A NOVEL METHOD FOR DUTY CYCLE IMPROVEMENT IN HRGC/HRMS USING A DUAL GC CONFIGURATION FOR SIMULTANEOUS RUNS

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Key Words
Dual data acqusition; HRMS; dynamic flow switching; staggered injection; sample throughput; productivity.

Gas chromatographic (GC) methods require a specific chromatographic resolution for a given set of compounds in order to resolve analyte peaks from interferences, other analytes or homologues present in the same sample solution. This requirement is often a limitation when trying to shorten down GC run times in order to save valuable analysis time. A good example is the analysis of polychlorinated dioxins and furans (PCDD/Fs) by GC/mass spectrometry (GC/MS), e.g. in accordance to methods EPA 1613, or EN 1948. In order to achieve the requested GC resolution and other method requirements, typical total GC runtimes of up to 45 minutes, with the first peaks of interest elution after about 20 minutes. In other words, during the first 20 minutes no data acquisition takes place on the MS detector, wasting valuable instrument time.

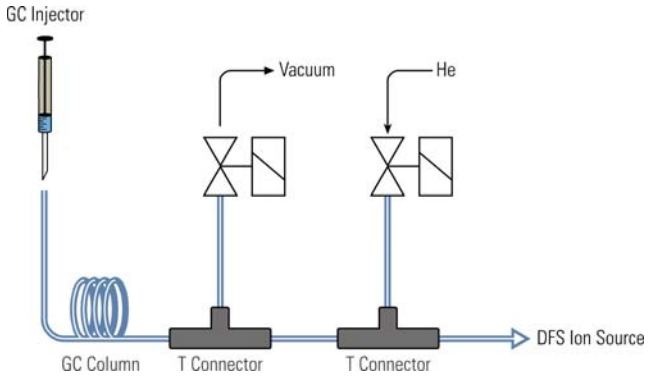

Figure 1: Principle of the DFS Dual Data Acquisition column switching system for dynamic flow switching of the GC effluent

Here we report on the use of two GCs coupled simultaneously to one high resolution mass spectrometer in order to improve the duty cycle of the mass spectrometer. The configuration used in this study consists of two GCs (Trace GC Ultra, Thermo Fisher Scientific, Rodano, Italy) equipped with two identical 5% Phenyl phase capillary columns TR-5MS, 60m, 0.25mm ID, 0.25um film thickness (Thermo Fisher Scientific) and a high resolution magnetic sector GC/MS instrument (DFS, Thermo Fisher Scientific, Bremen, Germany). The columns of each GC were directed into the ion source by direct coupling. Each GC is equipped with a dynamic flow switching system (see Fig. 1) that allows to divert the GC eluate to waste, while maintaining a stable carrier gas flow to the ion source (for details *vide infra*). The GCs are controlled using Thermo GCs Link software (Thermo Fisher Scientific, Rodano, Italy), while the DFS GC/MS system is operated under the Xcalibur software package (Thermo Fisher Scientific, San Jose, CA, USA and Bremen, Germany). Furthermore, some dedicated handshaking electronics were employed in order to synchronize the different devices reliably.

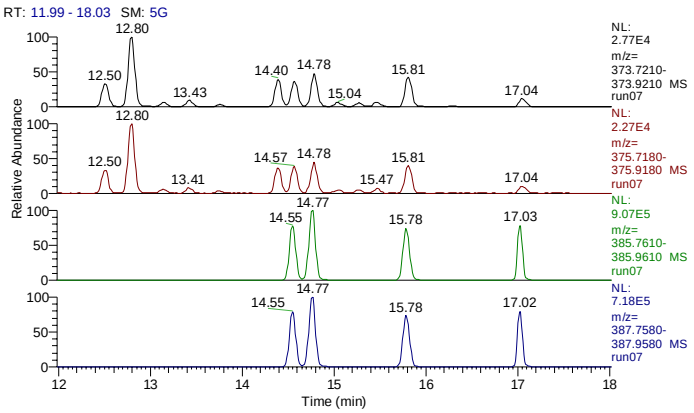

Figure 2: Dioxin trace analysis using the dual data acquisition showing the excellent chromatographic peak integrity.

In a typical experiment, the first GC run was started, and during the first 20 minutes, while the solvent peak as well as other compounds of no interest eluted, all GC eluate was diverted to waste. After 20 minutes, the GC eluate was directed to the ion source of the MS, and MS data acquisition started. At about the same time, a second sample was injected to the second GC, running the same sequence as the first one, i.e. during the first 20 minutes no GC eluate was directed towards the MS. Once the first GC finished cooling down the oven to start condition, another injection occurred, and the same scheme as denoted above occurred.

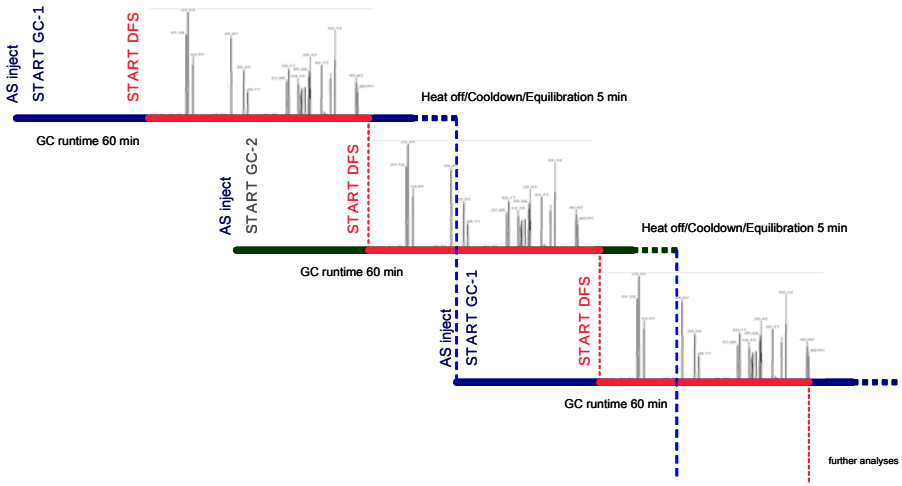

Fig. 3: Concept of the dual data acqusition scheme using two simultaneous GC runs with staggered injections for increased HRMS duty cycle and double sample throughput.

This resulted in two GCs running simultaneously with staggered sample injections. Only the retention time windows of interest from each GC were directed to the MS for data acquisition. The chromatographic integrity of each of the chromatograms remains untouched and provides sharp symmetrical peak shapes (see Fig. 2). As a result, the overall duty cycle on the MS data acquisition improved significantly (see Fig. 3). Roughly twice as many analyses could be carried out compared to a single GC solution. As a side-effect, we expect to see improved MS uptime due to the solvent and other background material of no interest are not eluting into the ion source. Furthermore additional flexibility for large volume injections or the quick change of capillary columns is inherent.