



Application Note AN-C-193

# Alkyl amines in scrubber solutions

## Determination of ethanolamines and methylamines besides inorganic cations for process monitoring

Scrubber solutions often contain mixtures of alkyl amines. These substances neutralize acidic harmful gases such as  $\text{H}_2\text{S}$  and  $\text{CO}_2$ , and remove them from industrial processes, which is known as «gas sweetening». In many industrial processes such as in oil refineries or natural gas production, this gas scrubbing treatment is crucial to inhibit corrosion and damage to piping and equipment from acidic gases. Additionally, such matrices are often very complex and can contain inorganic cations in higher concentrations as heat stable salts. Beside their use as corrosion inhibitors, ethanolamines and

methylamines are used as raw materials for various production processes, e.g., detergents, emulsifiers, polishes, or for pharmaceuticals and chemical intermediates. Ion chromatography provides an effective means to monitor such processes. Good peak resolution and the separation of amines from inorganic cations is required. The high-capacity Metrosep C 6 column provides excellent conditions: narrow peaks as well as high flexibility in eluent compositions. This Application Note shows the method development for analysis of ethanolamines, methylamines, and common inorganic cations.

## BACKGROUND

Harmful acidic gases form weak acids when transferred into an aqueous medium. They can react with weak bases, like ethanolamines in scrubber solutions, and transform into inert salts. Adding the appropriate amount of amines will neutralize the

solution. In order to hold the pH value in an optimal range, a tight control of the chemical composition is necessary. Ion chromatography with conductivity detection provides an effective means to monitor this process and to control amine addition.

## EXPERIMENTAL

The determination of cations and amines is performed as a non-suppressed analysis with a 940 Professional IC at 30 °C.

A mixture of nitric acid, dipicolinic acid, and acetone serves as mobile phase. Samples are injected with a 20 µL injection volume. Separation takes place on a Metrosep C 6 - 150/4.0 column equipped with a

Metrosep RP 2 Guard/3.5. The conductivity signal is recorded and quantified with the MagIC Net software.

Column temperatures, flow rates, and eluent composition were varied to find an optimal peak resolution within the shortest possible analysis time (Table 1).

**Table 1.** Adjustments during method development to shorten run time and to increase peak resolution.

| Parameter                 | Effect  |
|---------------------------|---|
| Temperature increase      | Shorter retention times, especially for alkaline earth metals           |
| Flow rate increase        | Faster elution with sharper peaks, with separation quality unchanged    |
| Dipicolinic acid modifier | Divalent cations accelerate, magnesium and calcium change elution order |
| Acetone modifier          | Improved resolution of amines   |

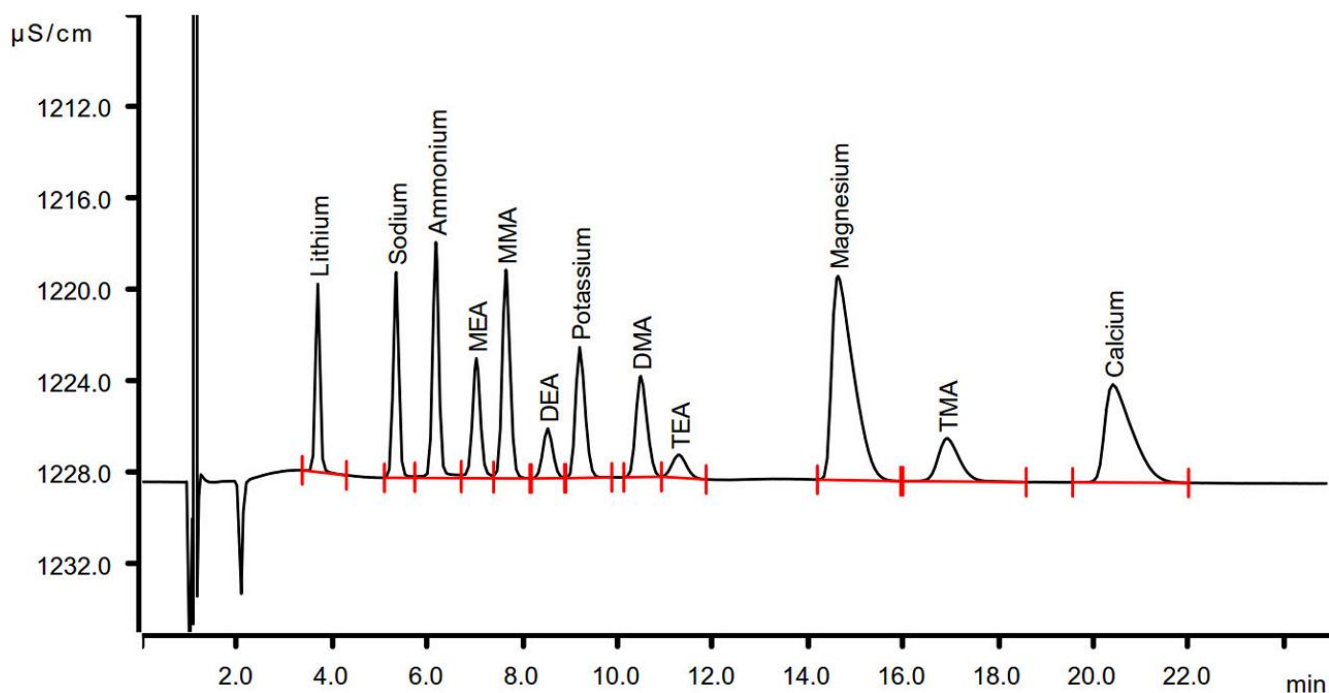
## RESULTS

Ethanolamines and methylamines are well separated from various alkali and alkaline earth metal cations in less than 25 minutes (resolutions above 1.6 with 10 mg/L of each analyte) (Fig. 1).

The good resolution of sodium and ammonium (resolution greater than 3.1) allows their precise quantification beside the amines, even when one of the components occurs in great excess.

Thanks to the high capacity of the Metrosep C 6 - 150/4.0, larger volumes can also be injected without

compromising the peak shapes. The column length allows the determination of these multiple compounds in a reasonable time of less than 25 minutes. In case of higher concentrations, resolution can be maintained by increasing the column length to a 250 mm column. Additionally, Inline Dilution can be used for automation of the dilution procedure to guarantee a proper resolution and quantification of all peaks.



**Figure 1.** Determination of mono-, di-, and trimethylamine (MMA, DMA, TMA respectively) as well as mono-, di-, and triethanolamine (MEA, DEA, TEA respectively) besides lithium, sodium, ammonium, potassium, magnesium, and calcium in a mixed solution with a concentration of 10 mg/L.

## CONCLUSION

Non-suppressed cation analysis with direct conductivity detection is a straightforward and robust technique which can be used at laboratory scale but also for process analysis. The 2060 Ion Chromatograph from Metrohm Process Analytics is therefore a reliable, highly precise automated solution (Fig. 2). These robust instruments for online process monitoring and control can be connected to up to 20 process points. Thus a sequential analysis at multiple areas inside of a plant is possible.

The application can be upgraded with further addons to further improve usability and automation:

- Dialysis or ultrafiltration as automated inline sample preparation techniques.

- MiPT for optimal injection volume, to cover a larger concentration range and to perform automatic calibration.
- Suppressed cations analysis for very low concentrations, to achieve an even better signal-to noise ratio.
- Mass spectrometry as a second independent detector in series after the conductivity detector to improve detection limits and confirm peak identity.



**Figure 2.** Ion chromatographs for laboratories (left) and for process analytics (right).

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## CONFIGURATION

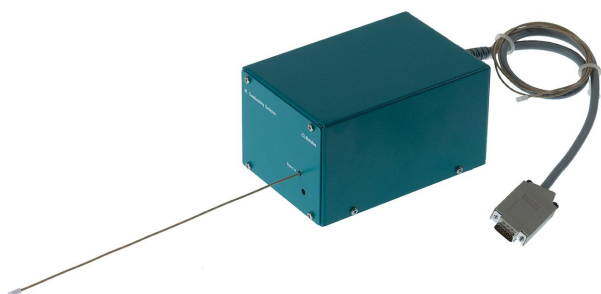


### 930 Compact IC Flex Oven/Deg

Le 930 Compact IC Flex Oven/Deg est un appareil CI compact intelligent avec un **four à colonne, sans suppression** et avec un **dégazeur** intégré. L'appareil peut être utilisé avec n'importe quelles méthodes de séparation et de détection.

Domaines d'application typiques :

- Déterminations d'anions et de cations sans suppression avec détection de conductivité
- Applications simples avec UV/VIS ou détection ampérométrique



### IC Conductivity Detector

Détecteur de conductivité haute performance compact et intelligent destiné aux appareils CI intelligents. Excellente constance de la température, tout le traitement du signal au sein du bloc de détecteur protégé et DSP – Digital Signal Processing – de la dernière génération garantissent une précision de mesure optimale. Grâce à la plage de travail dynamique, aucun changement de plage n'est nécessaire (même automatique).



### Metrosep C 6 - 150/4.0

Le matériau haute capacité de la C 6 fait de la colonne de séparation Metrosep C 6 - 150/4,0 la solution optimale pour la séparation des cations standard à des concentrations très différentes avec des temps de rétention raisonnables. Les eaux potables présentant de faibles teneurs en ammonium peuvent être déterminées à l'aide de cette colonne.



### 858 Professional Sample Processor – Pump

Le 858 Professional Sample Processor – Pump traite des échantillons de 500 µL à 500 mL. Le transfert des échantillons s'opère soit au moyen de la pompe péristaltique bidirectionnelle à deux voies intégrée soit par un 800 Dosino.



#### Station de manipulation des liquides, à gauche

Station combinée de rinçage et de dilution pour passeurs d'échantillons avec Swing Head. Pour montage à gauche de la tour.

# MagIC Net

#### MagIC Net 4.0 Professional : 1 licence

Programme PC professionnel pour le contrôle de tous les systèmes Professional IC intelligents, des appareils Compact IC et leurs périphériques, de tous les détecteurs et des différents passeurs d'échantillons, du 800 Dosino, du 771 Compact Interface, etc. Le logiciel assure le contrôle, permet d'enregistrer, d'évaluer et de contrôler les données, ainsi que de générer les rapports d'analyses par chromatographie ionique.

Interface utilisateur graphique pour les opérations de routine, programmes gestionnaires de base de données complets, développement de méthodes, configuration et panneau de configuration manuel ; administration des utilisateurs très adaptable, opérations de bases de données performantes, fonctions d'exportation de données complètes, générateur de rapports personnalisable, commande et contrôle de tous les composants du système et des résultats de chromatographie.

MagIC Net Professional satisfait totalement à la directive FDA 21 CFR Part 11 ainsi qu'aux BPL.

MagIC Net est disponible dans 16 langues de dialogue : allemand, anglais, chinois, chinois traditionnel, français, italien, espagnol, portugais, bulgare, tchèque, hongrois, japonais, coréen, russe, slovaque, polonais

1 licence

L'installation et les documents sont fournis sur une clé USB.