Application Note 303WA0801A

The CompactGC with Thermal Desorption option

Keywords: Thermal Desorption, air monitoring, sample collection, ppt analysis, BTX analysis, mass flow controller, unattended on-line monitoring, headspace analysis.

Summary

This application note describes the Thermal Desoprtion (TD) module that is available for the Compact GC. TD is a well-known technique used in gaschromatography for sample enrichment in order to lower the detection limit. Besides the TD technique, some applications are also shown.

Interscience

Introduction

Volatile components are present in nearly every atmosphere. Many of them are toxic, and have strict limit levels. Others may cause inconvenience due to low odour threshold levels. Thermal desorption is the technique of choice for air monitoring (indoor, outdoor, workplace, automobile interior, breath, etc.) It is an invaluable tool when sample enhancement is needed to reach the very low detection levels required. Air sampling/TD is also used in several other application fields, like quality control in food production. This technique is applicable for headspace analysis of liquid samples as well.

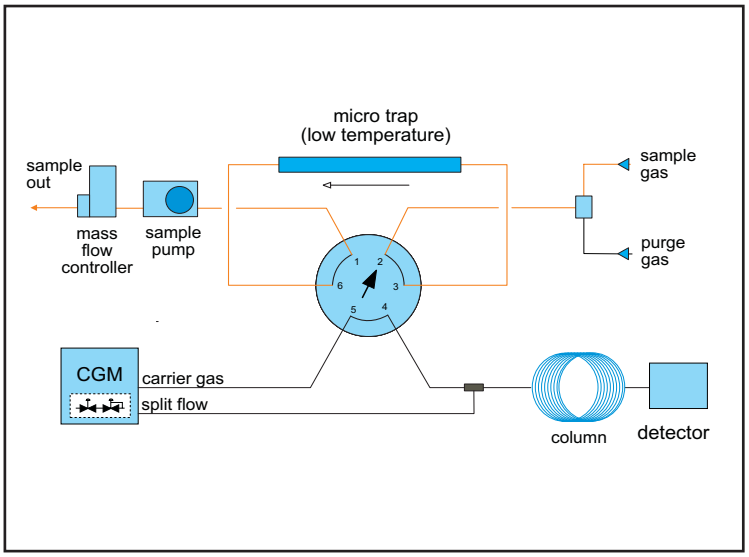

Figure 1: loading the trap with sample

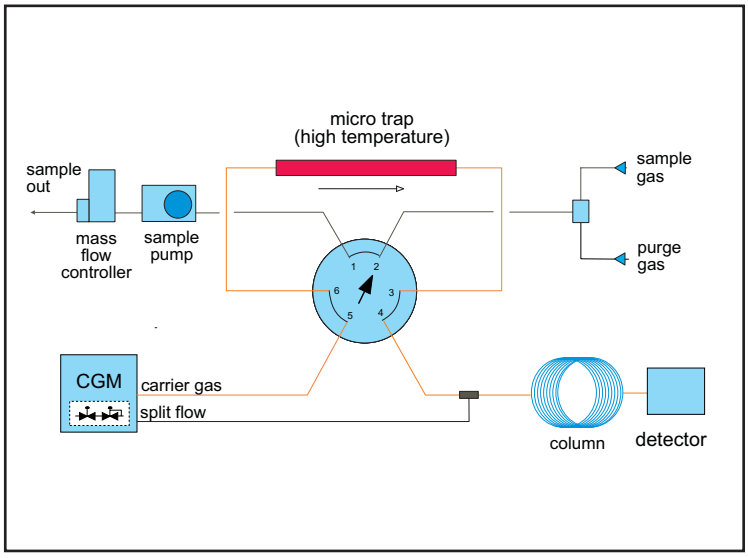

Figure 2: trap desorption

Principle

The typical detection limit of GC detectors like TCD, FID, PID and PDD is in the ppm and ppb range, while Air Monitoring often requires the analysis of low ppb or ppt concentration levels. Thermal Desorption offers a strong tool for sample enrichment to reach these low levels.

The core of the CompactGC-TD monitor is the adsorbent tube that contains a selected material to pre-concentrate the components of interest. Widely used adsorbents are for example Tenax and Vocarb. A precise air volume is directed to the adsorption trap by using a pump and a mass flow controller. Volumes typical range from 25ml to 1 litre. The trap is kept at a low temperature using a thermo electric cooling device (Peltier element), so the instrument runs unattended without the use of cooling agents like C02 or N2.

After the sampling stage, the trap is purged for air and water removal using an inert gas. This ensures good chromatography and avoids degradation of the adsorbent. The tube is still at a low temperature.

The injection valve is switched to the 'inject' position and the trap is heated, in a few seconds, to the required desorption temperature. The components are swept to the analysis column by the carrier gas. The temperature range of the trap depends on the adsorbent used and the components that need to be analysed; a typical temperature range is 0 to 250 °C. A fast heating rate is important in obtaining the small injection band necessary for fast GC analysis, which is a typical property of the CompactGC. During the desorption stage, the trap flow is reversed in relation to the sampling flow. This allows the use of multi-bed traps: two or three separated adsorbents with increasing trapping power for collection of components with a wide boiling point range. The trap temperature is raised again after desorption, to condition the absorbent for the next run.

Instrument configuration

The CompactGC uses isothermal column ovens to avoid time-consuming cooling down time. In case of a broad range of volatile components, the trap is simultaneous injected on two analysis columns with complementary separation power. The column for the low boiling components is equipped with a backflush option to avoid late eluting components.

All the parts described such as collection trap and mass flow controller are located inside the standard 19" enclosure, resulting in a very compact overall design. The CompactGC relies on proven GC technology, using standard available columns and Valco® valves, resulting in a highly reliable instrument with low operational costs.

Application examples

Chromatogram 1 shows a number of components of the TO-14 Aromatic standard (100 ppb concentration level, FID detection). With 30 ml sample volume, the detection limit for Toluene is < 0.3 ppb. The adsorbent used was Tenax TA at 0 °C, and the trap flow was 25 ml/min. Under these conditions, the safe sampling volume can easily be enlarged, resulting in much lower detection limits (ppt level).

Chromatogram 2 shows fermentation products in lager beer, trapped on Tenax TA adsorbent. These components are normally analysed by direct injection (without trapping) at ppm level. But in this case, the thermal desorption option was used to increase the signal to noise ratio, providing easier peak integration, resulting in an unattended analysis system. Several fermentation vessels were successively sampled using an automated stream selection valve.

Conclusion

The CompactGC with TD option has proved to be an important tool for trace compound analysis in application fields like air monitoring and food production. The integrated design in the standard 19" rack mount enclosure offers a compact and easy to handle instrument with powerful analysis properties.

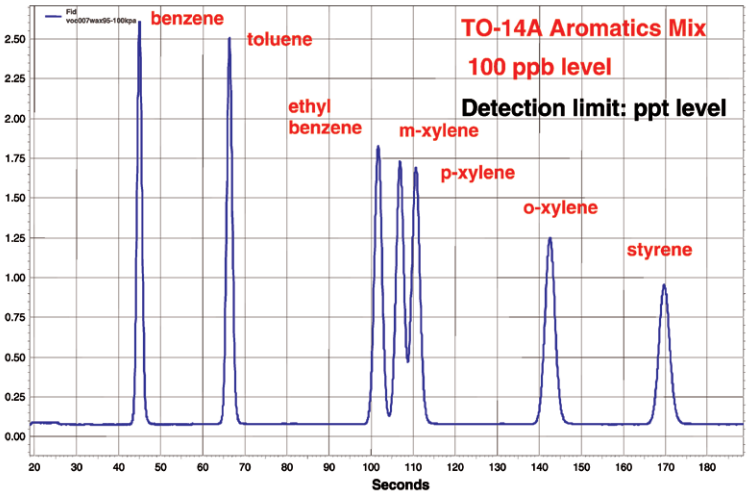

Figure 3: Aromatic compounds, 100 ppb level

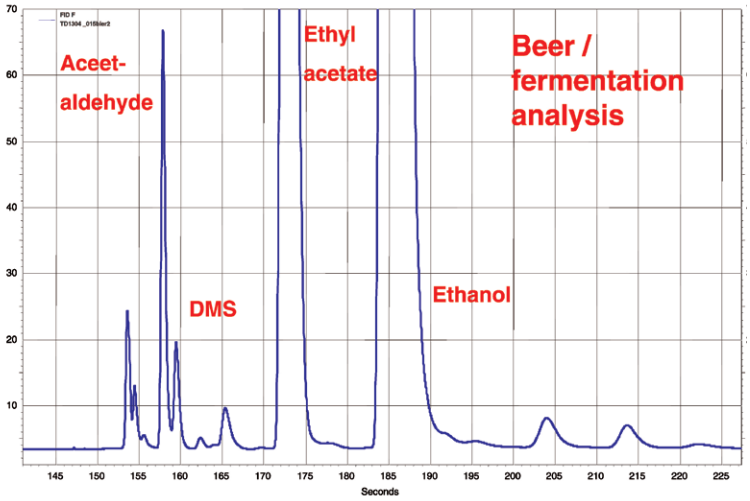

Figure 4: Headspace analysis of fermentation products of lager beer

Benefits

- **Unattended air monitoring and headspace analysis**
- **Analysis at ppt level**
- **No cooling agents needed (Peltier cooling)**
- **Fast desorption**
- **Built in mass flow controller**
- **Compact 19" rack mount GC**

The CompactGC

The CompactGC: Rugged concept based upon proven technology

The CompactGC provides fast analysis in seconds at the sampling point; either by local or remote control of operation and data reduction. It accommodates up to a maximum of 3 independent analysis channels that can be optimised separately for maximum efficiency. Since its construction is based upon proven GC technology, like Valco® valves and classic capillary columns, the CompactGC is synonymous with long-term, trouble-free operation, easy maintenance and low operational costs.

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