TECHNICAL BRIEF

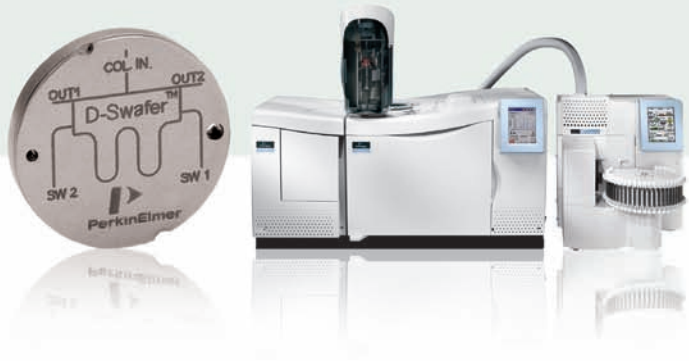
Automated Inlet Switching Using Swafer Technology

Author

Miles Snow

Senior Product Specialist

PerkinElmer, Inc.



The need for automated unattended inlet switching in gas chromatography (GC) is significant in high productivity environments and also in labs that desire instrument flexibility to adapt to changing customer requirements. The modern lab needs high productivity instruments such as headspace, purge and trap, liquid autosampler, or thermal desorption system connected to highly sensitive detectors such as a mass spectrometer (MS). Or most likely, they need to have the flexibility of multiple injection techniques available and controlled from the data station, with no hardware changes required. This paper will show a simple, straightforward approach for inlet switching while maintaining the robustness and ease of a traditional, direct-coupled system.

In order to obtain superior detection limits and excellent chromatographic peak shape, it is necessary to minimize any dead volume in the flow path. This is typically done by a direct connection of the transfer line (usually a section of deactivated fused silica tubing). This configuration does give great chromatography but does not allow the injection of standards or samples into the injection port.

To switch between the two inlet systems would normally mean that the complete GC system would have to be cooled and the column manually disconnected from one inlet and then reconnected to the other before resetting the temperatures back to the analytical conditions. With a MS detector involved, this process can take over an hour resulting in lost time and productivity as well as needing the services of an experienced chromatographer.

The technique described here allows the user to automatically switch between inlet systems as part of an analytical sequence using simple entries in the methods. In this way, it is possible to run samples on a sampling system and be able to use a liquid autosampler to run standards for independent calibration, troubleshooting or even run a totally different analysis.

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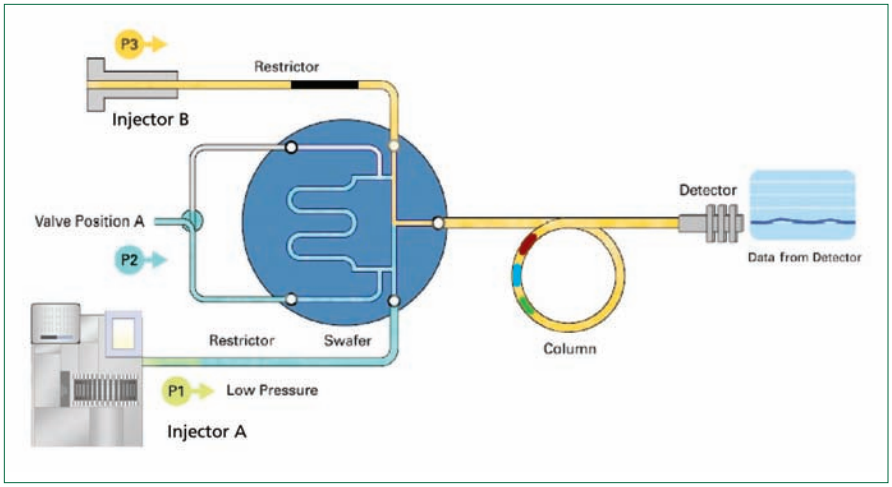


Figure 1. Schematic of D-Swafer system with a liquid injector enabled.

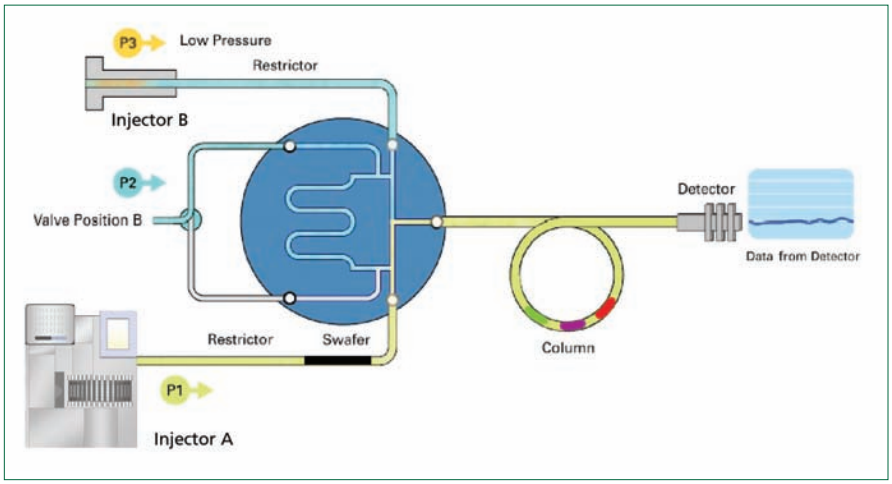


Figure 2. Schematic of D-Swafer system with a thermal desorption system enabled.

Figure 3. Complete TurboMatrix ATD-Clarus GC/MS system from PerkinElmer.

The inlet switching is performed using a PerkinElmer® D-Swafer™ system. This uses a pressure-balancing technique to enable one inlet and disable the other by simple changes to the PPC inlet pressure and a solenoid valve setting. Figures 1 and 2 illustrate how the D-Swafer is configured to enable the inlet switching.

The D-Swafer uses micro-channel flow technology which enables users to perform and totally automate a wide variety of enhanced applications. This technology uses state-of-the-art laser-fabrication techniques to create micro channels in small circular wafers. These wafers are able to be inserted into the sample flowpath to redirect the flow of vapors between injectors (as discussed in this paper), columns and detectors.

The sample considered here is an aerosol contact cleaner that requires analysis in both the native liquid form and as a vapor after evaporation. The gaseous sample will be collected on a PerkinElmer thermal desorption tube and by a TurboMatrix™ 650 Automated Thermal Desorber (ATD) and a Clarus® 600 C GC/MS (Figure 3). Figure 4 (Page 3) shows the D-Swafer installed within the GC oven. The complete conditions are shown at the end of this paper.

Our goal is to be able to either run the gaseous sample by thermal desorption or inject the liquid sample into the heated injection analyzed on the sample column/MS without any hardware changes. The following schematic shows a box diagram of the analysis.

The method is straightforward and the only differences are the relative pressures set at the sampling point (injector or ATD) and the position of the D-Swafer. All of these parameters are software controlled and thus do not require user intervention.

Figure 5 shows example chromatograms of liquid and gaseous samples taken from the same can of contact cleaner.

In these chromatograms, the same peaks are clearly visible. The retention times from the ATD are slightly longer because of the increased path length introduced by the transfer line and the delay introduced as a result of the need to program the temperature of the trap to its upper temperature.

The PerkinElmer D-Swafer demonstrates that it is possible to automate inlet switching without user intervention. In addition, the D-Swafer maintains both the detection limits and chromatography peak shape in an easy to use package.

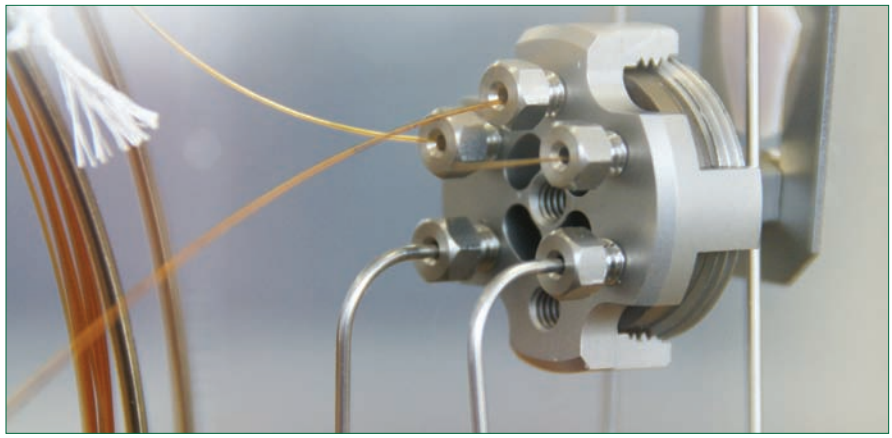
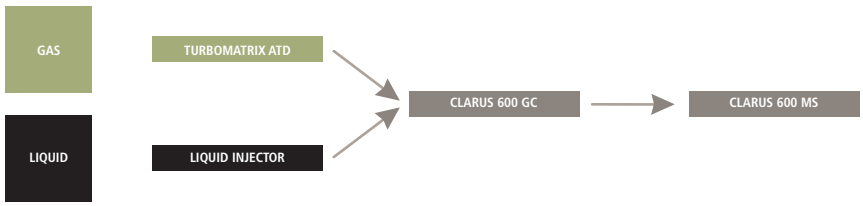


Figure 4. D-Swafer installed in the Clarus GC oven.



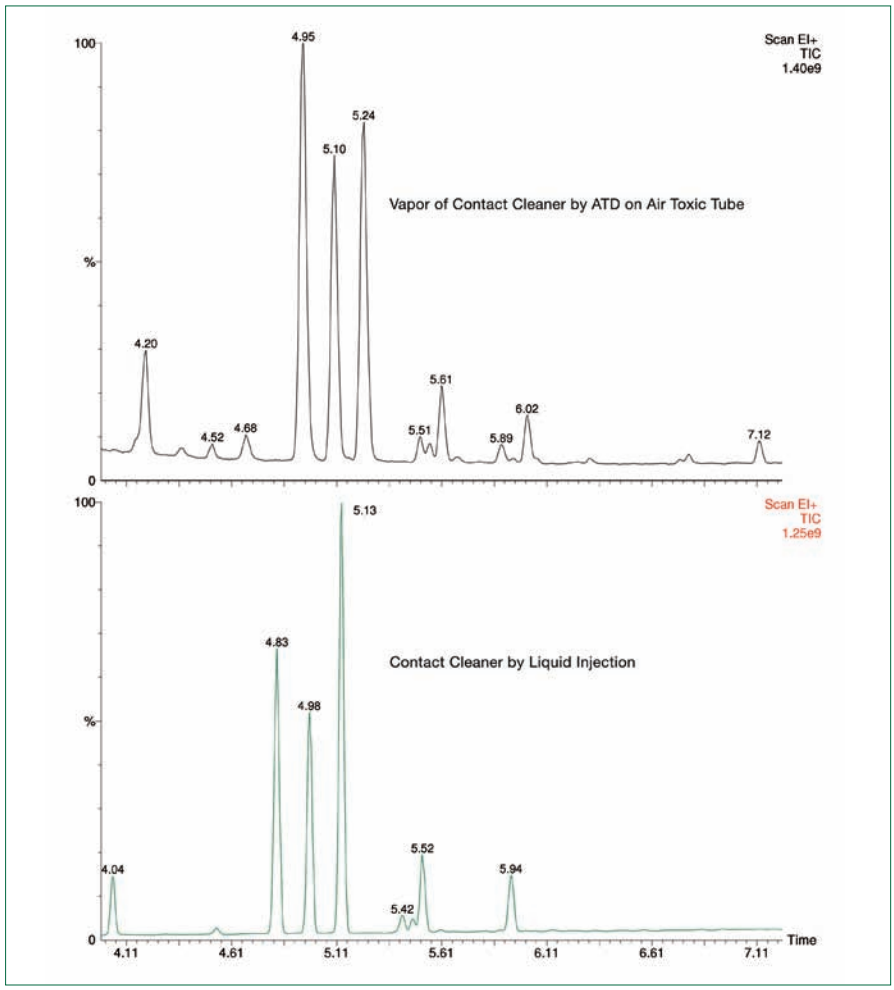


Figure 5. Chromatograms from ATD/gaseous injection (top) and autosampler/liquid injection (bottom) of aerosol contact cleaner.

Appendix

Table 1. Automated Thermal Desorber Parameters.

Instrument	TurboMatrix 650 ATD
Transfer Line	290 ˚C
Valve	220 ˚C
Tube	320 ˚C
Trap	20 to 325 ˚C @ 40 ˚C/sec
Install Trap	vapor intrusion
Tube	vapor intrusion
Mode	2nd stage desorb
Inlet Split	none
Outlet split	50 mL/min
Column Pressure	13.6 psi
Desorb Pressure	13.6 psi
Purge	1 min
Desorb1	10 min
Desorb2	0.2 min
Trap Hold	5.0 min
Cycle Time	20 min
Dry Purge	none
Carrier	helium

Table 2. Gas Chromatograph Parameters.

Instrument	Clarus 600 GC
Oven	40 ˚C; 20 ˚C/min to 300 ˚C; hold for 17 min
Column	Elite-1 60 m x 0.32 mm x 1.5 µm (PerkinElmer Part No. N9316580)
Injector	200 ˚C
Aux 1	12.5 psi

Table 3. Mass Spectrometer Parameters.

Instrument	Clarus 600 C MS
Scan Range	35-300 u
Scan Rate	0.2 sec/scan
Interscan Delay	0.01 sec

Table 4. ATD Injection Method.

Injector Pressure	7.5 psi
V4	off (Valve Position B – Figure 2)
Column Pressure	13.6 psi
Desorb Pressure	13.6 psi

Table 5. Liquid Autosampler Injection Method.

Injector Pressure	15 psi
V4	on (Valve Position A – Figure 1)
Column Pressure	10 psi
Desorb Pressure	10 psi

PerkinElmer, Inc.
940 Winter Street
Waltham, MA 02451 USA
P: (800) 762-4000 or
(+1) 203-925-4602
www.perkinelmer.com

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