TECHNICAL NOTE

Optimized Helium Consumption in the Thermo Scientific Flash*Smart* Elemental Analyzer

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Key Words
Argon, Carrier Gas, Consumption, Cost per Analysis, Elemental Analysis, Helium, Nitrogen, MVC Module

Goal

To illustrate different options for the reduction of helium consumption in the Thermo Scientific Flash*Smart* Elemental Analyzer.

Introduction

Recently, laboratories have suffered from increasing analytical costs due to worldwide reduced availability and higher market prices of helium. Elemental analyzers, including the Thermo Scientific™ Flash*Smart*™ Analyzer (Figure 1), use helium as a carrier and reference gas during periods of sample analyses and instrument Stand-By Mode. There is therefore a demand for reduced helium consumption or the use of an alternative gas, such as argon, which is more readily available and at lower cost compared with helium.

Figure 1. Thermo Scientific Flash*Smart* Elemental Analyzer.

The Flash*Smart* Analzyer has many workflow optimizations that increase system productivity and reduce cost per analysis. For example, the Thermo Scientific™ MultiValve Control (MVC) Module (Figure 2) has a two-fold functionality that is fully controlled by the Thermo Scientific™ Eager*Smart*™ Data Handling Software. The automated switching between carrier gases and between analytical configurations ensures lowest helium consumption and greater productivity.

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Figure 2. Thermo Scientific MultiValve Control (MVC) Module.

Optimization Methods for Helium Consumption

The Flash*Smart* Analyzer allows you to reduce helium consumption when no analysis is performed. In addition, argon can be used as a carrier gas during analysis and Stand-By Mode. Argon is readily available at a lower cost compared with helium. Table 1 describes five options to reduce helium consumption.

In most of the Flash*Smart* EA configurations (CHNS, CHN, NCS, NC, N/Protein, etc), the flow of helium during the analysis is in general, 140 ml/min Carrier Gas Flow and 100 ml/min Reference Helium Gas Flow. While for oxygen configuration, the flow is 100 ml/min for carrier and reference lines.

Table 1. Optimization methods for lower helium consumption.

Option	Option 1	Option 2	Option 3	Option 4	Option 5
Analytical configuration	Typical Stand-By Mode	EV3 and EV4 electrovalves closed (Leak Test Mode) and Stand-By Mode	Switch to nitrogen gas and Stand-By Mode	MultiValve Control (MVC) Module	Argon Carrier Gas
	All	All	All	CHN/O, CHNS/O, CHN/CHN, CHNS/CHNS, CHN/S, NCS/O, NC/S	N org, N/Protein, NC org, NC Soils, CHN
How do you use it?	Through the dedicated Eager*Smart* Data Handling Software. The Stand-By function can be selected before starting your sequence or activated manually after analyses have completed (Figure 3). The status page provides real time information on the conditions of the Analyzer (Figure 4). To return to analytical conditions, you can use the Auto-ready Function in the Eager*Smart* Data Handling Software.	Through the dedicated Eager*Smart* Data Handling Software. EV3 and EV4, electrovalves of the EFCt (thermoregulated Electronic Flow Controller) close the Carrier and Reference pneumatic circuits during the Leak Test (Figure 5, example NC configuration). During the Leak Test, the Carrier and Reference flows are less than 3 ml/min (Figure 6) if the system is leaks free. To return to Ready conditions, the Leak Test is stopped.	On the rear part of the instrument a three-way valve can be installed in the Helium Gas Inlet Port, which allows manual switching between nitrogen and helium gas. The nitrogen can come from a nitrogen cylinder or a nitrogen generator. To return to analytical conditions, you manually switch from nitrogen to helium.	Through the dedicated Eager*Smart* Data Handling Software (Figure 7). The MVC Module saves helium carrier gas by switching automatically to nitrogen or argon for instrument Stand-By Mode.	Dedicated kit for argon gas. Fully controlled through the Eager*Smart* Data Handling Software. The Stand-By Mode can be selected before starting your sequence or activated manually after analyses have completed.
Helium saving	You save greater than 90% of helium gas (Carrier and Reference). Furnace temperatures are reduced by 50%.	100% helium saving because the system remains under pressure and there is no helium flow. Furnace temperatures are reduced by 50%.	100% helium saving when using nitrogen gas during Stand-By Mode. Furnace temperatures are reduced by 50%.	100% helium saving during Stand-By Mode using nitrogen or argon as an alternative. Furnace temperatures are reduced by 50%.	No helium is used. Argon flows (Carrier and Reference) are much lower than helium flows. Furnace temperatures are reduced by 50%.
Stabilization time before you begin analysis	Less than 30 minutes from Stand-By Mode.	Less than 10 minutes after the Leak Test is stopped.	1 hour after switching from nitrogen to helium.	Less than 30 minutes from Stand-By Mode. One hour after switching from nitrogen/argon to helium.	Less than 30 minutes from Stand-By Mode.
Suggested use	Overnight, weekend, short and long periods.	Overnight, weekend.	Weekend or short and long periods.	Overnight, weekend, short and long periods.	Used as carrier gas for reduced analysis cost.

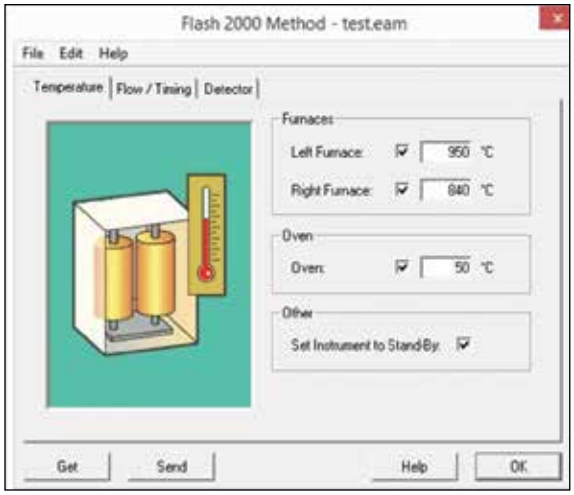

Figure 3. Eager*Smart* Data Handling Software EA Method page.

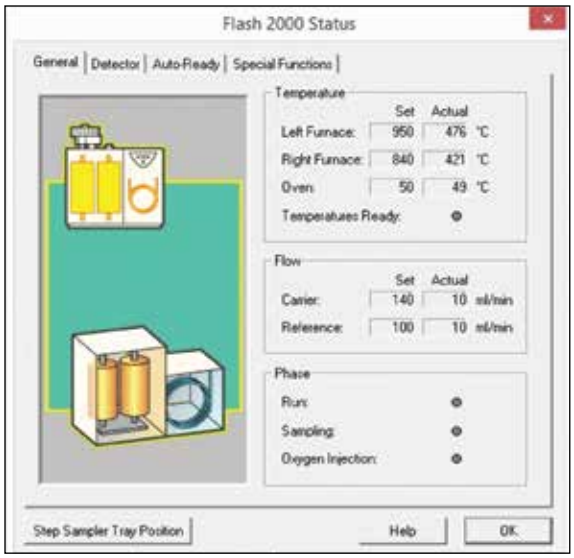

Figure 4. Eager*Smart* Data Handling Software EA Status page.

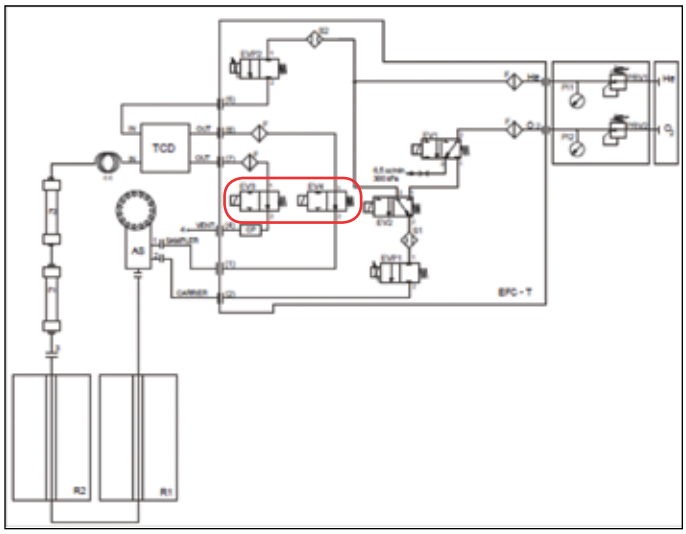

Figure 5. Pneumatic circuit for NC configuration.

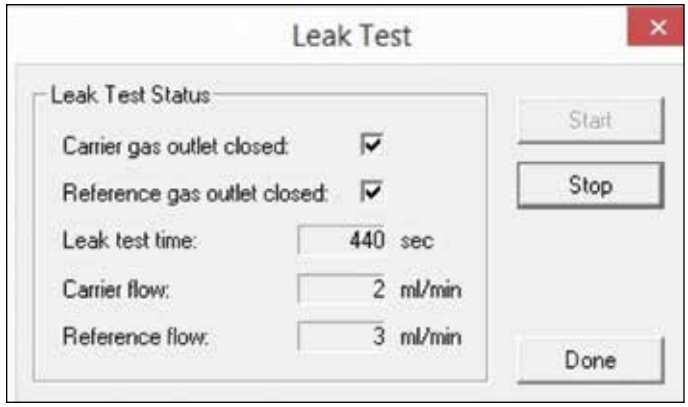

Figure 6. Eager*Smart* Data Handling Software Leak Test page.

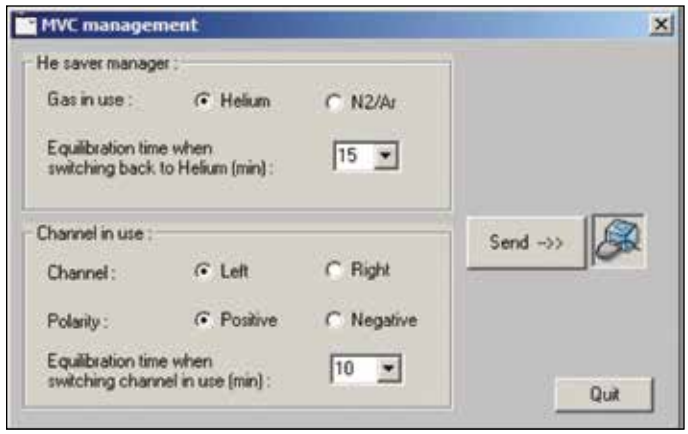

Figure 7. Eager*Smart* Data Handling Software – MVC Management page.

Helium Consumption

In Table 2, an example of helium consumption during analysis and Stand-By Modes for the Flash*Smart* Analyzer is presented. The analytical times are taken as 8 hours per day for 5 days and all other time the Analyzer is in Stand-By Mode.

The values in Table 2 are calculated from a carrier gas flow of 140 ml/min and reference flow of 100 ml/min during analysis times, and carrier gas flow of 10 ml/min and reference flow of 10 ml/min during Stand-By times.

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Table 2. Helium gas consumption.

Helium Consumption	Always Ready*	Option 1 Stand-By	Option 2 EV3 & EV4 closed	Option 3 Switch to N_2 gas	Option 4 MVC Module	Option 5 Argon as carrier gas
Per working day - 8 working & 16 Stand-By hours	345 L	134 L	115 L	115 L	115 L	0 L
Per one week - 5 working days & weekend	2419 L	729 L	577 L	576 L	576 L	0 L
Per month - 4 weeks	9676 L	2918 L	2310 L	2310 L	2310 L	0 L

* Helium flows remain active days and nights (Carrier 140 ml/min, Reference 100 ml/min)

Lifetime of Helium Gas Bottles

To illustrate the reduction in cost per analysis, the lifetime of the helium gas bottle (based on a gas bottle containing 10,000 liters, 200 bar) was evaluated. Results are shown in Table 3.

The lifetime of a helium gas bottle increases by at least 10 weeks when following the options described in Table 1.

Table 3. Helium gas bottle lifetime.

	Always Ready*	Option 1 Stand-By Mode	Option 2 EV3 & EV4 closed	Option 3 Switch to N_2 gas	Option 4 MVC Module
Lifetime	**He**	**He**	**He**	**He**	**He**
Weeks	~4	~14	~17	~17	~17
Months	1 month	3 months + 2 weeks	4 months + 1 week	4 months + 1 week	4 months + 1 week

Conclusions

The Thermo Scientific Flash*Smart* Elemental Analyzer is a valuable solution for the quantitative analysis of one to five elements (nitrogen, carbon, hydrogen, sulfur and oxygen) in terms of accuracy, reproducibility, sensitivity, automation, speed of analysis and cost per analysis.

The cost per analysis is significantly reduced in the Flash*Smart* Elemental Analyzer through its modularity and software driven optimization of helium consumption, which meets laboratories demands for low costs.

The Eager*Smart* Data Handling Software with its automated functions (Auto Stand-By, Auto Ready, Automatic Leak test, Auto OFF, etc) seamlessly manages the system, maximizing laboratory productivity.

Find out more at **thermofisher.com/OEA**

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