APPENDIX A

A-1 Calculation of pollutant gases in passive samplers

According to Fick's law, the concentration of gases in passive sampler in $\mu g/m^3$ unit is calculated as follow:

$$C = [Q * L] / [A * t * D]$$

Where

C = concentration measured by passive sampling tube (µg/m3)

Q = quantity of absorption products present in the sampler (µg)

L = diffusion length (m)

A = cross-sectional area (m^2) = πr^2

t = sampling time (s)

D = diffusion coefficient (m^2/s)

The diffusion coefficient of SO_2 in air must be corrected to average ambient temperature (K) and atmospheric pressure (Torr) during sampling period, according to equation:

$$D = 0.004832 (T^{1.75} / P) \quad cm^{-2} s^{-1}$$

Where

D = diffusion coefficient (m^2/s)

T = temperature (K)

P = atmospheric pressure (Torr)

Please note that when using the sampling chemical in form of solution, the diffusion length is measured from the surface area of the solution to the opened end of tube.

A-2 Quantity of absorption products present in the sampler (Q)

Q value of SO_2 determination was calculate by multiplication SO_3^{2-} concentration (ppm) obtained from calibration curve of spectrophotometry with 2 (2ml of absorbent solution volume). The value was then multiplied with 64/80 to convert SO_3^{2-} to the total amount of SO_2 in passive sampler.

$$Q\ (\mu g) = SO_3^{2-} \text{ concentration (ppm)} * 2\ ml * 64/80$$

A-3 Unit conversions

Mass per unit volume: usually $\mu g/m^3$. The mass of pollutant is expressed as a ratio to the volume of air. Since the volume of a given parcel of air is depended upon the temperature and pressure at the time of sampling, the pollutant concentration expressed in these units, should, strictly speaking, specify the conditions at the time of sampling.

Volume mixing ratio: usually ppm-part per million (10^{-6})**;** or ppb- part per billion (10^{-9})**.** This unit expressed the concentration of a pollutant as a ratio of its volume if segregated pure, to the volume of the air in which it is contained. Ideal gas behavior is assumed thus the concentration is not depended on temperature and pressure as these affect both the pollutant and the air to the same extent. As a consequence of the gas laws, a gas present at a volume mixing ratio of 1 ppm is not

only 1 cm^3 per 10^{-6} cm^3 of polluted air, it is also 1 molecule per 10^{-6} molecules and has a partial pressure of one millionth of the atmospheric pressure.

Conversion factors

$$ppb = \mu g/m^3 \times \frac{\text{molecular volume (litres)}}{\text{molecular weight}}$$

Where:

$$\text{molecular volume} = 22.41 \times \frac{T}{273} \times \frac{101.3}{P}$$

T = absolute temperature (K)

P = atmospheric pressure (kPa) (Remember that Celcius + 273 = Kelvin)

Similarly

$$mg/m^3 = ppm \times \frac{\text{molecular weigh}}{\text{molecular volume (litres)}}$$

Sources:

Posch M., de Smet P.A.M., Hetteling J.-P. and Downing R.J. [Eds.] (1999): Calculating and mapping of critical thresholds in Europe. Status Report 1999 – Coordination center for Effects. Working Group on Effects of convention on long-Range Transboundary Air Pollution. RIVM, Bilthoven, The Netherlands.

APPENDIX B

Concentration of color forming reagent

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	VAR00001	.683563	24	.3745167	.0764479
	VAR00002	.709767	24	.3274699	.0668445

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	VAR00001 & VAR00002	24	.997	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	VAR00001 - VAR00002	-.0262042	.0545541	.0111358	-.0492403	-.0031680	-2.353	23	.028

Effect of the interferences

Ammonia (NH_3)

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	VAR00001 - VAR00002	.00333	.00577	.00333	-.01101	.01768	1.000	2	.423

Hydrogen chloride (HCL)

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	VAR00001 - VAR00002	.00333	.00577	.00333	-.01101	.01768	1.000	2	.423
Pair 2	VAR00001 - VAR00003	-.00667	.00577	.00333	-.02101	.00768	-2.000	2	.184

Nitrogen dioxide (NO_2)

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	VAR00001 - VAR00002	.00333	.00577	.00333	-.01101	.01768	1.000	2	.423
Pair 2	VAR00001 - VAR00003	-.00667	.00577	.00333	-.02101	.00768	-2.000	2	.184

Ozone (O_3)

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	VAR00001 - VAR00002	.00333	.00577	.00333	-.01101	.01768	1.000	2	.423
Pair 2	VAR00001 - VAR00003	-.00667	.00577	.00333	-.02101	.00768	-2.000	2	.184

Type of diffusion tube

Type	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
PP short	5	.3400	.05477	.02449	.2720	.4080	.30	.40
PP long	5	.4600	.05477	.02449	.3920	.5280	.40	.50
PS	5	.3800	.08367	.03742	.2761	.4839	.30	.50
PE	5	.3400	.08944	.04000	.2289	.4511	.20	.40
Total	z	.3800	.08335	.01864	.3410	.4190	.20	.50

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
.791	3	16	.516

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.048	3	.016	3.048	.059
Within Groups	.084	16	.005		
Total	.132	19			

Filtration process of SO_2

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	VAR00001	.3685	20	.08400	.01878
	VAR00002	.4235	20	.07429	.01661

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	VAR00001 & VAR00002	20	.718	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	VAR00001 - VAR00002	-.05500	.06013	.01345	-.08314	-.02686	-4.090	19	.001

Sampling period

Period (day)	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	5	.7400	.13416	.06000	.5734	.9066	.60	.90
2	5	.8200	.08367	.03742	.7161	.9239	.70	.90
3	5	1.0000	.07071	.03162	.9122	1.0878	.90	1.10
4	5	.8400	.05477	.02449	.7720	.9080	.80	.90
5	5	1.0200	.13038	.05831	.8581	1.1819	.90	1.20
6	5	.9200	.13038	.05831	.7581	1.0819	.70	1.00
7	5	.7800	.14832	.06633	.5958	.9642	.60	1.00
Total	35	.8743	.14419	.02437	.8248	.9238	.60	1.20

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
1.249	6	28	.312

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.351	6	.058	4.599	.002
Within Groups	.356	28	.013		
Total	.707	34			

APPENDIX C

Table Population size (N) at 95% confidence, no. of sample (n) at 1% to 10% error level

population size (N)	no. of sample (n) at each error level					population size (N)	no. of sample (n) at each error level				
	1%	3%	5%	7%	10%		1%	3%	5%	7%	10%
30	30	29	28	26	23	5,000	3,333	909	370	196	98
50	50	48	44	40	33	6,000	3,750	938	375	197	98
100	99	92	80	67	50	7,000	4,118	959	378	198	99
200	196	169	133	101	67	8,000	4,444	976	381	199	99
300	291	236	171	121	75	9,000	4,737	989	383	200	99
400	385	294	200	135	80	10,000	5,000	1,000	385	200	99
500	476	345	222	145	83	15,000	6,000	1,034	390	201	99
500	476	345	222	145	83	20,000	6,667	1,053	392	202	100
700	654	429	255	158	88	25,000	7,143	1,064	394	202	100
800	741	465	267	163	89	50,000	8,333	1,087	397	203	100
900	826	497	277	166	90	100,000	9,091	1,099	398	204	100
1,000	909	526	286	169	91	200,000	9,524	1,105	399	204	100
2,000	1,667	714	333	185	95	300,000	9,677	1,107	399	204	100
3,000	2,308	811	353	191	97	500,000	9,804	1,109	400	204	100
4,000	2,857	870	364	194	98	∞	10,000	1,111	400	204	100

Sources: http://tulip.bu.ac.th/~wathna.s/poll.htm

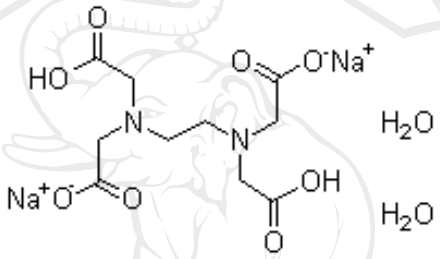
APPENDIX D

Name: Disodium edetate dehydrate

Synonyms: Ethylenediaminetetraacetic acid disodium salt dihydrate; EDTA disodium salt dehydrate

Molecular Formula: $C_{10}H_{14}N_2Na_2O_8 \cdot 2(H_2O)$

Molecular Structure:

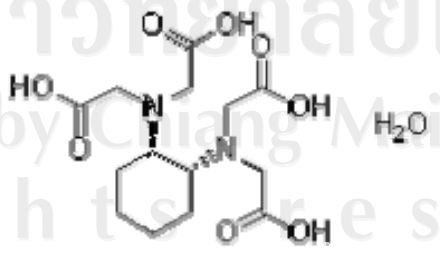


Name: Trans-1,2-Diaminocyclohexane-N,N,N',N'-tetraacetic acid monohydrate

Synonyms: 1,2-Cyclohexylenedinitrilotetraacetic acid monohydrate; CDTA monohydrate

Molecular Formula: $C_{14}H_{22}N_2O_8.H_2O$

Molecular Structure:



VITA

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List of Publications

1. Borisuttichun, P. and Chantara, S. Optimization Method for Determination of SO_2 in Ambient Air. Abstract in the PERCH-CIC Congress V, Jomtien Palm Beach Resort Pattaya, Chonburi, Thailand, 7-9 May 2007.
2. Borisuttichun, P. and Oungpipat, W. Potentiometric screen-printed electrodes for the determination of oxytetracycline hydrochloride. Abstract in the 31th Congress on Science and Technology of Thailand, Suranaree University, Nakhon Ratchasima, Thailand, 18-20 October 2005.
3. Borisuttichun, P., Sriyota, S. and Oungpipat, W. A Production of edible film from isolated red kidney bean protein. Abstract in the 30th Congress on Science and Technology of Thailand , Impact Exhibition and Convention Center, Muang Thong Thani, Thailand, 19-21 October 2004.