min  
 Dry Gas: 150mL, 70 min

**Thermal Desorption**  
 Sampling Tube: Carbotrap 400, 6mm OD x 4mm ID x 11.5cm  
 Cat. No.: 20359  
 Focusing Tube: Carbotrap 370, 6mm OD x 2mm ID x 11.5cm  
 Cat. No.: 20373  
 Sample Focus: 350°C, 3mL/min, 7 min  
 Tube Desorption Temp.: 350°C, 5 min  
 Flow: helium, 6mL, split 50:50  
 Valve Compartment Temp.: 245°C  
 Transfer Line Temp.: 250°C

**Chromatography**  
 Column: SPB-608, 30m x 0.25mm ID, 0.25µm film  
 Cat. No.: 24103-U  
 Oven: 40°C (2 min) to 300°C at 6°C/min, hold 10 min  
 Carrier: helium, 6mL/min  
 Det.: FID  
 Sample: polynuclear aromatic hydrocarbons, 5µg/mL in 30mL water

For hydrocarbons standards, please refer to our general catalog.

1. Naphthalene
2. Acenaphthylene
3. Acenaphthene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
9. Chrysene
10. Benzo(a)anthracene
11. Benzo(k)fluoranthene
12. Benzo(b)fluoranthene
13. Benzo(a)pyrene
14. Indeno(1,2,3-cd)pyrene
15. Dibenzo(a,h)anthracene
16. Benzo(ghi)perylene



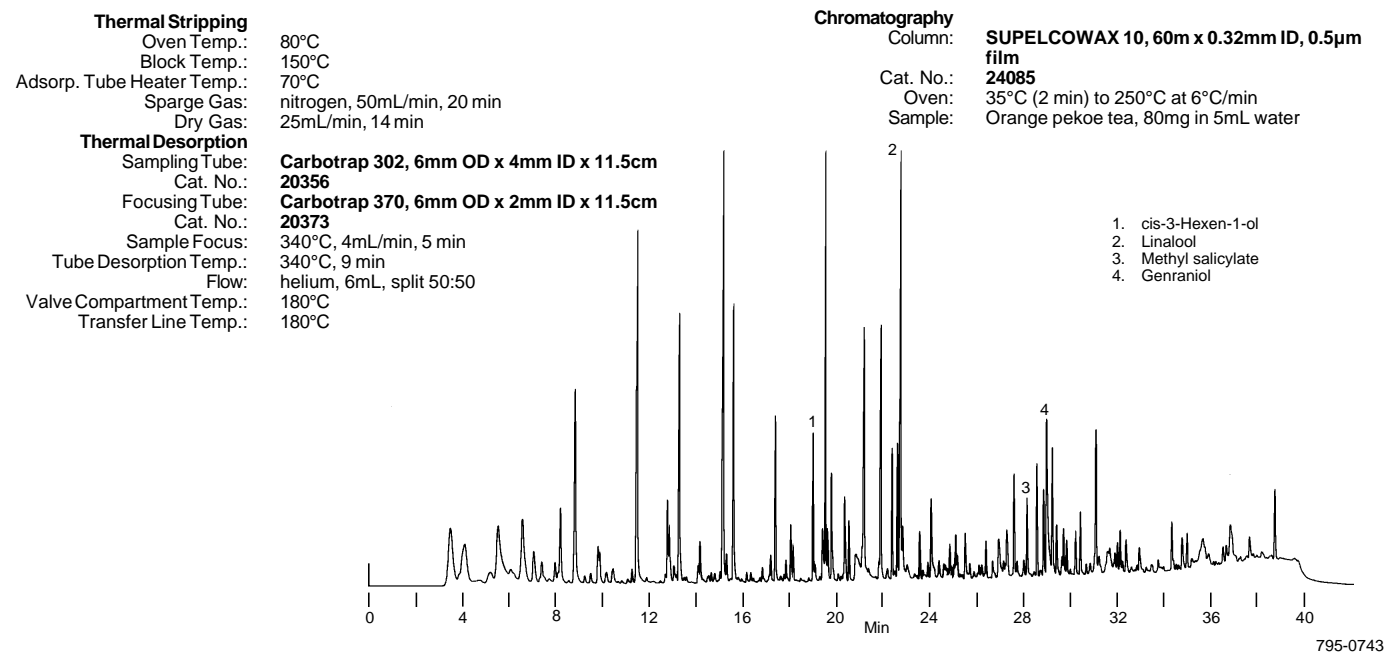
795-0742

## Food and Beverage Applications

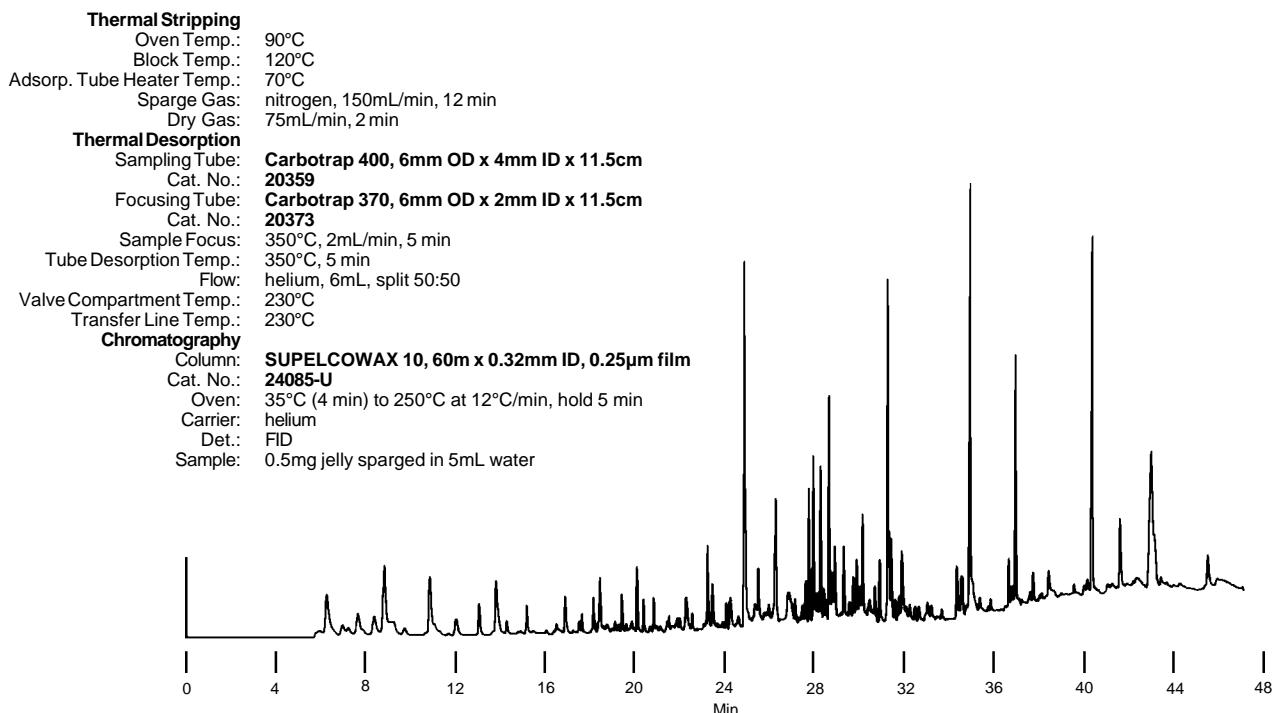
### Compounds Contributing to Aroma, Taste, or Texture

Information provided by thermal extraction/thermal desorption or steam distillation/thermal desorption can be very useful in food and flavor applications; in quality control to verify consistent composition of products; or in research and development to isolate and quantify compounds contributing to aroma, taste, or texture (Figures O and P).

**Figure O. Orange Pekoe Tea**



**Figure P. Jelly**



795-0744

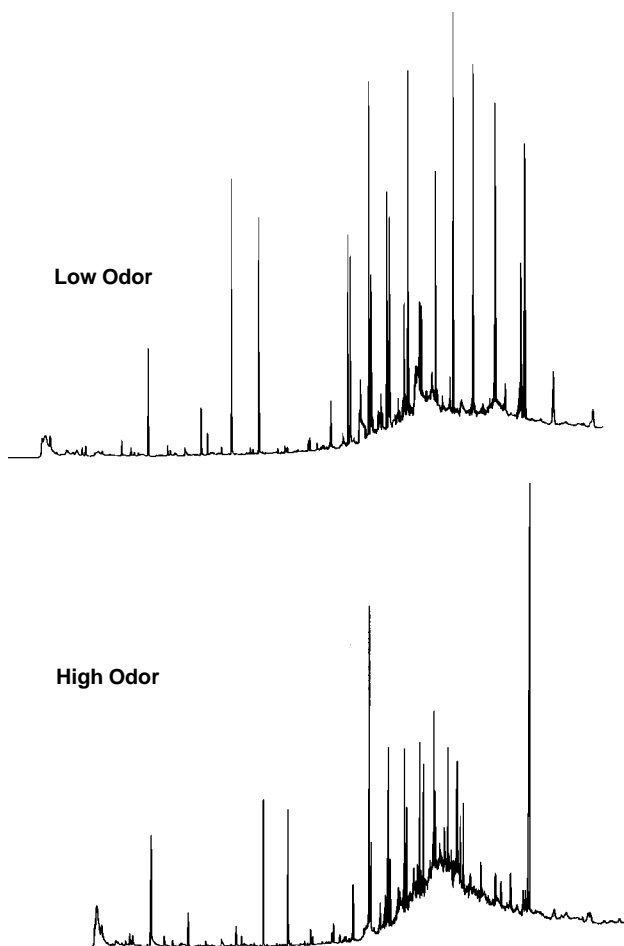
## Food and Beverage Applications

### Consistent Analyses

Thermal extraction/thermal desorption analyses using the Supelco Dynamic Thermal Stripper and the Model 890/891 Thermal Desorption Unit enable you to monitor product quality quickly and reliably (Figure Q). Highly reliable temperature control during thermal desorption helps ensure consistent profiles at specific temperatures (Figure R).

### Figure Q. Aqueous Sugar Samples

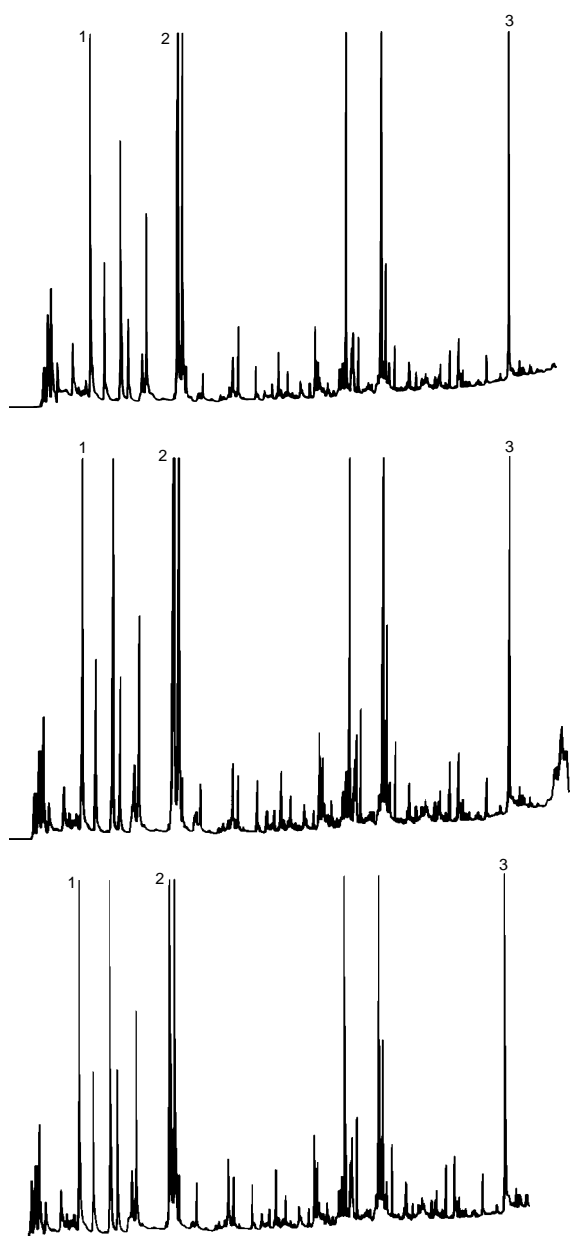
<b>Thermal Stripping</b>	
Oven Temp.:	110°C
Interface (Block) Temp.:	195°C
Adsorp. Tube Heater Temp.:	85°C
Sparge Gas:	nitrogen, 100mL/min, 30 min
Dry Gas:	50mL/min, 10 min
<b>Thermal Desorption</b>	
Sampling Tube:	<b>Tenax®TA, Ambersorb®XE-340, charcoal</b> <b>6mm OD x 4mm ID x 11.5cm</b>
Focusing Tube:	<b>Tenax TA, silica gel, Ambersorb XE-340</b> <b>6mm OD x 0.9mm ID x 11.5cm</b>
Sample Focus:	250°C, 8mL/min, 5 min
Tube Desorption Temp.:	300°C, 3 min
Flow:	helium, 5mL, split 50:50
Valve Compartment Temp.:	200°C
Transfer Line Temp.:	200°C
<b>Chromatography</b>	
Column:	<b>SPB-1, 30m x 0.32mm ID, 1.0µm film</b> <b>24045</b>
Cat. No.:	
Oven:	33°C (3 min) to 260°C at 10°C/min, hold 15 min
Carrier:	helium, 2.5mL/min
Det.:	FID
Sample:	4g sugar in 30mL water



### Figure R. Chocolate Chips: Three Replicates

<b>Thermal Stripping</b>	
Oven Temp.:	70°C
Interface (Block) Temp.:	150°C
Adsorp. Tube Heater Temp.:	60°C
Sparge Gas:	nitrogen, 200mL/min, 20 min
Dry Gas:	100mL/min, 7 min
<b>Thermal Desorption</b>	
Sampling Tube:	<b>Tenax TA, Ambersorb XE-340, charcoal</b> <b>6mm OD x 4mm ID x 11.5cm</b>
Tube Desorption Temp.:	225°C, 7 min
Flow:	helium, 7.5mL
Valve Compartment Temp.:	245°C
Transfer Line Temp.:	245°C
<b>Chromatography</b>	
Column:	<b>VOCOL, 60m x 0.75mm ID, 1.5µm film</b> <b>23731</b>
Cat. No.:	
Oven:	33°C (6 min) to 250°C at 7.5°C/min
Carrier:	helium, 3.5mL/min
Det.:	FID
Sample:	210mg chocolate chips in 5mL distilled water

1. Isobutylaldehyde
2. Isovaleraldehyde
3. Vanillin



Figures courtesy of Mr. D. Paul, Dynatherm, Inc., P.O. Box 159, Kelton, PA 19346, USA.

795-0745, 0746

795-0747, 0748, 0749

# Food and Beverage Applications

## Sample Differences Emerge

The Supelco Dynamic Thermal Stripper and Model 890/891 Thermal Desorption Unit easily enable you to monitor lot-to-lot or product-to-product differences in composition (Figure S).

**Figure S. Soft Drinks**

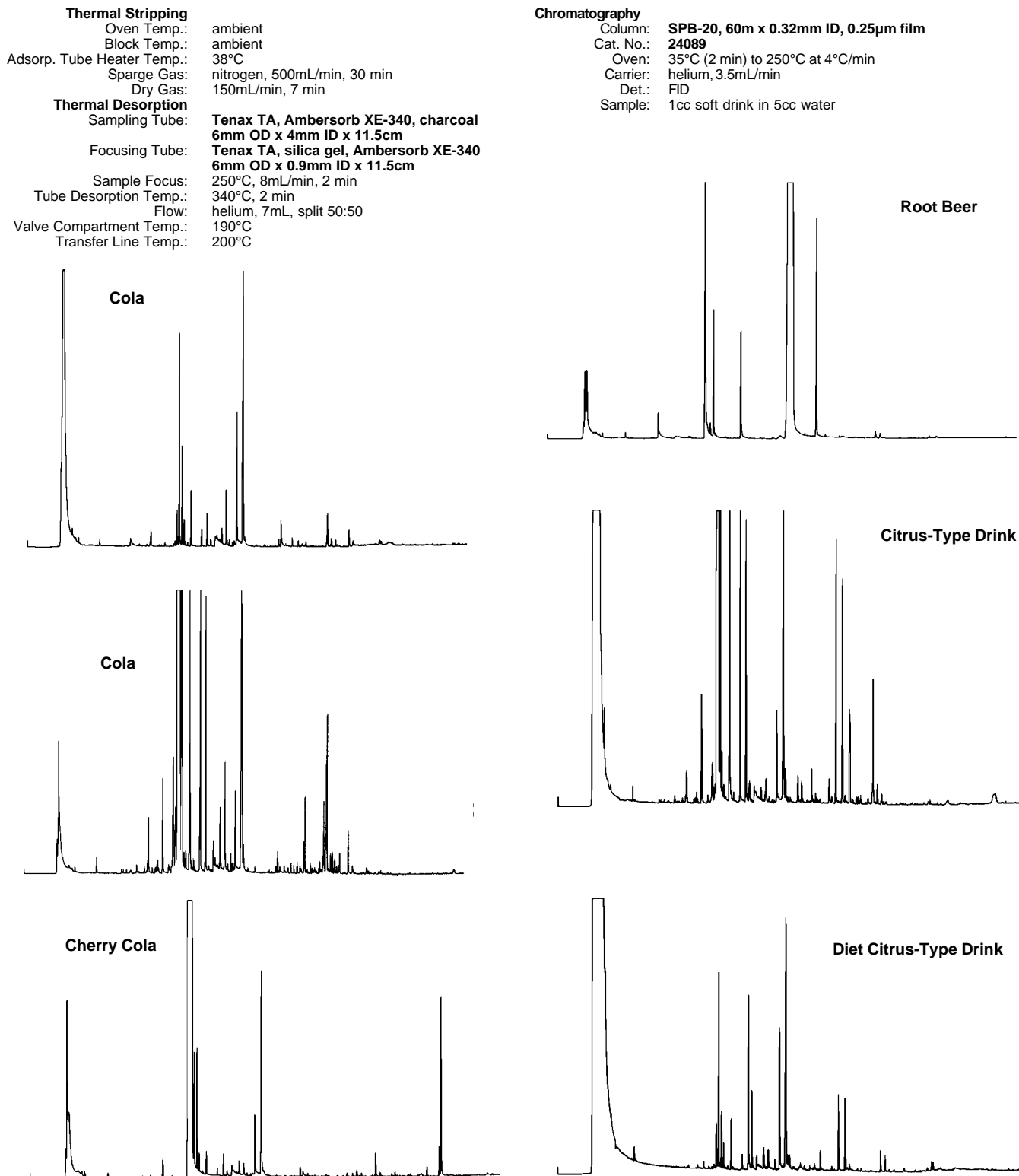


Figure courtesy of Mr. D. Paul, Dynatherm, Inc., P.O. Box 159, Kelton, PA 19346, USA.

795-0750, 0751, 0752, 0753, 0754, 0755

## Forensic Applications

### Fresh or Weathered Hydrocarbon Mixtures

Thermal desorption can be used to characterize liquids that are used as accelerants in arson (e.g., gasoline or charcoal lighter fluid). Both volatile and semivolatile sample components can be used as marker compounds, and fresh and weathered materials can be distinguished readily (Figures T-V). The procedure is faster than liquid-liquid extraction, involves lower materials costs, and alleviates solvent disposal problems.

### Figure T. Gasoline

#### Thermal Stripping (Standards)

Oven Temp.: ambient  
 Interface (Block) Temp.: 100°C  
 Adsorp. Tube Heater Temp.: 38°C  
 Sparge Gas: nitrogen, 300mL/min, 8 min  
 Dry Gas: 150mL/min, 7 min

#### Thermal Stripping (Weathered Standards)

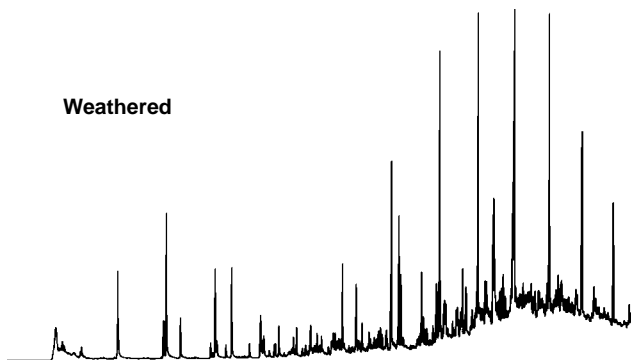
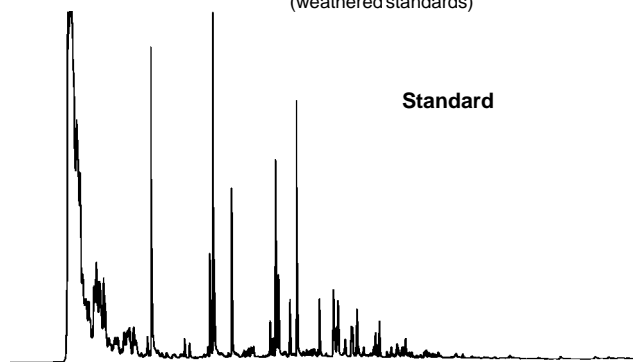
Injection: sample injected onto adsorbent tube packed with glass beads, purged at ambient temperature, 120cc/min, 15 min

#### Thermal Desorption (All Samples)

Sampling Tube: **Tenax TA, Amborsorb XE-340, charcoal 6mm OD x 4mm ID x 11.5cm**  
 Focusing Tube: **Tenax TA, silica gel, Amborsorb XE-340 6mm OD x 0.9mm ID x 11.5cm**  
 Sample Focus: 250°C, 8mL/min, 2 min  
 Tube Desorption Temp.: 350°C, 2 min  
 Flow: helium, 7mL, split 50:50  
 Valve Compartment Temp.: 150°C  
 Transfer Line Temp.: 200°C

#### Chromatography

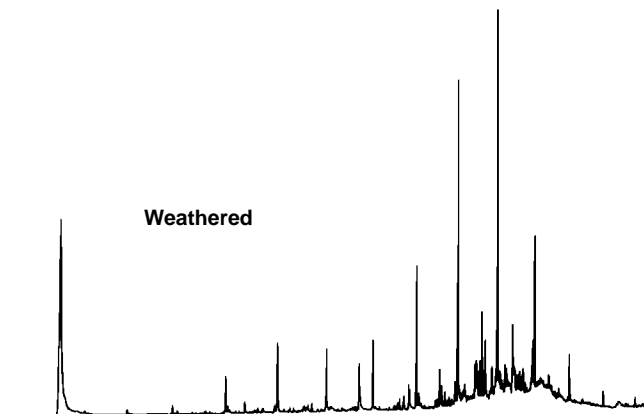
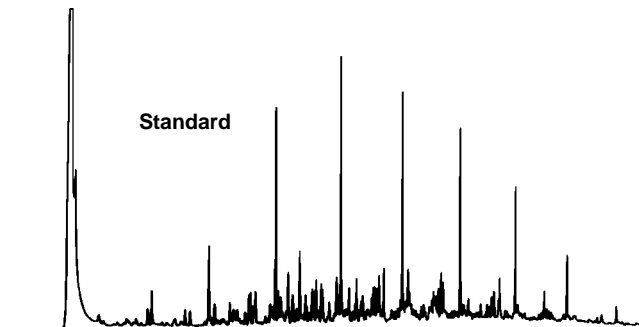
Column: **SPB-20, 60m x 0.32mm ID, 0.25µm film 24089**  
 Cat. No.: 24089  
 Oven: 35°C (4 min) to 250°C at 4°C/min  
 Carrier: helium, 3.5mL/min  
 Det.: FID  
 Sample: 1µL of 5µg hydrocarbon mixture/1µL water mixture in 20cc water (standards) or 2µL neat gasoline, mineral spirits, 40µL of 5µg charcoal lighter fluid/1µL water mixture (weathered standards)



Figures courtesy of Mr. D. Paul, Dynatherm, Inc., P.O. Box 159, Kelton, PA 19346, USA.

795-0756, 0757

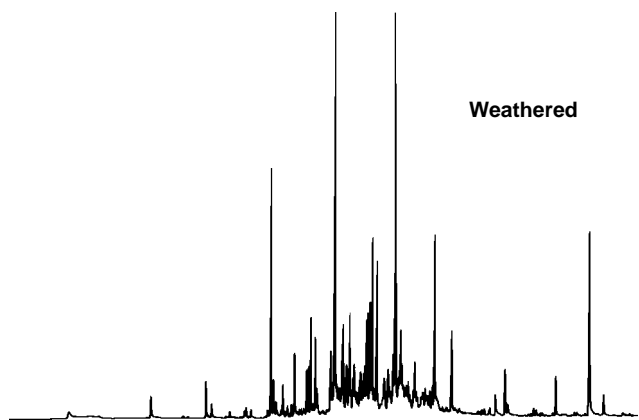
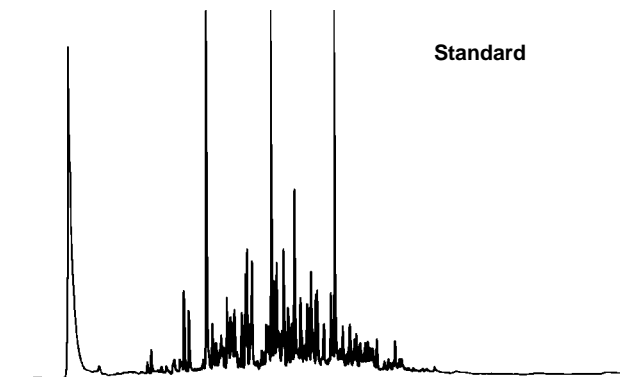
### Figure U. Charcoal Lighter Fluid



Conditions: see Figure T.

795-0758, 0759

### Figure V. Mineral Spirits



Conditions: see Figure T.

795-0760, 0761

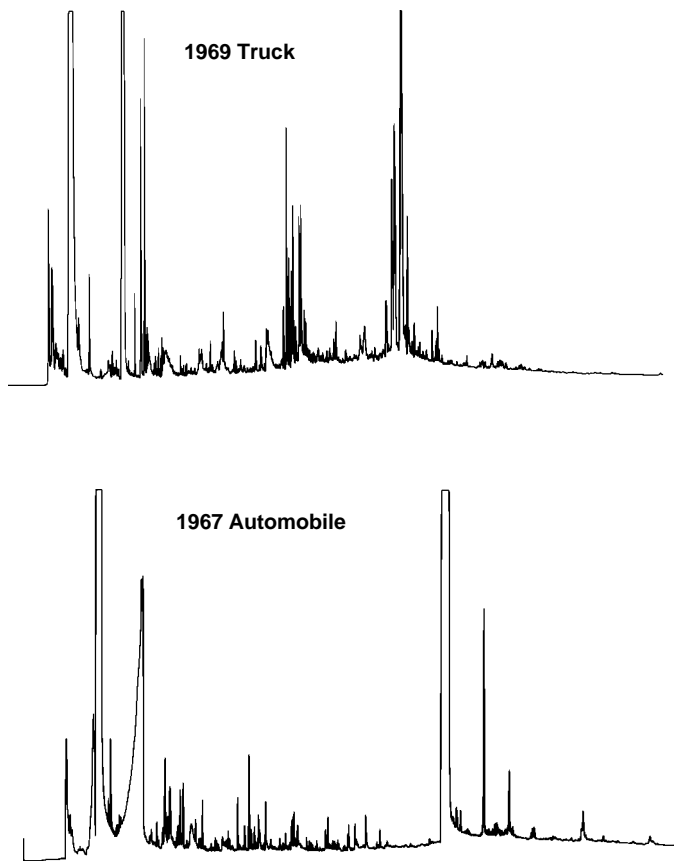
## Forensic Applications

### Solid Samples

To characterize solid materials such as paint chips, powders, etc., simply heat the samples to moderate temperatures in the Model 890/891 Thermal Desorption Unit, trap the thermally extracted components on an adsorbent tube in the trapping port, and separate the trapped components by GC (Figures W and X). Thermal extraction is faster than liquid-liquid extraction, materials costs are reduced, and solvent disposal problems are eliminated.

### Figure W. Red Paint Chips

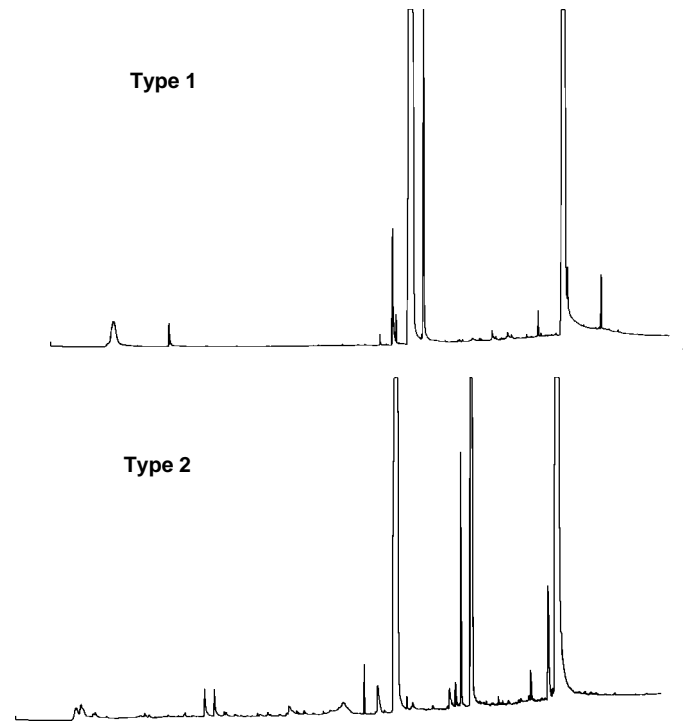
**Thermal Extraction** 390°C, 8cc/min, 10 min  
**Thermal Desorption**  
 Sampling Tube: **Tenax TA, Ambersorb XE-340, charcoal 6mm OD x 4mm ID x 11.5cm**  
 Tube Desorption Temp.: 340°C, 3 min  
 Valve Compartment Temp.: 240°C  
 Transfer Line Temp.: 250°C  
**Chromatography**  
 Column: **SPB-20, 60m x 0.32mm ID, 0.25µm film 24089**  
 Cat. No.:  
 Oven: 35°C (2 min) to 300°C at 7°C/min, hold 10 min  
 Carrier: helium, 3.5mL/min  
 Det.: FID  
 Sample: paint chips in unpacked glass tube, heated at 390°C, 8cc/min, 10 min



795-07692, 0763

### Figure X. Smokeless Powders

**Thermal Extraction** 150°C, 8cc/min, 20 min  
**Thermal Desorption**  
 Sampling Tube: **Tenax TA, Ambersorb XE-340, charcoal 6mm OD x 4mm ID x 11.5cm**  
 Focusing Tube: **Tenax TA, silica gel, Ambersorb XE-340 6mm OD x 0.9mm ID x 11.5cm**  
 Sample Focus: 250°C, 8cc/min, 2 min  
 Tube Desorption Temp.: 350°C, 2 min  
 Valve Compartment Temp.: 200°C  
 Transfer Line Temp.: 200°C  
**Chromatography**  
 Column: **SPB-20, 60m x 0.32mm ID, 0.25µm film 24089**  
 Cat. No.:  
 Oven: 35°C (4 min) to 300°C at 8°C/min, hold 10 min  
 Carrier: helium, 3.5mL/min  
 Det.: FID  
 Sample: 1.2mg powder in unpacked glass tube, heated at 150°C, 8cc/min, 20 min; thermally extracted components collected on adsorbent tube transferred to focusing tube at 250°C, 2 min



Figures courtesy of Mr. D. Paul, Dynatherm, Inc., P.O. Box 159, Kelton, PA 19346, USA.

795-0764, 0765

#### Trademarks

Ambersorb — Rohm & Haas Co.

Aroclor — Monsanto Co.

Tenax — Enka Research Institute Arnhem

Carbopack, Carbotrap, SP, SPB, Supelco, SUPELCOWAX, VOCOL — Supelco, Inc.

Fused silica columns manufactured under HP US Pat. No. 4,293,415.

## Ordering Information:

Description	Cat. No.
<b>Automated Thermal Desorption Equipment</b>	
See the following page.	
<b>Supelco Dynamic Thermal Stripper</b>	
110VAC	<b>22822</b>
220VAC	<b>22827</b>

### Sample Vials for Thermal Stripper

Capacity	Vial w/out Injection Port	Vial w/Injection Port
10mL	—	<b>22675</b>
20mL	<b>22671</b>	<b>22676</b>
40mL	<b>22672</b>	<b>22677</b>
100mL	<b>22674</b>	<b>22679</b>
250mL	<b>22727</b>	—
500mL	<b>22728</b>	—
1000mL	<b>22729</b>	—

### Thermal Desorption Tubes

The design of a thermal desorption tube and the adsorbents used in it are critical components of a well-performing system. We combine expertise in adsorbent chemistry and quality assurance with years of experience in manufacturing glassware to close tolerances. Many of the adsorbents we use are available nowhere else. Between our stock Carbotrap tubes and our custom tube program, we feel we offer the widest selection and highest quality thermal desorption tubes available.

All tubes listed here are 6mm OD x 11.5cm long; IDs are indicated. A screwtop glass storage container is included with each Carbotrap tube.

Carbotrap 100 4mm ID Adsorbents: 20/40 Carbotrap B Applications: trap C5-C12 compounds in air	<b>20238</b>
Carbotrap 150 4mm ID* Adsorbents: 70/80 glass beads, 20/40 Carbotrap C Applications: trap large molecules (PCBs, alkyl benzenes, etc.) in air or aqueous samples	<b>20381</b>
Carbotrap 200 4mm ID Adsorbents: 70/80 glass beads, 20/40 Carbotrap B, 60/80 Carbosieve™ S-III*** Applications: trap C2-C14 compounds in air	<b>20242</b>
2mm ID Adsorbents: 70/80 glass beads, 20/40 Carbotrap B, 60/80 Carbosieve S-III Applications: focus C2-C14 compounds	<b>20244</b>
Carbotrap 201 1mm ID** Adsorbents: 60/80 Carbopack B, 60/80 Carboxen™ 1000 Applications: focus very volatile, semivolatile compounds	<b>20361</b>

Description	Cat. No.
Carbotrap 300 4mm ID Adsorbents: 20/40 Carbotrap C, 20/40 Carbotrap B, 60/80 Carbosieve S-III Applications: trap C2, >C2 compounds in air	<b>20379</b>
2mm ID Adsorbents: 20/40 Carbotrap C, 20/40 Carbotrap B, 60/80 Carbosieve S-III Applications: focus volatile, semivolatile compounds	<b>20382</b>
Carbotrap 301 1mm ID** Adsorbents: 60/80 Carbopack C, 60/80 Carbopack B, 60/80 Carboxen 1000 Applications: focus volatile, semivolatile compounds	<b>20354</b>
Carbotrap 302 4mm ID* Adsorbents: 60/80 Carbopack C, 60/80 Carbopack B, 60/80 Carboxen 1001 Applications: trap volatile compounds in aqueous samples	<b>20356</b>
Carbotrap 370 2mm ID** Adsorbents: 60/80 Carbopack F, 60/80 Carbopack C, 60/80 Carbopack B Applications: trap C5-C30 compounds thermally extracted from solid samples; focus semivolatile compounds	<b>20373</b>
Carbotrap 400 4mm ID* Adsorbents: 20/40 Carbotrap F, 20/40 Carbotrap C, 20/40 Carbotrap B, 20/40 Carboxen 569 Applications: trap C2, >C2 compounds in aqueous samples	<b>20359</b>
Tenax TA 4mm ID* Applications: trap C5-C12 compounds in air	<b>20896</b>

### Empty Tubes

Specially cleaned and silanized. Fill 4mm ID tubes with adsorbents for air sampling, or with solid samples (soil, plastics, etc.) for thermal extraction. Use the narrower bore tubes to focus samples for better chromatography. Order storage containers separately.

Tube ID	Qty.	Cat. No.
0.75mm ID	5	<b>20236</b>
1mm/0.75mm ID**	3	<b>20385</b>
2mm/0.75mm ID**	3	<b>20386</b>
2mm ID	5	<b>20237</b>
4mm ID*	3	<b>20380-U</b>
4mm ID	5	<b>20235-U</b>
VOST Trap, 16mm	1	<b>21993</b>

### Storage Containers

All Carbotrap tubes include a screwtop glass storage container. Order containers for empty 11.5cm x 6mm OD tubes separately. **20375-U**

\*Glass frit at one end.

\*\*ID tapers to 0.75mm.

\*\*\*German Pat. No. 1935500. Patent holder – Badische Anilin- & Soda-Fabrik Aktiengesellschaft.

Description	Cat. No.
-------------	----------

### Automated Thermal Desorption Equipment

ACEM Model 900/901-FF\* **22587**

The ACEM 900 system combines sample adsorption and thermal desorption techniques with gas chromatography. Monitoring of a single source, multiple sources, or a mixture of sample types at the parts per billion or sub-ppb level can be accomplished either on- or off-line, and with automated calibration.

Each sample is collected on a high capacity sorbent tube transferred to a narrow-bore capillary tube packed with similar adsorbent material, and desorbed into the capillary column in a narrow-band, high-efficiency injection, without cryogenic cooling of the GC oven or column.

A patented sequential trapping design enables you to use the system with all sizes of capillary columns (0.20 - 0.75mm ID) without cryofocusing.

Linked with a Vacuum Interface Module, the ACEM can accept samples from a vacuum pump, pressurized canister or pressurized gas calibration standards. With the addition of a multiple thermal desorption unit (MTDU), the ACEM can process 8 to 16 sorbent tubes unattended.

The ACEM can be used as a continuous, on-line system to concentrate/desorb ambient or indoor air samples and low level organics from gas sampling streams. The system features excellent reproducibility of retention time and recoveries, and a sample saver capability for backup analyses or time-weighted average during automatic sampling.

Equipped with stainless steel fast flow valve, heater and swingarm assembly, EPC flow panel, 5-35mL/min column flow controller element, generic remote start cable.

### ACEM Installation Kit **22588**

Includes free-standing rotameter assembly, checkout standard with Tenax®-TA packed sample tubes and focusing trap, copper tubing and fittings for carrier gas connections.

### ACEM Installation Kit for HP 5890 GC **22592**

This is a combination of the ACEM installation kit and a top mounting plate which secures the ACEM 900 and Vacuum Interface to the GC.

### ACEM Vacuum Interface Module **22589**

The analytical conditions shown for the applications in this guide were used with the Model 890/891 Thermal Desorption Unit. These conditions are not necessarily applicable to the automated equipment listed on this page.

Description	Cat. No.
-------------	----------

### Multiple Tube Desorption Unit (MTDU)\*

Model 910, 8-Tube Unit **22594**

Model 916, 16-Tube Unit **22595**

The MTDU Model 910 can sequentially desorb eight sorbent tubes to the ACEM concentrator. In addition, it can interface with many other popular concentrators (such as Tekmar® 2000 or LSC-2), converting them to automatic air sampling tube systems. You can expand your system's automatic capacity to 16 tubes by combining two MTDU units. New sample tubes can be added to the MTDU while the unit is in use. The MTDU interface to the concentrator is through a heated transfer line (maximum 275°C).

### Transformer Assembly/Voltage Changer for the ACEM 900/901FF and MTDU **22593**

Adapts instruments to various voltages and power outlets. Includes two isolated 115VAC outlets, 1000VA max, from an input source of 100, 115 or 230volts, 50 or 60Hz. One voltage changer may supply power to multiple instruments, but total load may not exceed 1000VA.

### Fused Silica Capillary Columns

SPB-5

30m x 0.32mm ID, 1.0µm film **24049**

60m x 0.32mm ID, 1.0µm film **24051**

60m x 0.75mm ID, 1.0µm film **23721**

SPB-20

60m x 0.32mm ID, 0.25µm film **24089**

SPB-608

30m x 0.25mm ID, 0.25µm film **24103-U**

SUPELLOWAX 10

60m x 0.32mm ID, 0.25µm film **24082**

60m x 0.32mm ID, 0.5µm film **24085-U**

60m x 0.75mm ID, 1.0µm film **23723**

VOCOL

60m x 0.32mm ID, 3.0µm film **24157**

60m x 0.75mm ID, 1.5µm film **23731**

### Packed Columns

80/100 Carbopack C/0.1% SP-1000 Packing, 15g **11820**

60/80 Carbopack B/1% SP-1000 Packing, 15g **11815**

60/80 Carbopack B Packing, 10g **20273**

For other packed and capillary columns, please refer to our general catalog. We also custom-prepare thermal desorption tubes with other combinations of adsorbents, and tubes of other dimensions for other thermal desorption units. For information, please inquire. Manufactured by Dynatherm, Inc.