TECHNICAL NOTE

EA-IRMS: very low helium consumption on the EA IsoLink IRMS System

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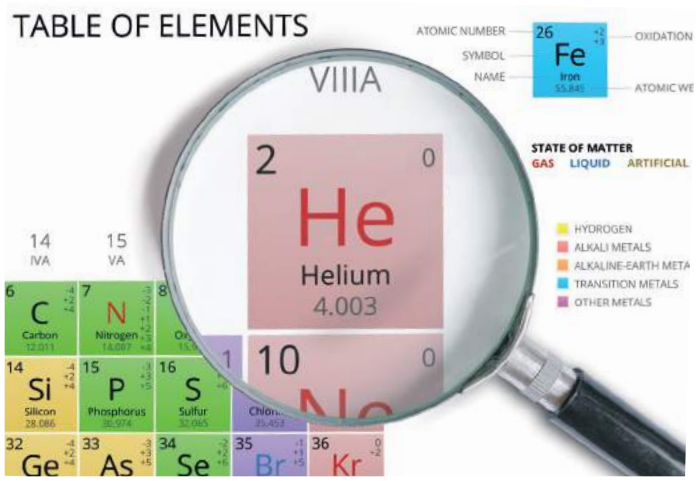
Key Words
Cost per Sample, EA-IRMS, Elemental Analysis, Helium

Goal

To describe the Helium Management (He^{M}) Module of the Thermo Scientific™ EA IsoLink™ IRMS System and demonstrate the helium savings achieved during analysis and stand-by modes



Introduction

Recently, laboratories have suffered from increasing analytical costs due to worldwide reduced availability and higher market prices of helium. In elemental analyzers, used as either standalone instruments for weight % elemental determinations or elemental analyzers coupled to isotope ratio mass spectrometers for isotope ratio determination, helium is traditionally used as a carrier gas in the analytical process and as a reference gas for the Thermal Conductivity Detector (TCD).

Figure 1. The Thermo Scientific EA IsoLink IRMS System.

The helium flow rates are typically very high, normally between 80-120 ml/min for carrier gas and 100-200 ml/min for reference gas.

As the demand for helium is high and availability globally has been recently under pressure this has resulted in very high prices, which has increased the cost per analysis and in some cases increased system downtime for laboratories. Therefore, a solution to alleviate these concerns for laboratories is necessary, however, the solution must increase the number of samples analyzed per helium gas bottle and reduce cost per sample analyzed without compromise on data accuracy and precision.

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In EA-IRMS analysis, the total helium consumption per sample analysis is defined by the helium flow rate for the:

- carrier gas in the elemental analyzer
- reference gas for the TCD
- autosampler purge
- inlet of the isotope ratio mass spectrometer
- the interface between the elemental analyzer and mass spectrometer, which can include dilution

In a watershed moment for EA-IRMS, Thermo Fisher Scientific™ has introduced a Helium Management (He^M) Module in an EA-IRMS System. The He^M Module has been designed to significantly lower helium consumption per sample analysis and therefore increases the number of samples processed per helium gas bottle without affecting data reproducibility.

This technical note briefly describes the He^M Module and how it works and shows data on the helium savings in comparison to previous Thermo Scientific™ Elemental Analyzers.

The Helium Management (He^M) Module

The Thermo Scientific™ EA IsoLink™ IRMS System (Figure 1) includes the Thermo Scientific™ Flash IRMS™ Elemental Analyzer, the Thermo Scientific™ ConFlo IV™ Universal Interface and a Thermo Scientific™ Delta V™ Isotope Ratio Mass Spectrometer, all of which are fully operated and automated through the Thermo Scientific™ Isodat™ Software Suite.

The Helium Management (He^M) Module is a standard feature of Flash IRMS Analyzers and automatically reduces helium consumption for combustion and pyrolysis sample analysis. Moreover, The Flash IRMS Analyzer has an automated stand-by mode that reduces helium consumption in the Flash IRMS and ConFlo IV Interface when the system is not undertaking analysis.

The He^M Module uses a gas splitting principle. The split is positioned before the water trap on the gas transfer line, in-line between the reactor outlet and the gas chromatography column. The split ratio is preset and defines two modes during an acquisition, as shown in Figure 2: an analysis mode, which last for 100 seconds after the sample delay and a helium saving mode, where the helium consumption is reduced. During the helium saving mode, the split gas from the reactor is redirected to the autosampler purge and reducing overall helium consumption. This process is automated as standard by the Isodat Software Suite for the EA IsoLink IRMS System.

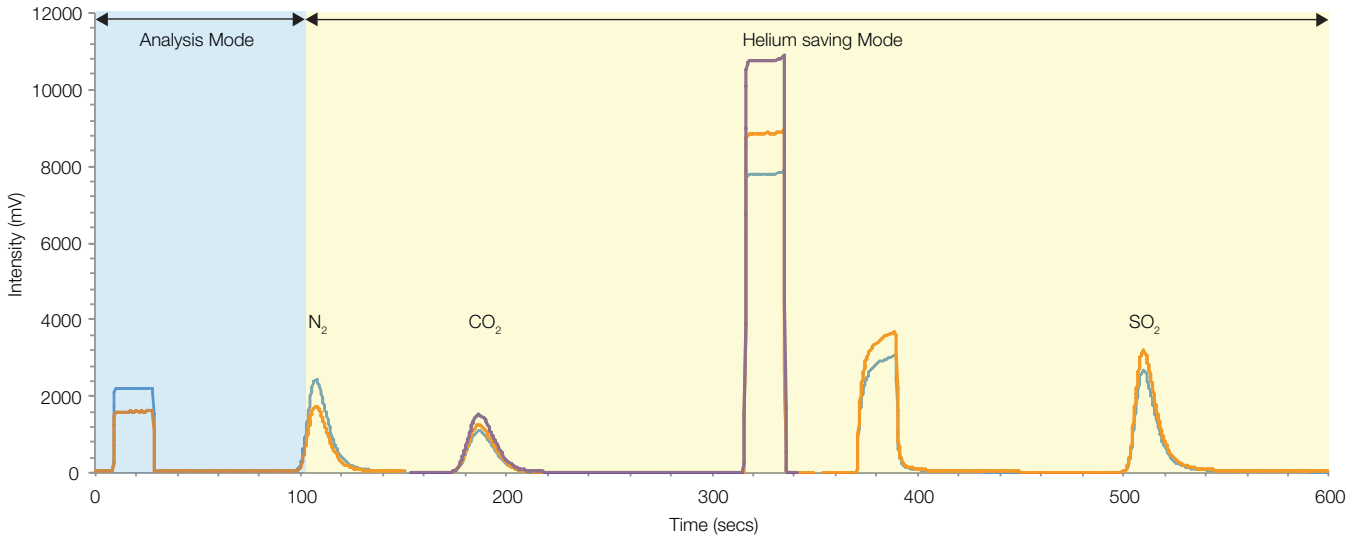

Figure 2. NCS chromatogram from the EA IsoLink IRMS System showing He^M Modes during sample analysis.

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How much helium is saved using the He^{M} Module on the EA IsoLink?

To determine the amount of helium saved using the EA IsoLink IRMS System, we compare here the EA IsoLink IRMS System for CNSOH, principally the Flash IRMS Analyzer, with the preceding model, the Thermo Scientific™ Flash HT Plus™. Table 1 shows the comparison in helium consumption between the EA IsoLink and Flash HT Plus. Using the EA IsoLink, helium consumption for a NCS and NC sample analysis is reduced by >60% and for an OH sample analysis, helium consumption is reduced by >30%.

In Table 1, the calculation for NC analysis is based on a carrier flow of 100 ml/min and an autosampler purge of 200 ml/min, for NCS analysis is based on a carrier flow of 80 ml/min and an autosampler purge of 200 ml/min and for OH analysis, the calculation analysis is based on a carrier flow of 100 ml/min and an autosampler purge of 150 ml/min. The calculation for NC, NCS and OH analysis is also valid for the EA IsoLink CN and EA IsoLink CN/OH models, where the analytical capability can be performed.

The reader is referred to Smart Note SN30376, which demonstrates that the He^{M} Module has no impact on data reproducibility.

Table 1. Comparison of Helium consumption on the Flash HT Plus and EA IsoLink CNSOH.

	Flash HT Plus	EA IsoLink CNSOH	He saving
NCS analysis time	15 mins	10 mins	-
Helium use per sample	4.2 liters	1.4 liters	66%
NC analysis time	8 mins	6 mins	-
Helium use per sample	2.4 liters	0.96 liters	60%
OH analysis time	6 mins	6 mins	-
Helium use per sample	1.5 liters	1 liter	33%

Summary

The EA IsoLink IRMS System offers an outstanding reduction in cost per analysis through very low helium consumption provided by the He^{M} Module, without analytical compromise (please see other published literature for the EA IsoLink IRMS System). Additionally, the capacity of the water and/or chemical traps is improved because the He^{M} Module is positioned before them.

The He^{M} Module delivers greater than 60% helium saving per simultaneous NC and NCS sample analysis and greater than 30% helium saving per simultaneous OH sample analysis.

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

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TN30380-EN 0916