

Enhancing Air Monitoring Methods with Thermal Desorption

Advantages Over Solvent Extraction Tubes

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- Accurately monitor down to ppb/ppt levels.
- Use thermal desorption tubes for either active or passive sampling, without modification.
- Compliant with air sampling methods.

The use of active sampling onto glass tubes packed with charcoal, followed by carbon disulfide (CS₂) extraction and gas chromatography (GC) analysis, was developed as an air monitoring method for vapor-phase organic compounds (VOCs) in the 1970s. The approach is still used today for some personal exposure assessment (occupational hygiene) applications and stack emission testing, but is fundamentally limited with respect to detection limits. Thermal desorption (TD) is a complementary gas extraction technique whereby sorbent tubes (Figure 1) are heated in a flow of carrier gas. Trapped vapors desorb from the sample tubes into the gas stream and are transferred into the GC/MS for analysis. Here, we summarize the key advantages of thermal desorption versus solvent extraction.

Sensitivity & Reproducibility

Solvent extraction of charcoal tubes requires at least 1 or 2ml of CS₂ followed by injection of only 1-2µl of extract into the GC/MS, resulting in a 1000-fold dilution of the sample right at the start of the process. Conversely, thermal desorption allows complete transfer of all target analytes to the analytical system, with no dilution or solvent interference. Detection limits offered by thermal desorption methods facilitate ambient monitoring at ppt/ppb levels as well as higher ppm (and %-level) concentrations. In addition to high sensitivity, thermal desorption is highly reproducible, offering efficiency greater than 95%, regardless of ambient conditions and the nature of the target analytes. By comparison, results from solvent desorption tubes may be highly variable.

Passive Sampling Option

While thermal desorption tubes are used extensively for active air sampling, they are also compatible with low-cost passive sampling. Passive samplers eliminate the requirement for personal monitoring pumps making them much less heavy/intrusive. Instead of a pump, each tube is simply fitted with a diffusion cap at the sampling end.

Repeat Analysis & Method Compliance

The historical advantages of solvent desorption tubes over thermal desorption, such as multiple sample injection and method compliance, no longer hold true. Since the advent of the SecureTD-Q™ thermal desorption unit, quantitative re-collection of split flow during both tube and trap desorption is possible. The utility of quantitative sample re-collection for repeat TD-GC/MS analysis has recently been recognized in standard methods as an aid to TD method/data validation.¹ Well-validated thermal desorption methods for many applications are now available from all the major international standards agencies. Key examples include: EN ISO 16017, ISO 16000-6, ASTM D-6196, US EPA Method TO-17, NIOSH 2549, MDHS 72, 80, etc. (UK) and EN 14662.

Conclusion

Thermal desorption technology offers several significant advantages over conventional solvent extraction. TD systems offer better sensitivity, desorption efficiency, and reproducibility compared to charcoal/CS₂ systems. Additionally, tubes may be used for both passive and active sampling without modification. These benefits, in combination with SecureTD-Q™ technology, which allows repeat analysis, make thermal desorption an excellent choice for many air monitoring applications.

References

1. ASTM D6196-03

Figure 1 A selection of thermal desorption air sampling tubes from Restek's new line.



Thermal Desorption Unit (TDU) Tubes

- Variety of sorbents to collect a wide range of VOCs.
- Use glass tubes for maximum inertness in active sampling.
- Choose stainless steel tubes for either active or passive sampling. No sampling pump necessary for passive sampling with diffusion caps!
- Individually etched with unique serial number for convenient sample identification.
- Available unconditioned or preconditioned and ready to sample. Tubes are Reusable after thermal desorption.

High-quality thermal desorption tubes by Markes International are now available from Restek. These sorbent tubes are suitable for ppt to ppm concentrations of volatile organic compounds (VOCs) in ambient, indoor, and industrial hygiene environments. Available in both stainless steel and glass (for thermally labile VOCs), they fit Markes ULTRA-UNITY, PerkinElmer, and Shimadzu thermal desorbers. Packed tubes come with a report detailing the total mass of sorbent in the tube; conditioned tubes also include a blank chromatogram.

Thermal Desorption Tube Sorbent	Applications
Tenax TA	Vapour phase organics from C6/7 to C26
Graphitized Carbon	Vapour phase organics from C5/6 to C14
Tenax GR/Carbopack™ B	Vapour phase organics from <i>n</i> -C5/6 to <i>n</i> -C20 (EPA Methods TO-14/TO-15/TO-17)
Carbopack™ B/Carbosieve™ SIII	Vapour phase organics from <i>n</i> -C2/3 to <i>n</i> -C12/14 (EPA Methods TO-14/TO-15/TO-17)
Tenax TA/Graphitized Carbon/Carboxen™ 1000	Vapour phase organics from C2/3 to C20
Carbopack™ C/Carbopack™ B/Carbosieve™ SIII	Vapour phase organics from <i>n</i> -C2/3 to <i>n</i> -C16/20 (EPA Methods TO-14/TO-15/TO-17)



method applications

Method	Application
US EPA	TO-17
ASTM	D-6196
NIOSH	2549
DIN EN ISO	16017

Specifications

Dimensions: 1/4" OD x 3-1/2" long
 Low sampling rates:
 0.01-0.20 L/min.
 (<10L total volume)
 Long-term storage caps are supplied with conditioned tubes

Thermal Desorption Unit Tubes, Unconditioned and Conditioned & Capped

Description	qty.	Unconditioned		Conditioned & Capped	
		Stainless Steel cat.#	Glass cat.#	Stainless Steel cat.#	Glass cat.#
TDU Tubes, Tenax TA	10-pk.	24056	24062	24080	24086
TDU Tubes, Graphitized Carbon	10-pk.	24057	24063	24081	24087
TDU Tubes, Tenax GR/Carbopack™ B	10-pk.	24058	24064	24082	24088
TDU Tubes, Carbopack™ B/Carbosieve™ SIII	10-pk.	24059	24065	24083	24089
TDU Tubes, Tenax TA/Graphitized Carbon/Carboxen™ 1000	10-pk.	24060	24066	24084	24090
TDU Tubes, Carbopack™ C/Carbopack™ B/Carbosieve™ SIII	10-pk.	24061	24067	24085	24091



Stainless Steel, Conditioned and Capped

Thermal Desorption Unit Tubes, Empty

Description	qty.	Stainless Steel cat.#	Glass cat.#
TDU Tubes, Empty	10-pk.	24054	24055



Glass, Unconditioned

Thermal Desorption Unit Tubes, Calibration

Description	qty.	Stainless Steel cat.#	Glass cat.#
TDU Tubes, Calibration, Tenax TA 1cm Bed	10-pk.	24075	24076
Description	qty.	cat.	
Calibration Solution Loading Rig	ea.	24077	
Calibration Solution Loading Rig 9.5mm Replacement Septa	10-pk.	24078	
Certified Reference Standard, 100ng BTX on Tenax TA	10-pk.	24079	



Stainless Steel, Unconditioned

Thermal Desorption Unit Tubes, Accessories

Description	Benefits/Uses	qty.	cat.
1/4" Brass Cap and PTFE Ferrules	Use for long-term storage of blank/sampled tubes.	20-pk.	24068
1/4" PTFE Ferrules	Long-term storage caps.	20-pk.	24069
CapLok Tool	Use for tightening long-term storage caps.	ea.	24070
Pen Clip		10-pk.	24071
TubeMate Tool	Assists with tube packing.	ea.	24072
1/4" Stainless Steel Union and PTFE Ferrules	Use for connecting tubes in series.	10-pk.	24073
Diffusion Caps	Required for diffusive sampling with stainless steel tubes.	10-pk.	24074



CapLok Tool



Diffusion Caps