HS5-TD

headspace-thermal desorption module

Offering ultimate sensitivity for organic volatiles in solids, liquids and gases - all on one flexible analytical system

MARKES international

HS5-TD module for UNITY 2

Automated equilibrium HS coupled with full-functionality TD

Markes International's HS5-TD module brings together two of the most powerful GC introduction techniques: headspace (HS) and thermal desorption (TD). The combined HS5-UNITY 2 system offers users optimum sensitivity for trace-level organics in solid, liquid and vapour-phase samples, all on one versatile analytical platform.

The HS5-TD comprises a manually operated, 5-vial headspace unit which integrates with Markes' state-of-the-art fully-functional UNITY 2 thermal desorber. The unit accommodates up to 5 standard (~20 ml) headspace vials in a common heated zone with manual vial selection. The inert needle used for vial pressurisation and HS vapour sampling, is lowered into the vial using a convenient, user-operated lever. A heated tower protects the needle and eliminates cold spots. HS vapours from the pressurised vial pass through the needle and directly into the cryogen-free focusing trap of UNITY 2, allowing efficient concentration of the compounds of interest. Water and other unwanted volatiles are selectively purged to vent allowing high sensitivity capillary GC(MS) analysis with minimal interference.

The HS5-UNITY 2 system can be operated in two modes:

- Mode 1: Headspace-trap
- Mode 2: Thermal desorption of sorbent tubes and direct thermal desorption of volatiles and semi-volatiles from materials

Mode 1: Headspace-trap

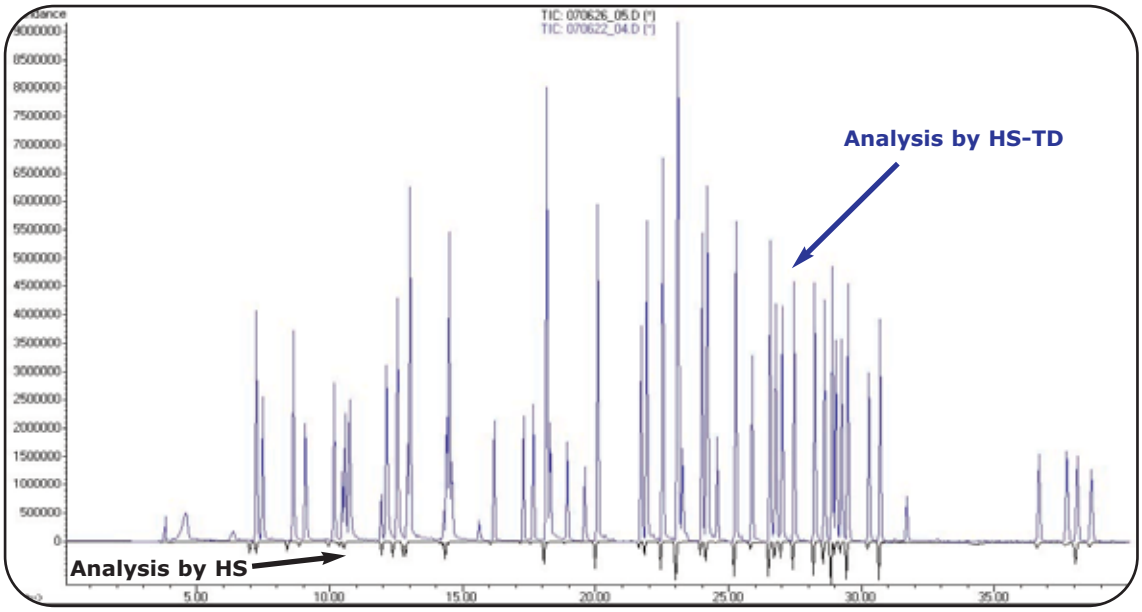
In this mode, pressurised headspace vapours are transferred from the sample vial into the electrically-cooled focusing trap of UNITY 2 before being desorbed/injected into the GC(MS) in a reverse flow of carrier gas. This re-focusing/trapping of vapours allows larger volumes of headspace to be sampled (relative to conventional HS methods) thus enhancing analytical sensitivity. The process of headspace transfer and focusing can be done in a single stage, or repeated several times before the trap is finally desorbed to trigger GC analysis.

The UNITY 2 focusing trap heats at rates up to 100 ºC/sec, transferring retained (S)VOC to the GC(MS) in a narrow, concentrated band of vapour. This ensures uncompromised high resolution capillary chromatography and optimum sensitivity. The UNITY 2 focusing trap is a well-proven technology, compatible with cryogen-free retention and efficient (100 %) desorption of compounds ranging in volatility from C_2 to n-C_{40} hydrocarbons.

The combination of multi-stage headspace trapping with super-efficient trap desorption/GC injection offers maximum sensitivity, ideal for drinking water analysis and other trace-level applications. Repeated pressurisation and evacuation of headspace vials also extends the analyte volatility range, allowing higher boiling compounds to be recovered and measured simultaneously with volatiles.

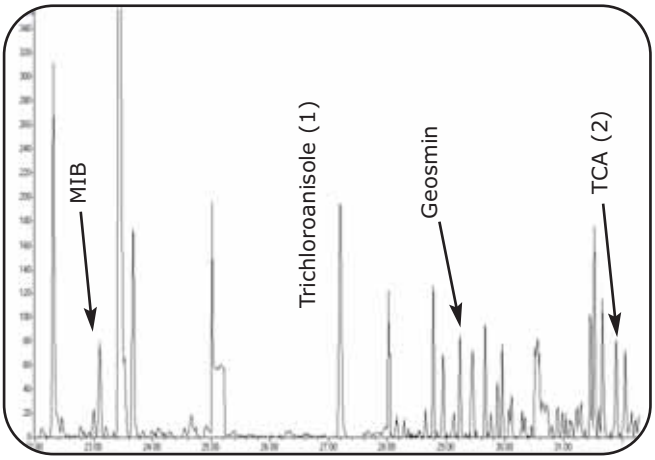
Headspace-trap for trace level detection

HS5-TD increases sensitivity by 1 or 2 orders of magnitude relative to static equilibrium HS. In many cases, it is possible to exhaustively extract all volatiles, leading to the same order of sensitivity as purge & trap analysis but without any of the foaming or aerosol issues that sometimes accompany these methods.



Trace level purgeable VOCs in drinking water analysed by conventional HS (black) and HS-TD (blue)

The high efficiency of UNITY 2 trap desorption ensures great peak shape and optimum sensitivity. It also enables true splitless injection to be carried out, without compromising chromatographic performance. Eliminating the requirement for split injection further enhances the sensitivity of HS5-UNITY 2 for trace applications such as odorants in drinking water

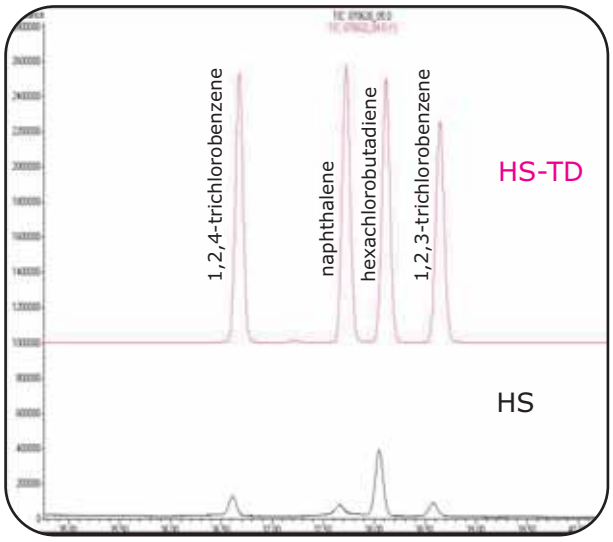


Trace level odorants at 5 ppt level in drinking water (semi-polar capillary column)

Enhanced sensitivity

Broad application range

HS5-TD uses what is, in effect, a dynamic process because volatiles are repeatedly extracted from the sample in multiple steps. This improves the recovery of higher boiling analytes, thus extending the overall volatility and application range compared with conventional static headspace.



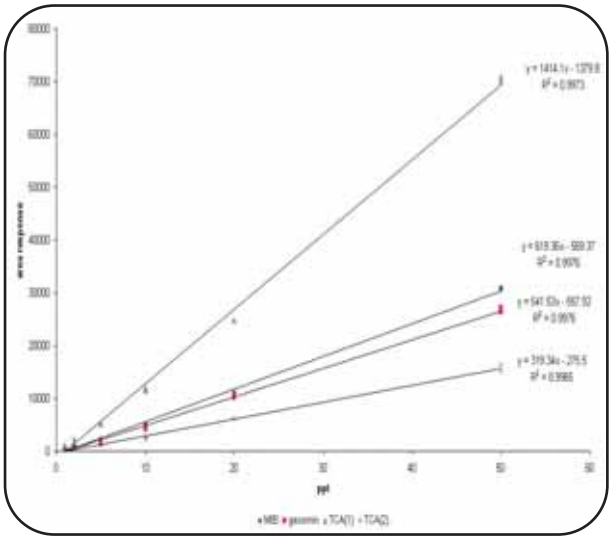
Comparison of conventional HS versus HS-TD analysis, demonstrating improved recovery of the less volatile "purgeable" components in drinking water. See table below

Compound	HS	HS-TD
1,2,4-trichlorobenzene	0.29	0.97
Naphthalene	0.19	1.06
hexacloro-butadiene	1	1
1,2,3-trichlorobenzene	0.22	0.88

Comparison of the relative peak areas (HS:HS-TD) of the least volatile components in the drinking water purgeables standard, normalised to hexachlorobutadiene in each case

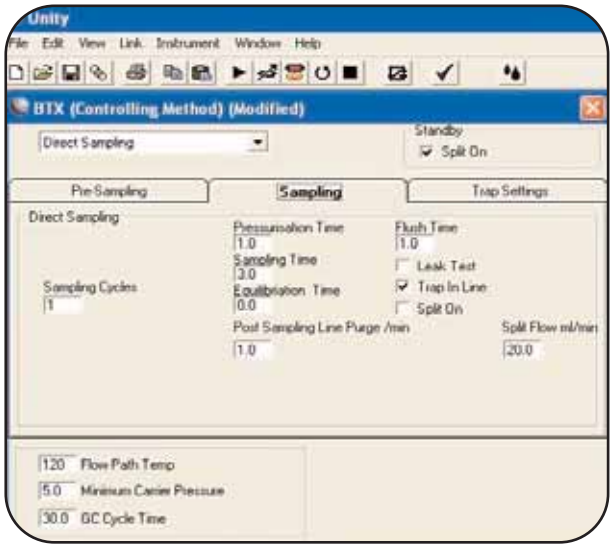
The sophisticated trapping technology used in Markes' HS5-UNITY 2 systems also enables the selective elimination of unwanted volatiles (*e.g.* water or ethanol) whilst compounds of interest are retained. This further enhances system sensitivity for target analytes.

Featuring split or splitless operation in HS-TD mode plus splitless, single-split or double-split operation with 2-stage tube desorption, the HS5-UNITY 2 system provides quantitative information over a wide concentration range. An inert sample flowpath and the ability to switch between HS-trap and two-stage TD operation also ensure compatibility with the widest possible range of analytes and sample matrices.



Linearity of response for ppt level odour compounds, geosmin, methyl-*i*-borneol and trichloroanisoles in drinking water

Solid, liquid & vapour samples



HS5-TD Sampling parameters defined in software

Mode 2: Two-stage thermal desorption

Mode 2 offers state-of-the-art, two stage thermal desorption functionality. Key applications for this include environmental/workplace air monitoring, direct thermal desorption/extraction of residual volatiles/ semi-volatiles, flavour/fragrance profiling and materials emissions testing. All the standard features of UNITY 2, the world's most versatile TD platform, are available to system users including:

- full compliance with standard TD methods
- cryogen-free operation
- stringent leak-testing
- wide concentration range (ppt to %)
- totally inert flow path
- C_2 to C_{40} volatility range, plus compatibility with labile analytes, all on one platform.

UNITY 2 also offers SecureTD-Q™, Markes innovation for quantitative re-collection of all TD sample split flow onto a conditioned sorbent tube. SecureTD-Q enables repeat analysis (overcoming the one-shot limitation of traditional TD systems) and method/data validation per standard TD methods such as ASTM D6196-03.

Switching between mode 1 and mode 2 of HS5-UNITY 2 operation is a simple process, involving selection of the appropriate mode in system software.

"Future-proof" expansion versatility

One of a new generation of multi-function analysers from Markes, the cost-effective HS5-TD system offers unique versatility, uncompromised analytical performance and maximum productivity. It is also fully **upgradeable**. If your laboratory workload increases, your HS5-UNITY 2 system can be extended by adding an UltrA 2 TD autosampler or one of a range of commercial automated headspace systems.

HS5-UNITY 2 upgrade options include:

- Markes UltrA 2 TD autosampler for 100 sample tubes
- G1888 Headspace system for 70 vials (Agilent Technologies)
- G1290 Headspace system (HP7694) for 44 vials (Agilent Technologies)
- HS40 and HS40XL Headspace sampler for 40 vials (Perkin Elmer)*

**Note: Not compatible with the PE TurboMatrix HS40*

Application versatility

Application range

Whether you work in the service laboratory sector, research or quality control, Markes' HS5-TD module offers you the best of all analytical worlds and a secure return on investment. Whatever the sample matrix …, whatever the application … If you have an interest in (semi) volatile organics, **Markes HS5-UNITY 2 system** gives you a flexible, high-sensitivity analytical solution.

Environmental

- VOCs in drinking water, ground water, soils and waste; no risk of sample foaming
- Detection of trace odourants such as geosmin and methyl-*i*-borneol in drinking water
- Ambient and indoor air quality monitoring
- Workplace air monitoring: Personal exposure assessment and biological monitoring *via* breath
- Screening/mapping of contaminated land
- Environmental research

Food, flavour & fragrance

- Fragrance profiling of consumer products and food/drink
- Off-odour and taint in foods (*e.g.* trichloroanisole in wines and food shelf-life tests)
- Residual solvents in packaging, and investigation of odour complaints.
- Biological emissions: Kinetic studies, fragrance profiling, species identification, *etc.*
- Tobacco profiling and smoking research

Materials/product testing

- Residual monomer in polymer
- Product and materials emissions testing
- Forensic applications: Ink characterisation, explosive residues, fire debris, proscribed drugs, *etc.*
- Organics in water based paints
- Residual solvents in powdered pharmaceuticals, ointments and creams

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