

## DiatoSorb-W Diatomaceous Earth: Great Chromatography Millions of Years in the Making

- Officially listed USP S1A and S1NS support material
- Ideal for many USP and ASTM packed column methods
- Consistent quality and performance
- Always available

### What is DiatoSorb-W?

Diatomaceous earth (DE) is a type of siliceous earth that is made up of the fossilized silica exoskeletons of single-celled algae called diatoms. It was discovered in Germany in the 1830s and since then these humble fossils have grown to play a critical role in many industries and are specified in numerous procedures including many ASTM and USP compendial methods. Since the 1960s, those using packed column methods have depended heavily on diatomaceous earth brands (e.g., Chromosorb) as the solid support material in their packed columns. These original materials worked well, but due to unpredictable availability and quality, today's analysts face long delays and inconsistent product performance.

As a leader in packed column technology, Restek has engineered an improved, saltwater-based diatomaceous earth product called DiatoSorb-W, which is available in acid-washed (WAW), nonacid-washed (WNAW), and high-performance (WHP) varieties. Restek has now replaced white Chromosorb solid support with DiatoSorb-W solid support as the diatomaceous earth used in our GC packed columns and Silcoport W columns. We now pair DiatoSorb-W solid support with our stationary phases and inert tubing types to ensure our diatomaceous earth columns provide the inertness and stability you need for all of your challenging separations. We also offer a wide variety of stationary phases on DiatoSorb-W solid support in 60/80, 80/100, and 100/120 mesh sizes for those who pack their own columns.

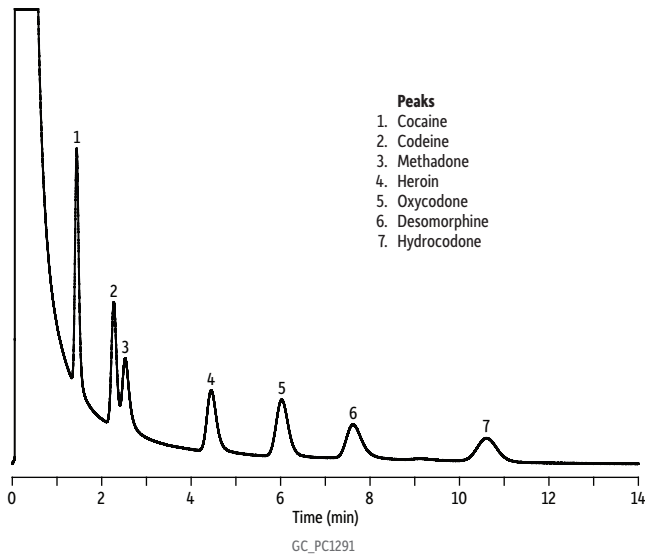
### Why use DiatoSorb-W?

*Consistent Quality and Supply—Finally, a Reliable Source for Diatomaceous Earth*

Virtually unlimited in supply—but only available from Restek—new DiatoSorb-W offers a reliable alternative for packed column users. After years of dealing with white diatomaceous earth brands, such as Chromosorb, being in short supply, users of chromatographic grade material now have a reliable new source. Whether you need diatomaceous earth columns or custom packing materials, DiatoSorb-W products from Restek are always available and consistent in quality.

All DiatoSorb-W solid support undergoes rigorous quality testing to ensure high purity and dependable performance. QC testing includes particle size distribution, density control, and chromatographic analysis to ensure inertness and reproducibility. Every mesh size of DiatoSorb-W raw material is QC tested for particle size distribution and density to ensure it meets our stringent quality control specifications for white diatomaceous earth. Particle size distribution is important since the narrower the distribution, the more efficient a column is; for applications with closely eluting peaks, the narrow peak widths afforded by high efficiency are essential for accurate quantification. The particle size distribution of DiatoSorb-W is extremely narrow, resulting in higher efficiencies and narrower peaks than were obtained on a similar column packed with a non-DiatoSorb-W support (Figures 1 and 2). The basic compounds shown in this comparison clearly show much better resolution and peak shape on the DiatoSorb-W diatomaceous earth column than on the non-DiatoSorb column made with the same tubing and stationary phase.

**Figure 1:** Tight QC specifications for DiatoSorb-W particle size distribution result in high efficiency, narrow peaks, and better separation of closely eluting compounds.



- Peaks**
1. Cocaine
  2. Codeine
  3. Methadone
  4. Heroin
  5. Oxycodone
  6. Desomorphine
  7. Hydrocodone

**Column** 3% OV-17, 0.1% Versamid 900, 100/120 mesh on DiatoSorb-WHP, SilcoSmooth tubing, 1 m, 1/8 in OD, 2 mm ID

**Sample** Methadone (cat.# 34005)  
Cocaine (cat.# 34015)  
Codeine (cat.# 34000)  
Morphine (cat.# 34006)

**Conc.:** 140 µg/mL

**Injection** Inj. Vol.: 1 µL on-column  
Inj. Temp.: 250 °C

**Oven** Oven Temp.: 230 °C (hold 15 min)

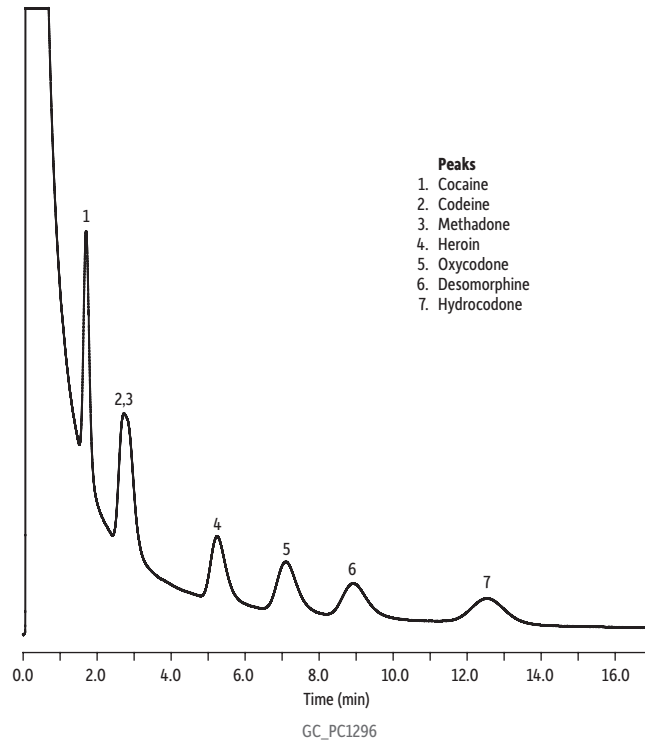
**Carrier Gas** He, constant flow

**Flow Rate:** 40 mL/min

**Detector** FID @ 275 °C

**Instrument** Agilent 7890B GC

**Figure 2:** Coelution occurs on non-DiatoSorb-W diatomaceous earth columns due to the poor efficiency that results from a wider particle size distribution.



- Peaks**
1. Cocaine
  2. Codeine
  3. Methadone
  4. Heroin
  5. Oxycodone
  6. Desomorphine
  7. Hydrocodone

**Column** 3% OV-17, 0.1% Versamid 900, 100/120 mesh on diatomaceous earth WHP, SilcoSmooth tubing, 1 m, 1/8 in OD, 2 mm ID

**Sample** Methadone (cat.# 34005)  
Cocaine (cat.# 34015)  
Codeine (cat.# 34000)  
Morphine (cat.# 34006)

**Conc.:** 140 µg/mL

**Injection** Inj. Vol.: 1 µL on-column  
Inj. Temp.: 250 °C

**Oven** Oven Temp.: 230 °C (hold 15 min)

**Carrier Gas** He, constant flow

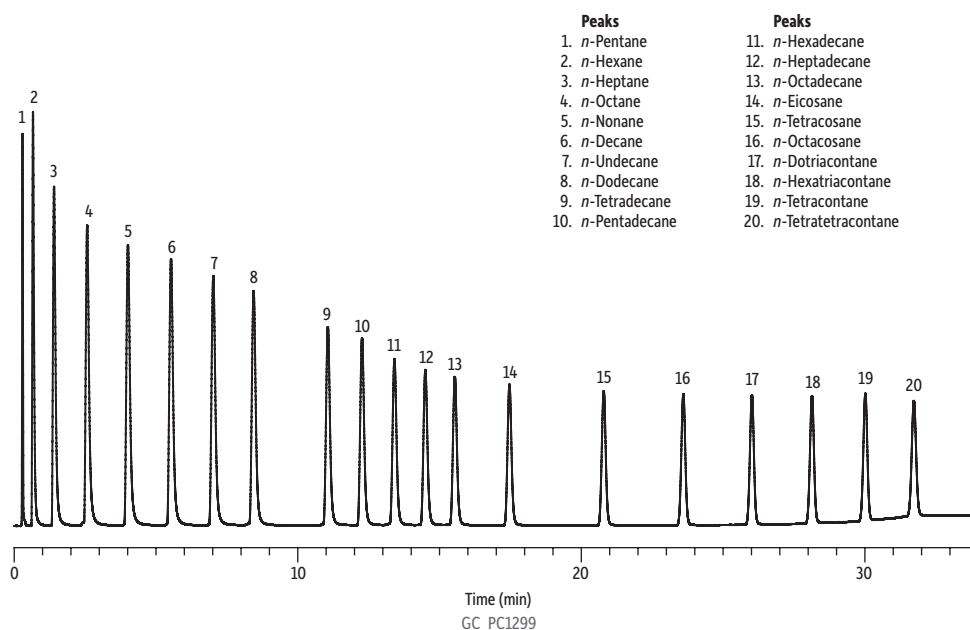
**Flow Rate:** 40 mL/min

**Detector** FID @ 275 °C

**Instrument** Agilent 7890B GC

Along with particle size distribution, small pore size, high density, and high surface area also contribute to packed column efficiency, compound resolution, retention time reproducibility, and overall data quality. Supports with smaller pores have more surface area and higher density, which allows more consistent stationary phase loading. Ultimately, this provides greater retention and more interaction between the compounds of interest and the stationary phase/support. Supports having larger pores have lower surface area and density, which results in less compound-phase/support interaction and decreased resolution of closely eluting compounds. The surface area of Restek's DiatoSorb-W solid support is high enough to accommodate higher stationary phase loading, resulting in higher efficiency and improved resolution, as well as consistent retention time reproducibility. The D2887 chromatogram in Figure 3 illustrates the excellent separation of closely eluting hydrocarbons that is achieved using a high efficiency DiatoSorb-W packed column. The same analysis on a non-DiatoSorb diatomaceous earth column results in broader peak widths and poorer resolution (Figure 4). In addition, a comparison of three different lots of DiatoSorb-W shows very consistent retention time reproducibility (Figure 5).

**Figure 3:** Highly efficient DiatoSorb-W packed columns provide excellent results for simulated distillation.



**Column** Rtx-1 SimDist 2887, 100/120 mesh on DiatoSorb-WHP, SilcoSmooth tubing, 25 in. <sup>1</sup>/<sub>8</sub> in OD, 2.0 mm ID

**Sample** ASTM D2887-12 calibration standard (cat.# 31674)

**Diluent:** Carbon disulfide

**Conc.:** 1% w/w

**Injection**

**Inj. Vol.:** 0.1 µL on-column

**Inj. Temp.:** 350 °C

**Oven**

**Oven Temp.:** 35 °C to 350 °C at 10 °C/min (hold 5 min)

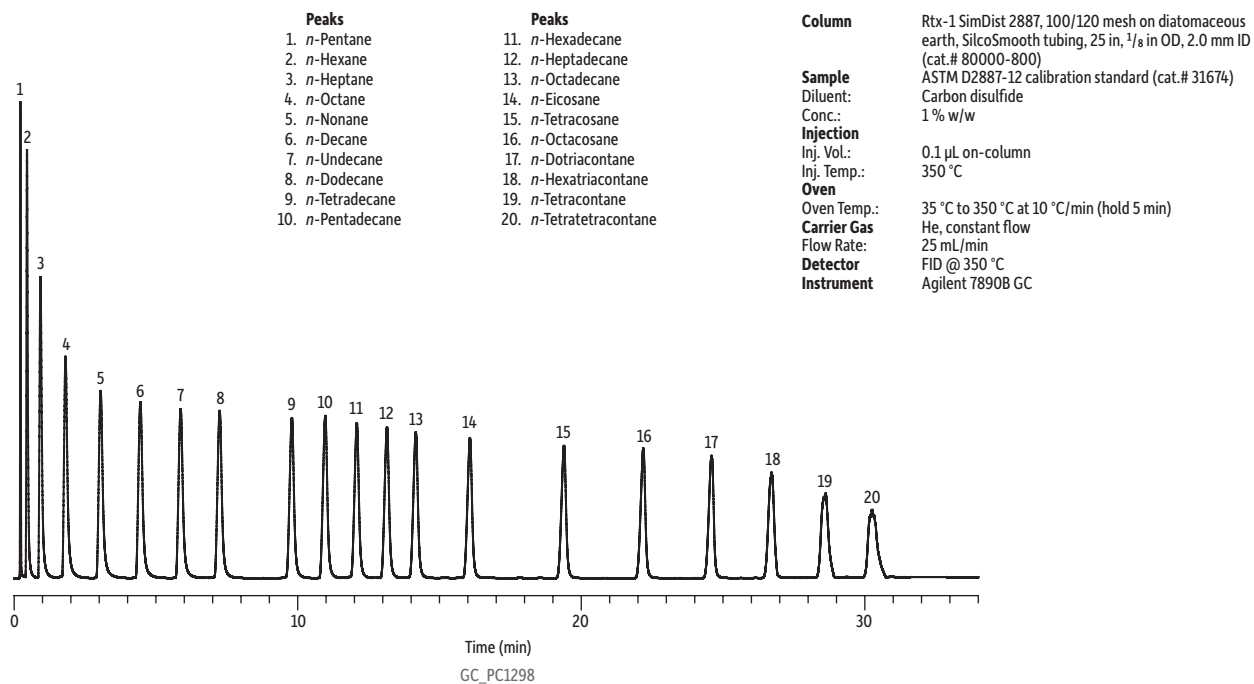
**Carrier Gas** He, constant flow

**Flow Rate:** 25 mL/min

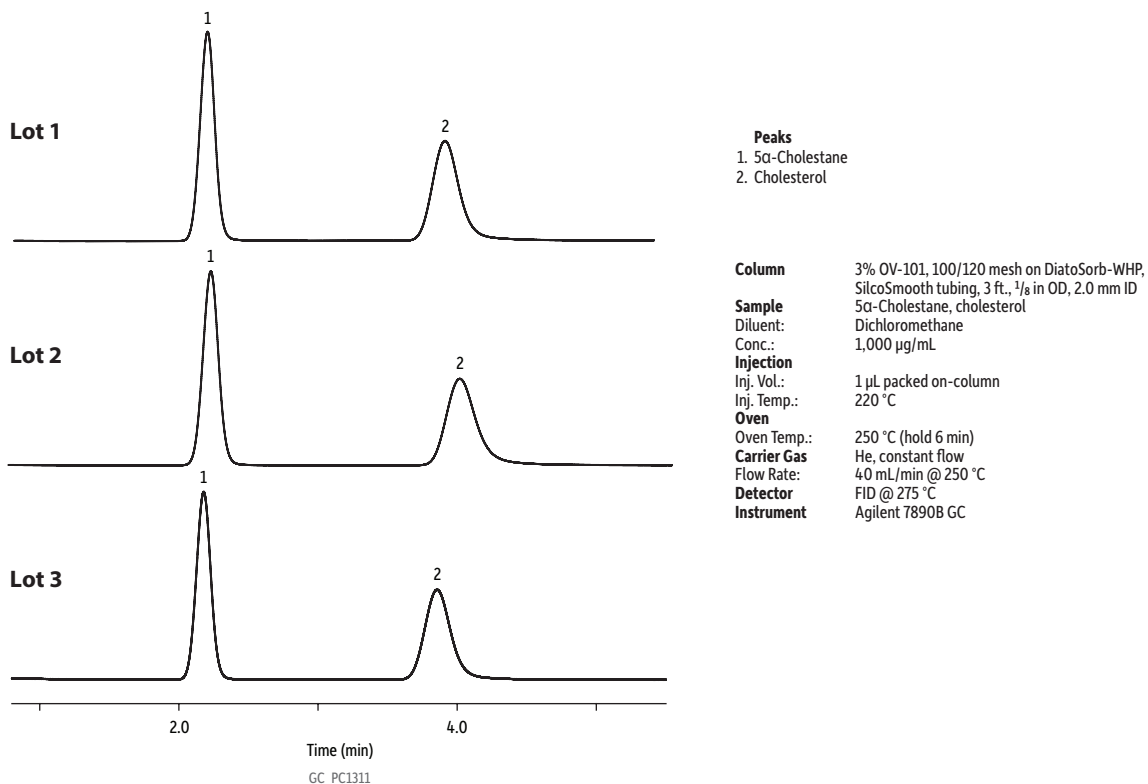
**Detector** FID @ 350 °C

**Instrument** Agilent 7890B GC

**Figure 4:** Non-DiatoSorb-W diatomaceous earth columns show wider peak shapes and poorer separations for simulated distillation.



**Figure 5:** Excellent retention time reproducibility of DiatoSorb-W diatomaceous earth is ensured by tightly controlled manufacturing and strict QC testing.

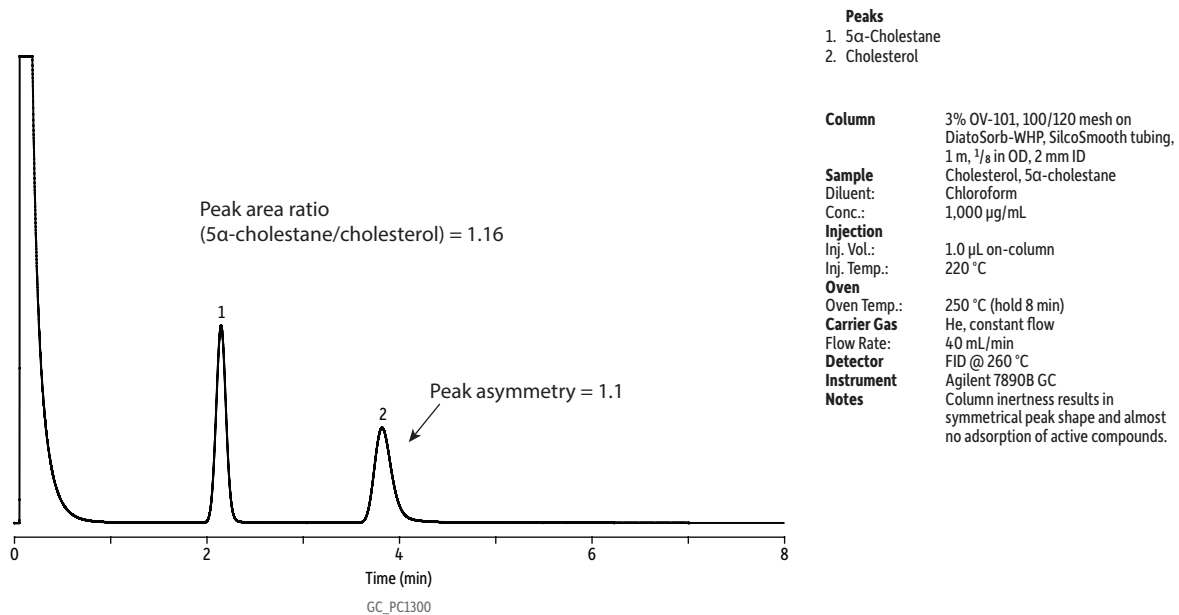


To guarantee inertness, which is critical for obtaining accurate data, each batch of DiatoSorb-W is QC tested with cholesterol and 5 $\alpha$ -cholestane so consistently superior chromatographic performance can be assured. Figures 6–8 compare results for diatomaceous earth columns from different suppliers; all columns are packed with white diatomaceous earth supports coated with 3% OV-101 polymer. The packed columns made with DiatoSorb-WHP support and SilcoSmooth tubing are highly inert and clearly outperform competitor columns as demonstrated by the 5 $\alpha$ -cholestane/cholesterol area ratios. The DiatoSorb-W column produces a ratio of nearly 1.0; whereas, scores of 1.3 and 1.6 on columns from other vendors indicate that compound adsorption is occurring due to poor deactivation and active sites in the column.

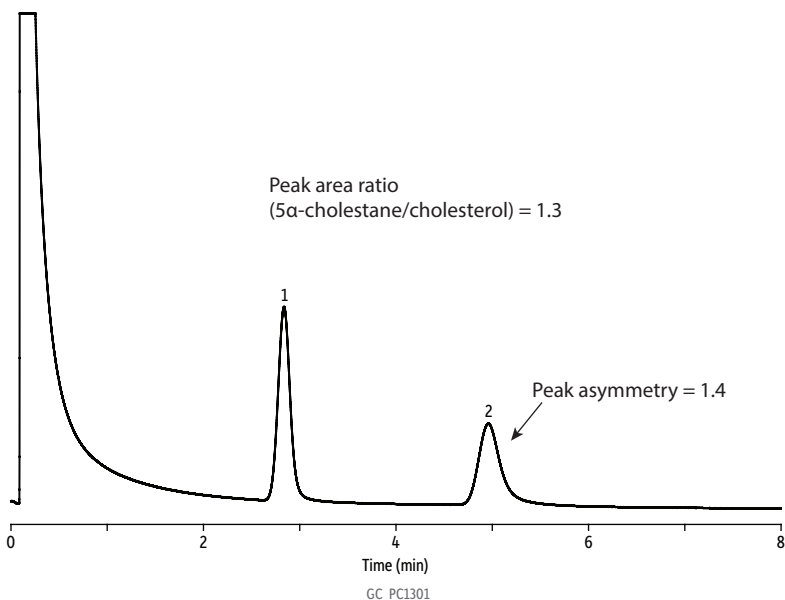
**Table I:** Each lot of DiatoSorb-W diatomaceous earth column solid support is tested with cholesterol and 5 $\alpha$ -cholestane to ensure superior chromatographic performance.

Quality Parameters	Average (n = 9)	Standard Deviation (n = 9)	%RSD (n = 9)
Retention time, min (cholesterol)	3.92	0.13	3.4
Efficiency (cholesterol)	1,893	207	11
Peak area ratio (5 $\alpha$ -cholestane/cholesterol)	1.15	0.01	0.48

**Figure 6:** A 5 $\alpha$ -cholestane:cholesterol area ratio near 1.0 demonstrates that DiatoSorb-W diatomaceous earth columns are highly inert and will produce accurate results.



**Figure 7:** A 5 $\alpha$ -cholestane:cholesterol area ratio of 1.3 indicates the Vendor A column is less inert than the DiatoSorb-W column.



**Peaks**  
1. 5 $\alpha$ -Cholestane  
2. Cholesterol

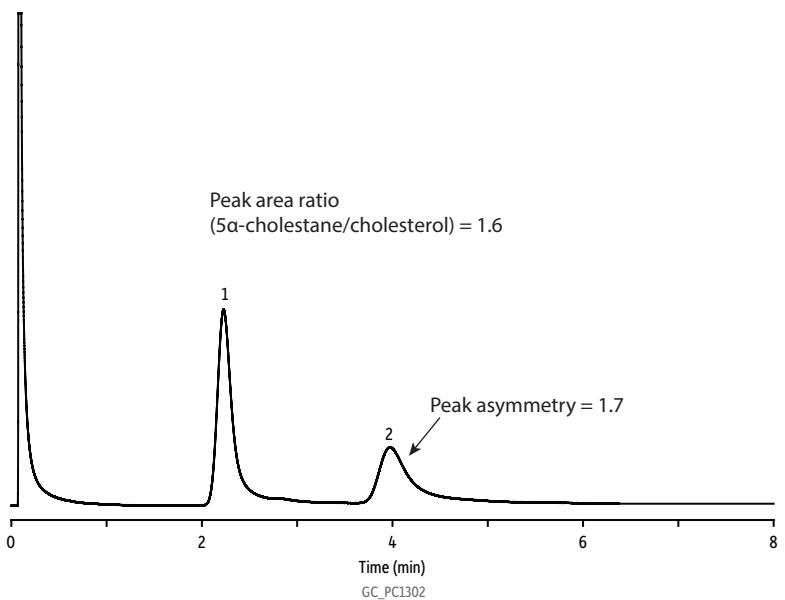
**Column** 3% OV-101, 100/120 mesh on diatomaceous earth WHP type material, glass column, 1 m, 1/4 in OD, 2 mm ID

**Sample**  
Diluent: Chloroform  
Conc.: 1,000  $\mu$ g/mL

**Injection**  
Inj. Vol.: 1  $\mu$ L on-column  
Inj. Temp.: 220  $^{\circ}$ C

**Oven**  
Oven Temp.: 250  $^{\circ}$ C (hold 8 min)  
**Carrier Gas** He, constant flow  
Flow Rate: 40 mL/min  
**Detector** FID @ 260  $^{\circ}$ C  
**Instrument** Agilent 7890B GC

**Figure 8:** A 5 $\alpha$ -cholestane:cholesterol area ratio of 1.6 indicates significant compound loss is occurring due to active sites in the column from Vendor B.



**Peaks**  
1. 5 $\alpha$ -Cholestane  
2. Cholesterol

**Column** 3% OV-101, 100/120 mesh on diatomaceous earth WHP type material, glass column, 1 m, 1/4 in OD, 2 mm ID

**Sample**  
Diluent: Chloroform  
Conc.: 1,000  $\mu$ g/mL

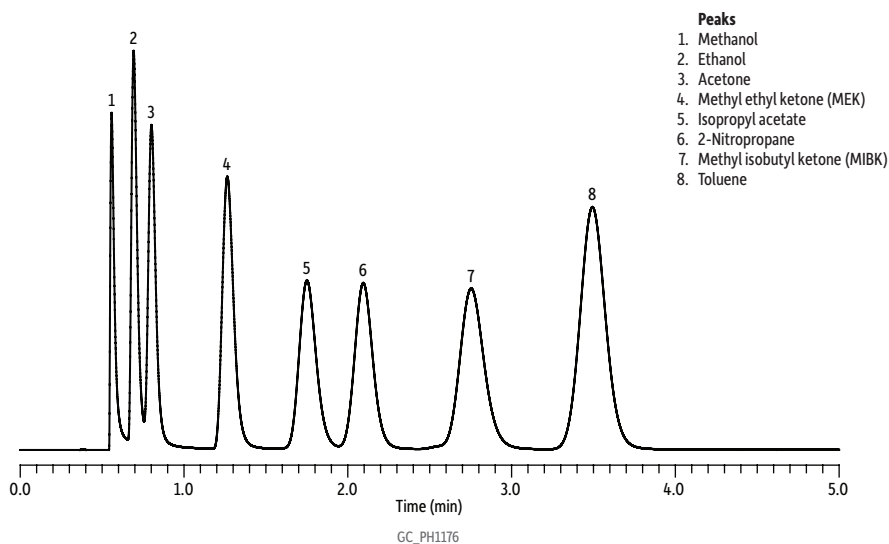
**Injection**  
Inj. Vol.: 1  $\mu$ L on-column  
Inj. Temp.: 220  $^{\circ}$ C

**Oven**  
Oven Temp.: 250  $^{\circ}$ C (hold 8 min)  
**Carrier Gas** He, constant flow  
Flow Rate: 40 mL/min  
**Detector** FID @ 265  $^{\circ}$ C  
**Instrument** Agilent 7890B GC

## Consistent Performance Means Results You Can Trust for Critical Applications

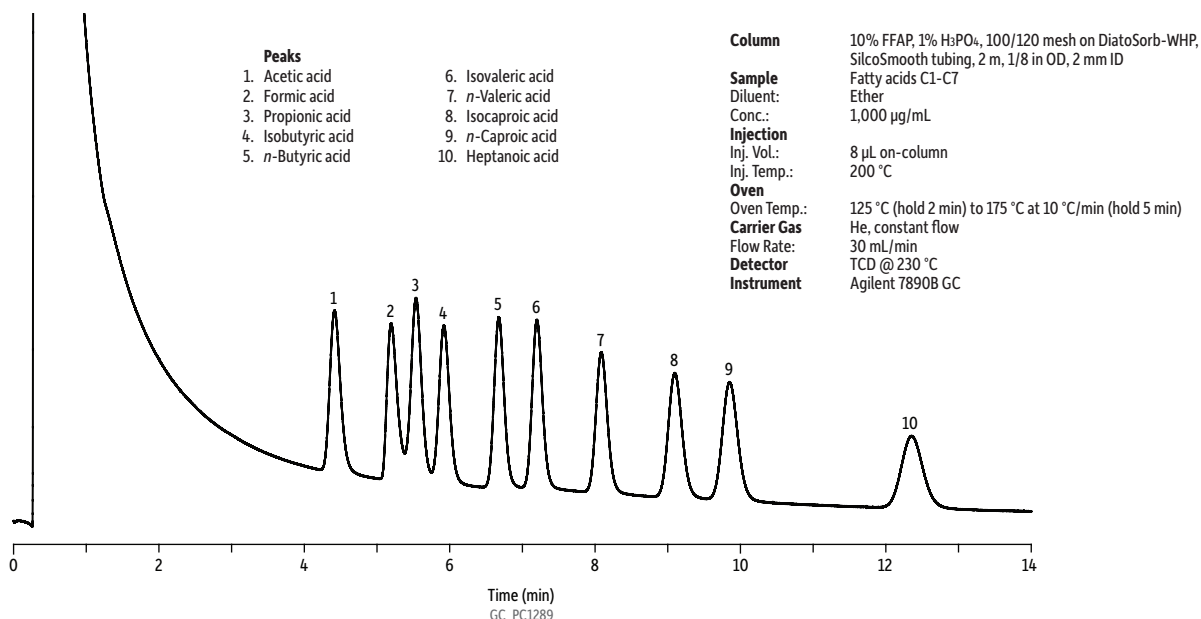
As discussed above, all characteristics of DiatoSorb-W solid support are tightly controlled and rigorously tested. This ensures that DiatoSorb-W packed columns will work dependably for vital applications. For example, accurate solvent analysis is critical for ensuring the safety of finished pharmaceutical products as well as for controlling solvent content in waste streams. As shown in Figure 9, DiatoSorb-W diatomaceous earth columns are a great choice for this analysis because the high surface area of the DiatoSorb-W solid support increases the coating capacity of the polymer, resulting in a column with high efficiency that is able to separate even the most volatile solvents. The analysis of underivatized free fatty acids in Figure 10 is another example of how DiatoSorb-W packed columns perform well for difficult applications. In this case, the high inertness of the DiatoSorb-W column allows these reactive compounds to be monitored reliably even at low levels.

**Figure 9:** Even volatile solvents can be retained and reliably separated on high-efficiency DiatoSorb-W diatomaceous earth columns.



<b>Column</b>	20% OV-101, 0.1% CW-1500, 100/120 mesh on DiatoSorb-WHP, SilcoSmooth tubing, 3 m, 1/8 in OD, 2 mm ID
<b>Sample</b>	
Conc.:	Equal proportions of neat compounds
<b>Injection</b>	
Inj. Vol.:	0.1 µL on-column
Inj. Temp.:	200 °C
<b>Oven</b>	
Oven Temp.:	100 °C (hold 5 min)
<b>Carrier Gas</b>	He, constant flow
Flow Rate:	40 mL/min
<b>Detector</b>	FID @ 250 °C
<b>Instrument</b>	Agilent 7890B GC
<b>Notes</b>	The particle size distribution of DiatoSorb material is more uniform than that of commercially available diatomaceous earth material. For this application, the pressure required to achieve a flow rate of 40 mL/min He (@ 100 °C) on a diatomaceous earth packed column is 50 psi, whereas it is only 33.7 psi on a DiatoSorb packed column. Furthermore, the narrower particle size distribution of the DiatoSorb material results in highly efficient columns.

**Figure 10:** Highly inert DiatoSorb-W packed columns are ideal for analyzing underivatized free fatty acids.



### Switch to DiatoSorb-W and Say Goodbye to Poor Quality and Long Delivery Times

Struggling to find a reliable supply of white diatomaceous earth? Frustrated by the high cost of long delivery times and inconsistent product quality? Save time, money, and aggravation by switching to DiatoSorb-W today. Restek's exclusive supply of raw material and rigorous QC testing ensures that DiatoSorb-W products are consistent in quality and always available. Whether you need packed columns or custom packing materials, DiatoSorb-W diatomaceous earth provides the dependable performance you need for your packed column applications.

#### Meet the Experts

Restek's packed column experts have decades of industry experience. If you have any questions about DiatoSorb-W products or packed column applications, consider them your personal technical resources!



#### Barry Burger

Restek's Senior Petrochemical Innovations Chemist, Barry has more than 30 years of chromatography experience and has been a voting member of the ASTM D2 committee for over a decade. He specializes in petrochemical applications.

[Barry.Burger@restek.com](mailto:Barry.Burger@restek.com)



#### Jaap de Zeeuw

Jaap is a world-renowned chromatographer with over 35 years of experience, including 27 years with Varian/Chrompack focusing on industrial analysis challenges. For his 1979 graduation from The Institute for Higher Education Specialized in Chemistry, Jaap authored a paper titled "The Challenge of Coating Flexible Fused Silica Capillary Columns" and has since distinguished himself as an authority on the subject. Directly involved with the creation of numerous chemically bonded columns, including the first bonded PEG column and the stabilized PLOT columns widely used in the petrochemical arena, Restek's International GC Specialist has helped develop new

techniques, such as fast GC-MS using vacuum GC technology, and has filed two patents for his work. Based out of the Netherlands, Jaap is extensively published and regularly travels internationally to share his knowledge.

[Jaap.deZeeuw@restek.com](mailto:Jaap.deZeeuw@restek.com)



#### Katarina Oden

Katarina came to Restek with a BS in Chemistry from the University of Ljubljana, Slovenia, and research experience in both commercial and university labs. After three years as a QA Analyst, she joined the Innovations Department, where her work focuses on supporting new product development and applications for the petrochemical market.

[Katarina.Oden@restek.com](mailto:Katarina.Oden@restek.com)