



Application Note AN-D-002

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Streamlining beverage analysis with ion chromatography

Beverage analysis methods must be fast and robust to fulfill many quality control regulations. Optimal product quality is critical for consistent taste and other sensory characteristics in mass produced beverages.

In the case of beer, the ionic composition heavily influences the taste. For example, potassium chloride salts lead to a bitter, astringent, and soapy taste while magnesium sulfates form more sweet-sour flavors. Therefore, analytical control of anions and cations in beer is essential to guarantee the quality and meet consumer needs.

Major anions in beer are precisely determined with ion chromatography (IC) and suppressed conductivity detection, while cations are quantified with non suppressed conductivity. With a two-channel system, cations and anions can be determined simultaneously for the same sample. To reduce manual preparation steps, beer samples are automatically filtered with Inline Ultrafiltration. Features like automatic calibration and logical sample dilution streamline such beverage analyses and ensure the fast analysis of samples in high-throughput laboratories.

EXPERIMENTAL

Beer samples from different providers (e.g., Warsteiner™) were automatically diluted and filtered through a 0.22 µm membrane in the Ultrafiltration cell (Figure 1). Analyte concentrations outside of the calibration range are diluted with an optimal dilution factor and analyzed again with logical dilution, a feature of the chromatographic software MagIC Net. Hence, the results always fit within the calibration range.

After Inline Sample Preparation is performed, the sample is injected into two analytical channels that simultaneously analyze cations and anions under **isocratic elution** conditions (Table 1). Conductivity is a universal and

sensitive detector to determine all relevant ions present in the beer sample. The MagIC Net software offers time-saving reliable calibration from a single standard solution by injecting increasing volumes on to the separation column (MiPT – Metrohm intelligent Partial Loop Injection Technique). This avoids pipetting errors during standard preparation. Furthermore, samples can be injected with the most suitable injection volume. Together with logical dilutions, sample concentrations in the range 1:10,000 can be analyzed reliably. High accuracy of results is achieved by an optimal fit for the calibration points (feature: high-low calibration).

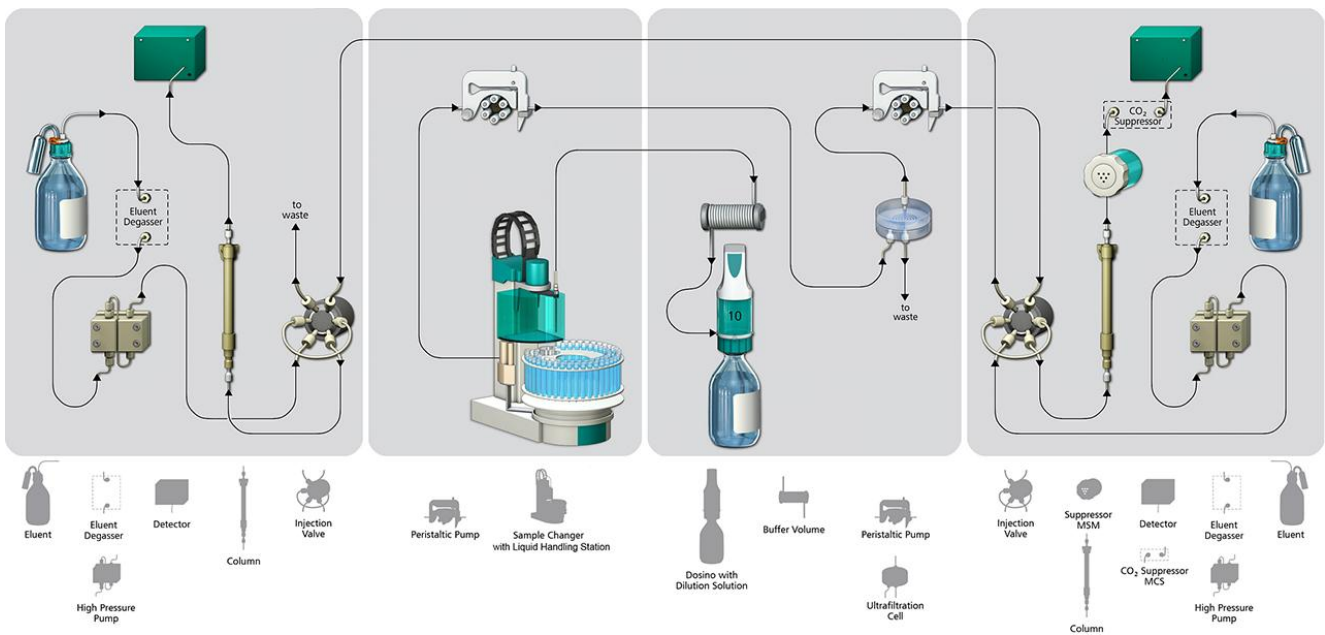


Figure 1. One autosampler (including filtration and dilution equipment) prepares the sample for two analysis channels such that anions and cations are determined in parallel from the same sample. The IC for cation analysis is displayed on the left side, and the IC used for anion analysis is shown on the right side.

Table 1. Measuring conditions for the determination of anions and cations in beer with ion chromatography.

Method parameter	Anions	Cations
Column	Metrosep A Supp 10 - 100/4.0	Metrosep C 6 - 150/4.0
Eluent	4 mmol Na ₂ CO ₃ + 6.0 mmol/L NaHCO ₃ + 5.0 μmol/L NaClO ₄	2.3 mmol HNO ₃ + 1.7 mmol/L dipicolinic acid
Flow rate	0.7 mL/min	0.9 mL/min
Temperature	30 ° C	35 ° C
Injection	20 μL	20 μL
Detection	Suppressed conductivity	Non-suppressed conductivity

RESULTS

Potassium was identified as a major cation in all beer samples, while the concentration of other cations (e.g., Na⁺, Ca²⁺, and Mg²⁺) was lower than 100 mg/L (**Figure 2**). The results reveal the effect of K⁺ in beer, as it provides a bitter and astringent taste. Other ions such as ammonium (eluting between Na⁺ and K⁺) can also be

determined.

Chloride, phosphate, nitrate, and sulfate were the main anions detected in beer (**Figure 2**). Sulfite, a common preservative, can be determined next to other anions in the same run (retention time approximately 11 minutes).

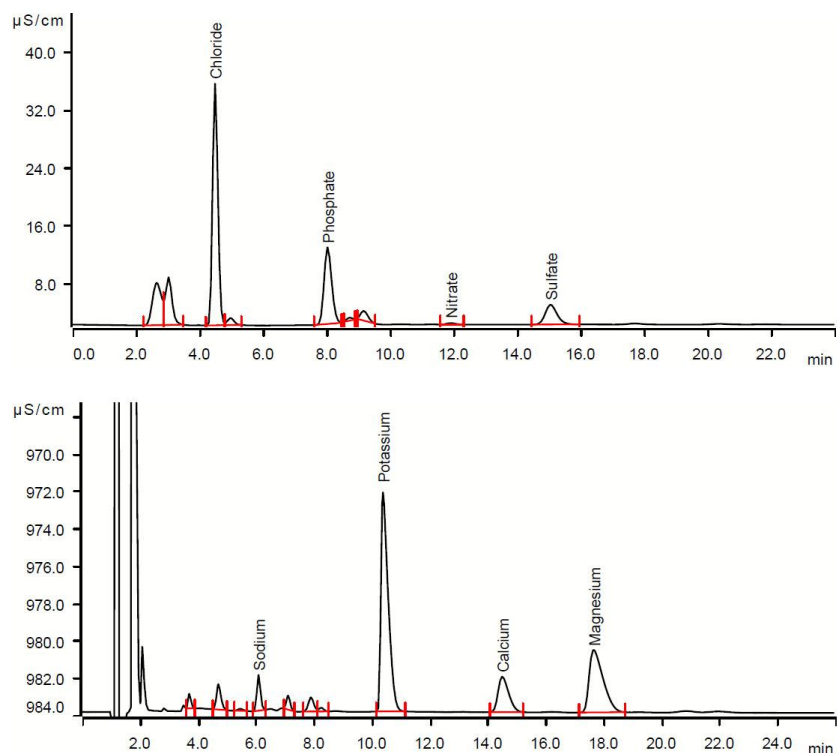


Figure 2. Analysis of a Warsteiner Pils sample (10-fold dilution) containing chloride (229 mg/L), phosphate (352 mg/L), nitrate (5 mg/L), and sulfate (60 mg/L) as major anions (top), and sodium (13 mg/L), potassium (365 mg/L), calcium (53 mg/L), and magnesium (56 mg/L) as major cations (bottom).

CONCLUSION

Ion chromatography is a robust and straightforward analytical technique to monitor beer production and to control its quality. Beverage samples are automatically diluted and filtered prior to analysis to protect the analytical

system. All essential anions and cations are simultaneously quantified in one analysis run. Features like logical dilution further save time and reduce manual work.

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CONFIGURATION

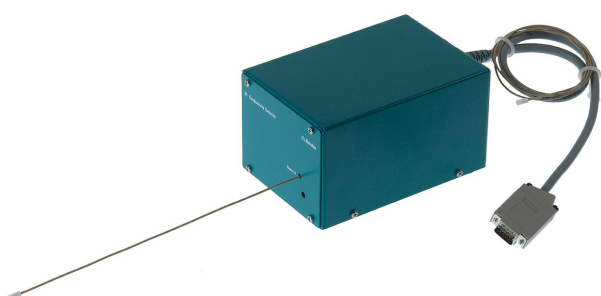


930 Compact IC Flex Oven/SeS/PP/Deg

930 Compact IC Flex Oven/SeS/PP/Deg 是智能型 Compact 子色器,有柱加炉、序列抑制和蠕用于抑制器再生,以及内置的脱气装置。器可使用各分和方法。

典型的用范:

- 子或子定,序列抑制法及



IC Conductivity Detector

用于智能型子色的智能型高性能器。卓越的温度定性,受保的器端子板内的整个信号理程以及最新一代的 DSP(数字式信号理)均能保量的精性。功于工作范,无需行范更(也不是自行)。



Metrosep A Supp 10 - 100/4.0

Metrosep A Supp 10 - 100/4.0 分柱基于大容量聚乙/二乙共聚物,其粒大小 4.6 μm 。分柱具有基数高、性大的特点。无需添加有机改性便可在淋洗液中可靠地分硫酸和硫酸。此外,分柱具有柱温、流速和淋洗液成活性高的属性。

它固、性价比越且分效率好,同其所需的色分析中,些特点使 Metrosep A Supp 10 - 100/4.0 成可通用的子分柱。



Metrosep C 6 - 150/4.0

大容量的 C 6 材料使分柱 Metrosep C 6 - 150/4.0 成在度差很高的正常保留内分准子的最佳解决方法。可用此柱定含量很高的用水。



858 Professional Sample Processor

858 Professional Sample Processor 可处理在500 μL 至 500 mL 之间的样品。样品转移,既可以使用 850 Professional IC System 上的蠕动泵,也可通过 800 Dosino 来完成。



941 Eluent Production Module

941 Eluent Production Module 可自动制备淋洗液。能够在无需人工干涉的情况下持续不断地工作,并保证稳定的保留。可与所有的万通离子色谱仪配合使用,并由 MagIC Net 进行控制。



800 Dosino

可用于智能型加液单元的/写硬件。固定。



MSM A

抑制器离子,用于所有MSM的IC器。



MagIC Net

英稀的附加。与 858 Professional Sample Processor、800 Dosino 和 741 Magnetic Stirrer 磁力拌器一同使用。

MagIC Net 4.0 Professional1

用于控制所有智能型 Professional IC 系、Compact IC 器及其外部,所有器和各 Autosampler、800 Dosino、771 Compact Interface 的计算机程序。件可用于子色分析的控制、数据采集、数据估和控,以及生成告。

形用界面,用于常操作、大量数据程序、方法、配置和手系控制;活的用管理、高效的数据操作、大量数据出功能、可个性化配置的告生成器、控制和控全部系元件和色分析果。

MagIC Net Professional 完全符合 FDA 准 21 CFR 第 11 部分以及 GLP。

MagIC Net 提供 16 框言:德、英、中文、繁体中文、法、意大利、西班牙、葡萄牙、保加利、捷克、匈牙利、日、、俄、斯洛伐克、波

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