RESEARCH REPORT

Determination of Aliphatic Amines Using the SKC UMEx 400 Diffusive Sampler

Abstract

A sampling method for dimethyl amine, isopropyl amine, allyl amine, n-butyl amine, and methyl amine has been developed using the UMEx 400 Diffusive Sampler. The method has been partially validated for concentrations from 0.5 ppm to 10 ppm at 0.25 to 8-hour time intervals. The UMEx 400 badge consists of a Whatman filter paper treated with 1-napthylisothiocyanate (NITC) in a polypropylene housing. The sampler contains two compartments, one for the sample and the other for a blank. After sampling, each tape is placed in a vial, extracted with acetonitrile, and analyzed by High-performance Liquid Chromatography (HPLC) with UV detection at 254 nm.

The average sampling rates for methyl amine, dimethyl amine, allyl amine, isopropyl amine, and n-butyl amine were 18.4, 18.2, 22.4, 13.0, and 18.1 ml/min, respectively. The sampling rates were independent of concentration, relative humidity, orientation, and face velocity. All compounds were within the ± 25% NIOSH guidelines except for methyl amine, which showed a high degree of variation and should be used in a semi-quantitative mode. The UMEx 400 can detect amine levels at 0.1 ppm for an 8-hour sample.

This data represents a compilation of data generated by the National Institute of Working Life in Sweden and the SKC Media Research Department.

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Introduction

The health effects of amines are irritation of the eye, nose, throat, and skin. There have been some cases of dermatitis and pulmonary edema with certain individuals. Butyl amine has a 5 ppm short-term excursion limit (STEL) with a skin notation. All the other amines have a 5 ppm time-weighted average (TWA) with a STEL ranging from 10 to 15 ppm. Allyl amine has no guidelines. The purpose of this study was to develop a passive sampler for monitoring aliphatic amines over a concentration range of 0.5 to 10 ppm and under a variety of environmental conditions including relative humidity and sampling times.

Experimental

Standard atmospheres were generated using a certified cylinder (Matheson TriGas) containing five amines. The contaminants from this cylinder were blended and mixed with air to vary the concentration of amines. Relative humidities ranged from 10 to 80% and the face velocity was maintained at 20 cm/sec. The atmospheres were verified with a 226-30-18 sorbent tube and battery-operated pumps.

The sampler comprised a badge housing made from polypropylene. Two Whatman (SG-81) filters were treated with 1-naphthyl-isothiocyanate (NITC) and were placed in compartments below the diffuser plate. The treated filter beneath the diffusion holes was used for sampling; the other half was used as a blank or control. A blue sliding cover sealed the holes when the sampler was not in use.

When sampling was complete, the two coated filter samples were placed in vials and capped. The NITC derivatives were extracted using 3.0 ml of acetonitrile, shaken by hand initially, and then placed on a vibrator for 15 minutes. Desorption efficiencies are shown in Table 1. The extract was analyzed by HPLC using UV detection at 254 nm. The analytical conditions with chromatogram are shown in Figure 1. Quantitation was performed by using the various amines and injecting known quantities into acetonitrile solutions containing NITC.

Results and Discussion

The recoveries for the five amines at different humidities are listed in Tables 2 through 6 and represent a compilation of data from the National Institute of Working Life[1] and SKC Inc. They are based on the mean sampling rates of 18.4, 18.2, 22.4, 13.0, and 18.1 ml/min for methyl amine, dimethyl amine, allyl amine, isopropyl amine, and n-butyl amine, respectively. The badges stored for 14 days at 18 C as shown in Table 7. Storage at ≤ 39.2 F (4 C) is recommended for longer storage times.

References

[1] Lindahl, R., Levin, J., and Andersson, K., "Determination of Volatile Amines in Air by Diffusive Sampling, Thiourea Formation, and High Performance Liquid Chromatography", *Journal of Chromatography*, 643, 1993, pp. 35-41

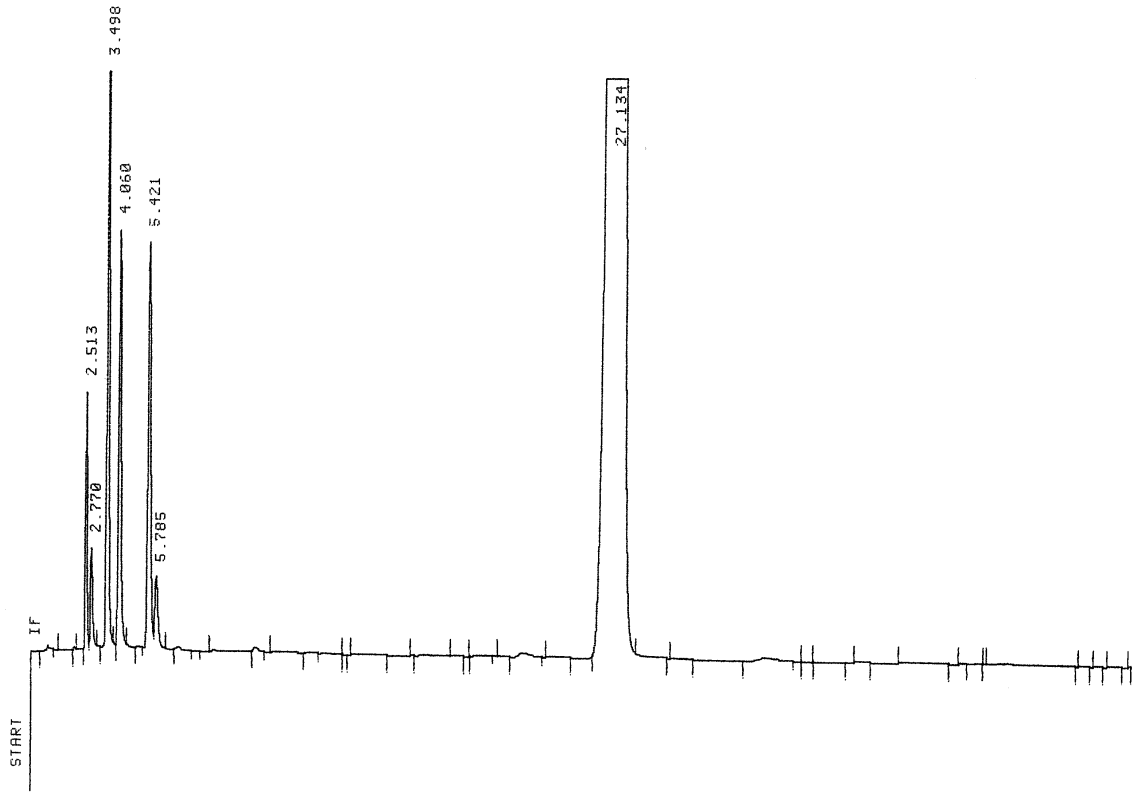
Table 1

Desorption Efficiencies of Amines on NITC Treated Tape

Compound	Range (μg)	Recovery (%)
Methyl amine	5.1 to 119	101.0
Dimethyl amine	7.3 to 172	111.0
Allyl amine	9.3 to 187	107.0
Isopropyl amine	9.6 to 193	106.0
n-Butyl amine	12.7 to 300	106.0

All samples were shaken by hand for 1 minute, transferred to vials, and analyzed by HPLC.

Figure 1
Chromatogram with HPLC Conditions



Column: 250 mm x 4.6 mm, 5 micron, Betasil ODS, made by Keystone Scientific

Eluent: 60/40 Acetonitrile/Distilled water

Pump Flow: 2.0 ml/min

Injection: 20 microliters

Detector: UV at 254 nm wavelength

Table 2
Recovery of Isopropylamine on the UMEx 400 Badge

Concentration (ppm)	Time (min)	RH (%)	Recovery (%)	RSD (%)
0.62	480	10	93.2	3
0.62	480	80	94.6	9
0.62	120	45	115.0	2
3.1	256	80	107.0	6
4.0	240	20	91.7	5
5.0	120	45	108.0	2
5.0	120	45	112.0	2
5.7	78	50	96.4	1
7.8	240	50	106.0	9
10.0	480	10	113.0	1
10.0	480	80	98.3	2
10.0	240	45	102.0	3
10.0	30	80	102.0	5
10.0	15	10	86.6	7
10.0	15	80	83.9	2

Mean Recovery (%)	**100.7**
SD	**9.6**
RSD (%)	**9.6**

Table 3
Recovery of Methyl Amine with the UMEx 400 Badge

Concentration (ppm)	Time (min)	RH (%)	Recovery (%)	RSD (%)
1.0	480	10	108.0	3
1.0	480	80	94.8	7
1.0	240	45	92.0	2
2.4	256	80	97.2	6
3.0	240	20	86.8	6
5.0	120	45	109.0	4
6.4	240	50	121.0	5
10.0	120	45	118.0	2
20.0	30	10	117.0	5
20.0	30	80	117.0	2
20.0	480	80	82.2	3
20.0	480	10	81.0	1
20.0	240	45	92.0	2
20.0	30	80	90.2	1

Mean (%)	**100.4**
SD	**14.1**
RSD (%)	**14.0**

Table 4
Recovery of n-Butyl Amine with the UMEx 400 Badge

Concentration (ppm)	Time (min)	RH (%)	Recovery (%)	RSD (%)
0.62	480	10	93.8	3
0.62	480	80	94.6	9
0.62	120	45	115.0	2
2.20	256	80	103.0	5
2.20	240	50	87.5	3
2.60	240	20	99.1	7
4.60	78	50	111.0	10
5.0	120	45	108.0	2
5.0	120	45	112.0	2
5.1	240	50	95.0	4
10.0	15	10	86.6	7
10.0	15	80	83.9	2
10.0	480	10	93.8	3
10.0	480	80	98.2	2
10.0	240	45	102.0	3
10.0	30	80	102.0	5

Mean (%)	**99.03**
SD	**9.2**
RSD (%)	**9.3**

Table 5

Recovery of Allyl Amine with the UMEx 400 Badge

Concentration (ppm)	Time (min)	RH (%)	Recovery (%)	RSD (%)
0.20	480	10	94.0	2
0.20	480	80	102.0	7
0.20	240	45	97.2	3
1.83	256	80	107.0	4
2.44	240	20	86.1	8
2.0	120	45	112.0	7
2.0	240	45	89.9	3
4.3	73	50	102.0	7
4.6	240	50	109.0	4
9.1	30	10	94.0	2
9.1	30	80	104.0	9
9.1	480	80	97.5	2
9.1	480	10	94.0	2
9.1	240	80	94.6	2
9.1	30	80	89.9	3

Mean (%)	**98.2**
SD	**7.52**
RSD (%)	**7.7**

Table 6

Recovery of Dimethyl Amine on the UMEx 400 Badge

Concentration (ppm)	Time (min)	RH (%)	Recovery (%)	RSD (%)
1.0	480	10	97.5	6
1.0	480	80	93.7	2
1.0	240	45	104.0	3
4.4	256	80	112.0	5
5.1	120	45	98.7	2
5.1	120	45	99.4	3
5.9	240	20	96.9	1
10.0	30	10	98.7	3
10.0	30	80	113.0	2
10.0	480	10	98.7	1
10.0	480	80	98.1	5
10.0	240	45	98.7	3
10.0	30	80	95.6	3
12.2	240	50	92.9	4
14.4	78	50	101.0	8

Mean (%)	**99.9**
SD	**5.75**
RSD (%)	**5.76**

Table 7

Storage Study
14 days at 18 C

Compound	**Recovery (%)**
Methyl amine	118.4
Dimethyl amine	99.4
Allyl amine	89.9
Isopropyl amine	101.0
n-Butyl amine	111.0

These treated badges can be stored for 14 days at ambient temperatures. For storage periods longer than 14 days, it is recommended that these treated tapes be stored at ≤ 39.2 F (4 C).