Chloramine Analysis, Using SIFT-MS

Exposure to chloramines is a recognized health hazard in the home, recreation centers, and the workplace.[1] Examples include:

- Home kitchens and bathrooms when ammonia and bleach may be mixed;
- The air layer above heavily chlorinated swimming pools when human pollutants (sweat, urine, etc.) are present;
- Poultry plants where surfaces and equipment cleaned with chlorine solutions come into contact with animal body fluids.

Chloramines are produced in aqueous solutions through the following sequence of chemical reactions.[2] The more acidic the solution, the more favored is the production of NCl_3.

$$HOCl + NH_3 \rightarrow NH_2Cl + H_2O$$

$$HOCl + NH_2Cl \rightarrow NHCl_2 + H_2O$$

$$HOCl + NHCl_2 \rightarrow NCl_3 + H_2O$$

From the industrial hygiene and public health perspective, the interest in measuring chloramines arises because they are known skin, eye and respiratory irritants.[3] Since trichloramine is believed to be the most noxious, differentiation of the three compounds (speciation) is highly desirable.

The current sampling and chromatographic method used for chloramine analysis is INRS Method 007.[3] Because this technique uses an ion chromatograph, and requires a toxic reagent (arsenic trioxide) and the preparation of sampling tubes, it is laboratory-based and performed by a qualified chemist. More importantly, it cannot quickly speciate all three chloramines, nor is it specific for chloramines because it is affected by the presence of chlorine and hypochlorite.[3]

SIFT-MS

A new analytical technique, Selected Ion Flow Tube – Mass Spectrometry (SIFT-MS), identifies and quantifies Volatile Organic Chemicals (VOCs) directly from air in real-time. Based on sound principles of chemical ionization mass spectrometry and precisely controlled ion reaction kinetics, SIFT-MS uses a sequence of three reagent ions to resolve interfering species, differentiate isobaric compounds and produce intrinsically quantitative data without laborious calibration procedures.

SIFT-MS easily resolves all three chloramines and chlorine, as shown in Figure 1. This scan shows distinctive ions that can be monitored in Selected Ion Mode to produce the absolute concentration of each compound in air … in seconds. The power of this sophisticated technique belies the simple touch screen operation in the Voice200® instrument as shown in Figure 2.

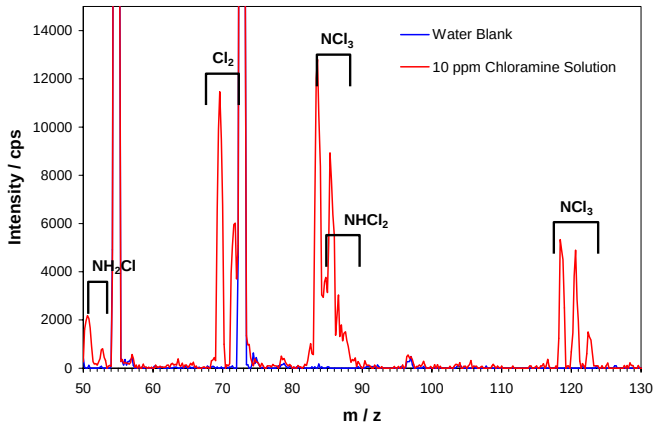

Figure 1. SIFT-MS mass spectrum of a nominally 10 ppm solution of chloramines using O_2^+ reagent ions.

Syft Technologies offers a gas sample collection system, shown in Figure 3, to facilitate analysis when the instrument is not located near a sampling point.

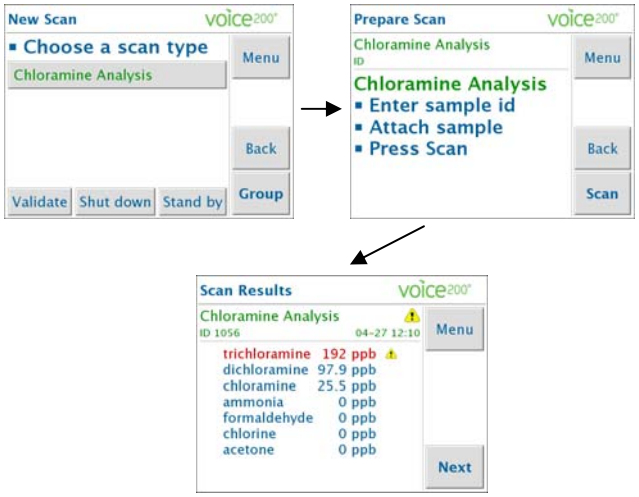

Figure 2. The Voice200 touch screen display.

Figure 3. Syft Technologies' Sample Case holds three 1-liter Tedlar or Kynar sample bags, which are removed for Voice200 analysis as shown. The operator uses the integrated touch screen display to start testing and to view results.

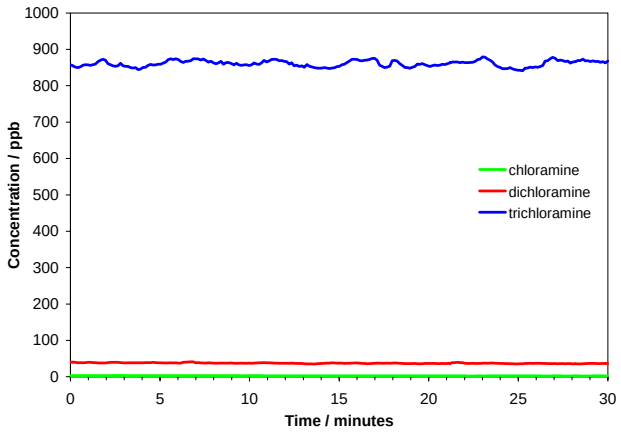

Figure 4. Mono-, di- and trichloramine lifetime in a Tedlar bag. Acidic sample preparation used to optimize trichloramine.

This technique is viable if the sample does not degrade while in transit from the sampling point. Testing has shown that trichloramine is stable in a Tedlar bag for more than half an hour, as shown in Figure 4. While Tedlar performs well, we have also established that Kynar may be a more suitable sample bag material, as shown in Figure 5.

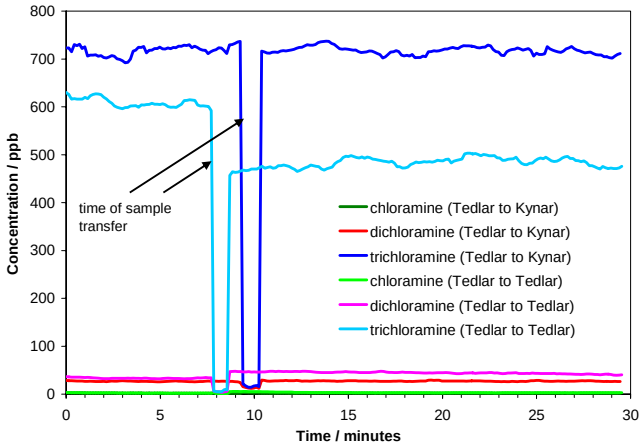

Figure 5. Transfer of a stable, humid, room-temperature mixture of chloramines from a Tedlar sampling bag to a Kynar or Tedlar sampling bag to simulate field sampling.

THE VOICE200® SOLUTION. FAST, ACCURATE, SIMPLE.

Syft Technologies' Voice200® instrument can speciate all three chloramines at ppb levels in seconds. Specifically designed for ease of use, the push-button, stand-alone system requires minimal training for operation and provides instantaneous results.

For more information about this unique technology, please contact your nearest Syft Technologies office or visit www.syft.com.

References

1. See, for example, NIOSH Health Hazard Evaluation Report HETA #2004-0337-3051, November 2007.

2. G.E. Hailin, et.al. (1990). "Determination of trace amounts of chloramines by LC", *Anal. Chim. Acta*, **237**, 149-153.

3. M. Hery, G.M. Gerber, et.al. (1998). "Exposure to Chloraminies in a Green Salad Processing Plant", *Ann. Occup. Hyg.*, **42**, 7, 437 – 451.

International enquiries
Syft Technologies Ltd.
3 Craft Place Middleton
PO Box 28 149
Christchurch, New Zealand
Website www.syft.com
Phone +64 3 338 6701
Facsimile +64 3 338 6704
Email sales@syft.com

North American enquiries
Syft Technologies Inc.
1525 Park Manor Blvd, Suite 272
Pittsburgh, PA15205 4805, USA
Phone 888 200 5991
Email NAInfo@syft.com