



## Application Note AN-D-002

# Anions and cations in beer

## 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.

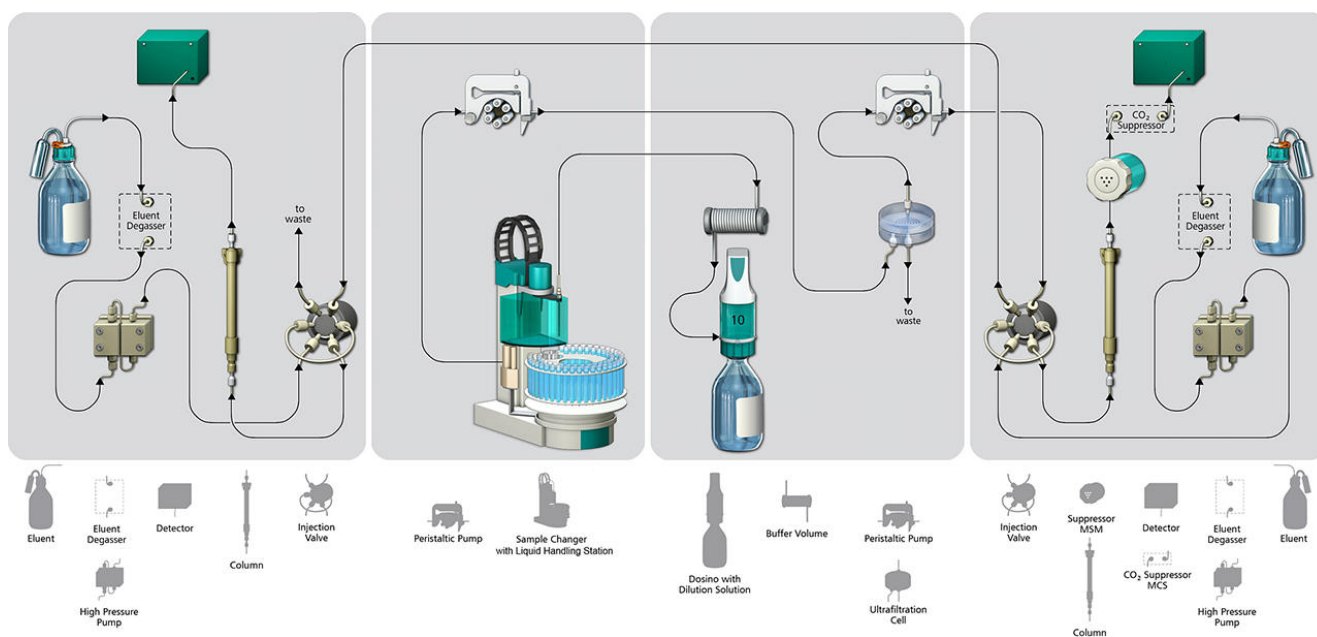
Major anions in beer are precisely determined with ion chromatography (IC) and suppressed conductivity detection, while cations are quantified with non suppressed conductivity. With a two-channel system, cations and anions can be determined simultaneously for the same sample. To reduce manual preparation 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.

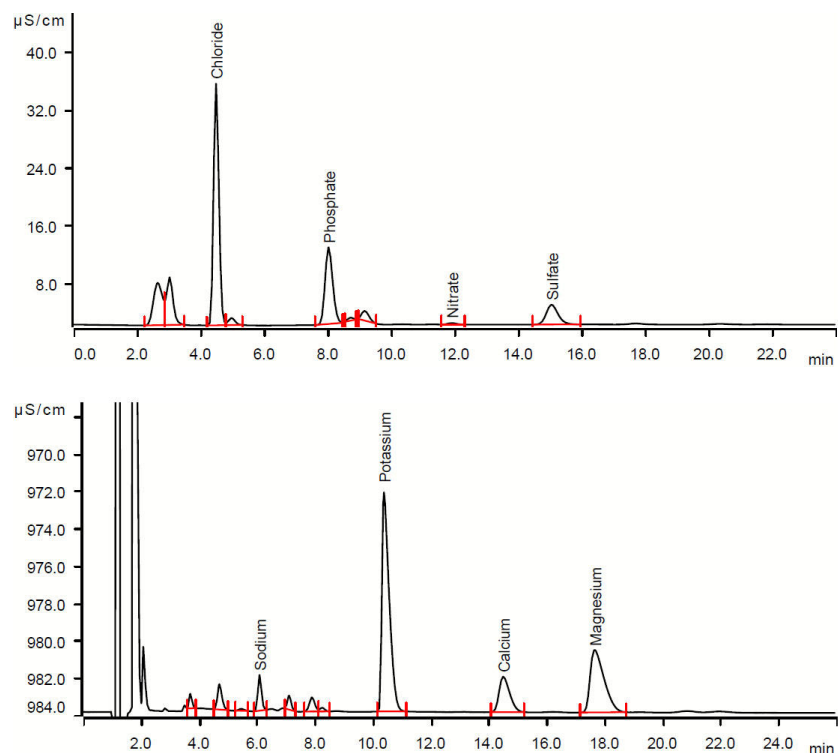
Method parameter	Anions	Cations
Column	Metrosep A Supp 10 - 100/4.0	Metrosep C 6 - 150/4.0
Eluent	4 mmol Na <sub>2</sub> CO <sub>3</sub> + 6.0 mmol/L NaHCO <sub>3</sub> + 5.0 mol/L NaClO <sub>4</sub>	2.3 mmol HNO <sub>3</sub> + 1.7 mmol/L dipicolinic acid
Flow rate	0.7 mL/min	0.9 mL/min
Temperature	30 °C	35 °C
Injection	20 L	20 L
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<sup>+</sup>, Ca<sup>2+</sup>, and Mg<sup>2+</sup>) was lower than 100 mg/L (**Figure 2**). The results reveal the effect of K<sup>+</sup> in beer, as it provides a bitter and astringent taste. Other ions such as ammonium (eluting

between Na<sup>+</sup> and K<sup>+</sup>) 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.

Internal reference: AW IC BE6-0113-092015

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## CONFIGURATION

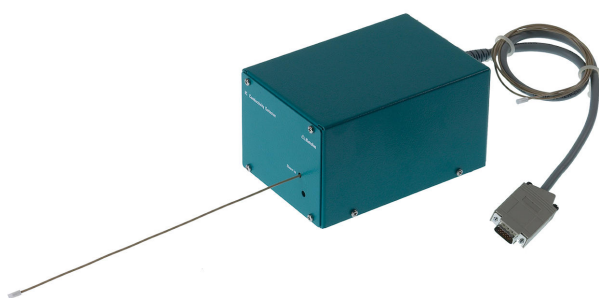


### 930 Compact IC Flex Oven/SeS/PP/Deg

930 コンパクト IC Flex Oven/SeS/PP/Deg はカラムオーブン、連続サフレーション、サフレッサー再生のためのヘリスタリックポンプ、内蔵式脱気装置を備えたインテリシエントコンパクトIC装置です。この装置は任意の分離メソッドおよび検出メソッドによって使用することかてきます。

典型的な使用領域:

- 連続サフレーションおよび電気伝導度検出器による陰イオンの測定



### IC Conductivity Detector

インテリシエントIC装置のためのコンパクトかつインテリシエントな高出力電気伝導度検出器。優れた温度安定性、保護された検出器ブロック内の総合的な信号処理、最新版のDSP (Digital Signal Processing) が高精度の測定を保証します。稼動範囲がダイナミックなので測定範囲の変更は(自動のものも含めて)必要ありません。



### Metrosep A Supp 10 - 100/4.0

Metrosep A Supp 10 - 100/4.0分離カラムは、粒子径たった4.6  $\mu\text{m}$ の大容量ホリスチレン・シヒニルヘンセン共重合体をベースとしています。このカラムの特徴は、理論段数と選択性の高さです。そのため、溶離液に有機性修飾剤を添加しなくても、亜硫酸塩と硫酸塩を確実に分離することかてきます。カラム温度、流量、溶離液の構成成分における柔軟性の高さか、この特性を補完します。

頑丈な造り、極めて高いコストパフォーマンス、非常に優れた分離性能、適度なクロマトグラフィーの分析時間により、Metrosep A Supp 10 - 100/4.0は汎用的に使用可能な陰イオンカラムです。



### Metrosep C 6 - 150/4.0

C 6 の材料の容量が大きいため、分離カラム Metrosep C 6 - 150/4.0 は、妥当な保持時間の場合、濃度差の大きな標準陽イオンを分離するのに最も適したソリューションです。アンモニウム含有量の少ない飲料水は、このカラムで測定することかてきます。



### 858 Professional Sample Processor

858 フロフェッショナルサンプルプロセッサは、500  $\mu$ Lから500 mLまでのサンプルを処理します。サンプルは850 フロフェッショナル IC システムのヘリスタリックホフまたは800 トシーノ電動ヒュレットを使用することによって転送されます。



### 941 Eluent Production Module

941 溶離液生成モジュールにより、溶離液の自動製造が可能となります。このモジュールは、手動で介入しなくても連続して処理することを可能にし、安定した保持時間を保証します。このモジュールはあらゆるメトロームのICテハイスと接続させることかてき、MagIC Netによって制御されます。



### 800 Dosino

800 Dosino 高機能電動ヒュレットのトーシンクユニット用書き込み・読み取り用ハードウェア付き駆動部。固定されたケーフル付き (長さ150 cm)。



### MSM Rotor A

Suppressor rotor for all IC instruments with MSM (Metrohm Suppressor Module)



### IC:

インライン希釈のための付属品セット。858フロフエッショナルサンプルフロセッサ、800 トシーノ電動ヒュレット、741 マクネチックスターラとの併用に。