Spectrophotometric determination of ammonium ion

The method is based on standard ISO 7150-1:1984

SCOPE AND FIELD OF APPLICATION: the present method is used for the determination of ammonium ions in drinking waters, surface water and ground water. The method is also suitable for the analysis of swimming pool water. If the water is strongly colored or has high salt content, distillation of the sample is needed. Ammonium concentrations from 0,05 to 1,25 mg/L can be measured. In the case of higher contents dilutions are to be used.

INTERFERENCES: Primary amines interfere (ethanolamine, aniline etc.). Extremely acidic and alkaline waters also strongly interfere with the determination.

PRINCIPLE: The method is based on the reaction of ammonium ions with salicylate and hypochlorite in the presence of sodium nitroprusside. The absorbance of the obtained blue-colored solution is then measured spectrophotometrically at wavelength 655 nm. The experimental protocol is given in the comments of the model section.

APPLICATION OF THE PRESENT SMU FILE: Calculation presented in this file uses some input data from file NH4.xls. These two files must be located in the same folder.

The values of uncertainty components of volumetric ware and photometric equipment are taken according to our experience, experiments carried out in our lab and data from equipment manufacturers. The users of these examples are advised to use these data only as the first approximation and to substitute these uncertainty estimates by their own data that corresponds to the actual situation in their labs.

Model Equation:

{ The main equation }

$C = (A_{sample} - b_0) / b_1 * L + \Delta C_{cont\_decomp}$;

{ Ammonium ion stock solution. Prepared from ammonium chloride.

}

$C_{st\_0} = m_{NH4Cl} / V_{500} * P_{NH4Cl} * f$;

$V_{500} = V_{500\_cal} + V_{500\_rep} + V_{500\_temp}$;

$V_{500\_temp} = V_{500\_cal} * \Delta t * \gamma$;

$m_{NH4Cl} = m_{NH4Cl\_0} + m_{NH4Cl\_drift} + m_{NH4Cl\_round}$;

{ Ammonium standard solution. Prepared from ammonium stock solution. The standard solution is further used for preparation of the calibration standard solutions. }

$C_{st} = C_{st\_0} * V_1 / V_{1000} * 1000$;

$V_{1000} = V_{1000\_cal} + V_{1000\_rep} + V_{1000\_temp}$;

$V_{1000\_temp} = V_{1000\_cal} * \Delta t * \gamma$;

$V_1 = V_{1\_cal} + V_{1\_rep} + V_{1\_temp}$;

$V_{1\_temp} = V_{1\_cal} * \Delta t * \gamma$;

{ Concentrations of calibration standard solutions. 1 to 25 ml of the standard solution is transferred to 50 ml volumetric flasks.

The reagents are added and the solution is made up to the mark. The solution is left to stand for 60 min and then the absorbance at 655 nm is measured. }

$C_1 = C_{st} * (V_{1\_st} / V_{1\_50})$;

$C_2 = C_{st} * (V_{2\_st} / V_{2\_50})$;

$C_3 = C_{st} * (V_{3\_st} / V_{3\_50})$;

$C_4 = C_{st} * (V_{4\_st} / V_{4\_50})$;

$C_5 = C_{st} * (V_{5\_st} / V_{5\_50})$;

$V_{1\_st} = V_{1\_st\_cal} + V_{1\_st\_rep} + V_{1\_st\_temp}$;

$V_{1\_st\_temp} = V_{1\_st\_cal} * \Delta t * \gamma$;

$V_{2\_st} = V_{2\_st\_cal} + V_{2\_st\_rep} + V_{2\_st\_temp}$;

$V_{2\_st\_temp} = V_{2\_st\_cal} * \Delta t * \gamma$;

$V_{3\_st} = V_{3\_st\_cal} + V_{3\_st\_rep} + V_{3\_st\_temp}$;

$V_{3\_st\_temp} = V_{3\_st\_cal} * \Delta t * \gamma$;

$V_{4\_st} = V_{4\_st\_cal} + V_{4\_st\_rep} + V_{4\_st\_temp}$;

$V_{4\_st\_temp} = V_{4\_st\_cal} * \Delta t * \gamma$;

$V_{5\_st} = V_{5\_st\_cal} + V_{5\_st\_rep} + V_{5\_st\_temp}$;

$V_{5\_st\_temp} = V_{5\_st\_cal} * \Delta t * \gamma$;

$V_{1\_50} = V_{1\_50\_cal} + V_{1\_50\_rep} + V_{1\_50\_temp}$;

$V_{1\_50\_temp} = V_{1\_50\_cal} * \Delta t * \gamma$;

$V_{2\_50} = V_{2\_50\_cal} + V_{2\_50\_rep} + V_{2\_50\_temp}$;

$V_{2\_50\_temp} = V_{2\_50\_cal} * \Delta t * \gamma$;

$V_{3\_50} = V_{3\_50\_cal} + V_{3\_50\_rep} + V_{3\_50\_temp}$;

$V_{3\_50\_temp} = V_{3\_50\_cal} * \Delta t * \gamma$;

$V_{4\_50} = V_{4\_50\_cal} + V_{4\_50\_rep} + V_{4\_50\_temp}$;

$V_{4\_50\_temp} = V_{4\_50\_cal} * \Delta t * \gamma$;

$V_{5\_50} = V_{5\_50\_cal} + V_{5\_50\_rep} + V_{5\_50\_temp}$;

$V_{5\_50\_temp} = V_{5\_50\_cal} * \Delta t * \gamma$;

{ Preparation of the sample. 40 ml of the sample is transferred to a 50 ml volumetric flask. The reagents are added and the solution is made up to the mark. The solution is left to stand for 60 min and then the absorbance at 655 nm is measured. }

$L = V_{50} / V_{40}$;

$V_{50} = V_{50\_cal} + V_{50\_rep} + V_{50\_temp}$;

$V_{50\_temp} = V_{50\_cal} * \Delta t * \gamma$;

$V_{40} = V_{40\_cal} + V_{40\_rep} + V_{40\_temp}$;

$V_{40\_temp} = V_{40\_cal} * \Delta t * \gamma$;

{ Photometric measurements

It is assumed that the uncertainty of all photometric measurements consists of three components (on the example A_{sample}):

- Repeatability uncertainty (included in A_{sample_rep});

- Uncertainty due to drift (A_{sample_drift})

- Uncertainty due to rounding of the reading (A_{sample_round}) (The photometer use din this example has three decimal places)

The absorbance of blank is not subtracted but all the measurements are made against blank.

}

{ Absorbance of sample solution }

$A_{sample} = A_{sample\_rep} + A_{sample\_drift} + A_{sample\_round} + A_{sample\_chem}$;

{ Absorbances of calibration standard solutions}

$A_1 = A_{1rep} + A_{1drift} + A_{1round} + A_{1\_chem}$;

$A_2 = A_{2rep} + A_{2drift} + A_{2round} + A_{2\_chem}$;

$A_3 = A_{3rep} + A_{3drift} + A_{3round} + A_{3\_chem}$;

$A_4 = A_{4rep} + A_{4drift} + A_{4round} + A_{4\_chem}$;

$A_5 = A_{5rep} + A_{5drift} + A_{5round} + A_{5\_chem}$;

{ The regression equations for finding the slope (b_1) and intercept (b_0) of the calibration line }

$\Sigma AC = C_1*A_1 + C_2*A_2 + C_3*A_3 + C_4*A_4 + C_5*A_5$;

$AvgC=(C_1+C_2+C_3+C_4+C_5)/n;$

$AvgA=(A_1+A_2+A_3+A_4+A_5)/n;$

$\Sigma CC=C_1*C_1+C_2*C_2+C_3*C_3+C_4*C_4+C_5*C_5;$

$b_1=(\Sigma AC-n*AvgC*AvgA)/(\Sigma CC-n*AvgC*AvgC);$

$b_0=AvgA-b_1*AvgC$

List of Quantities:

Quantity	Unit	Definition
C	mg/l	Concentration of NH4+ in the sample solution
A_{sample}	AU	Absorbance of the sample solution
b_0	AU	Intercept of calibration line
b_1	AU*l/mg	Slope of calibration line
L	unitless	Dilution factor
ΔC_{cont_decomp}	mg/l	Uncertainty due to possible concentration change due to sample contamination or partial analyte decomposition
C_{st_0}	g/ml	Concentration of NH4 in calibration stock solution
m_{NH4Cl}	g	Weight of NH4Cl
V_{500}	ml	Volume of 500 ml volumetric flask
P_{NH4Cl}	unitless	Purity of NH4Cl
f	unitless	Conversion factor for converting the amount of ammonium chloride (NH_4Cl) to the amount of ammonium (NH_4)
V_{500_cal}	ml	Volume of 500 ml volumetric flask and its calibration uncertainty
V_{500_rep}	ml	Uncertainty of filling the 500 ml volumetric flask to the mark (repeatability component of the uncertainty of the 500 ml flask volume)
V_{500_temp}	ml	Temperature uncertainty component of the 500 ml volumetric flask
Δt	C	Difference of the actual laboratory temperature from 20 degrees centigrade
γ	1/C	The coefficient of volume expansion for water
m_{NH4Cl_0}	g	Value and repeatability uncertainty component of the weight of NH4Cl
m_{NH4Cl_drift}	g	Drift uncertainty component of the weight of NH4Cl
m_{NH4Cl_round}	g	Temperature uncertainty component of the weight of NH4Cl
C_{st}	mg/l	Concentration of NH_4+ in the ammonium standard solution
V_1	ml	Volume of 1 ml pipette
V_{1000}	L	Volume of 1 L volumetric flask
V_{1000_cal}	L	Value and calibration uncertainty component of the volume of 1 L volumetric flask

Quantity	Unit	Definition
V_{1000_rep}	L	Repeatability uncertainty component of 1 L volumetric flask
V_{1000_temp}	L	Temperature uncertainty component of the 1 L volumetric flask
V_{1_cal}	ml	Value and calibration uncertainty component of the volume of 1 ml pipette
V_{1_rep}	ml	Repeatability uncertainty component of the volume of 1 ml pipette
V_{1_temp}	ml	Temperature uncertainty component of the volume of 1 ml pipette
C_1	mg/l	Concentration of the 1. ammonium calibration standard solution
V_{1_st}	ml	Volume of ammonium standard solution taken for preparing the 1. ammonium calibration standard solution
V_{1_50}	ml	Volume of the 1. ammonium calibration standard solution
C_2	mg/l	Concentration of the 2. ammonium calibration standard solution
V_{2_st}	ml	Volume of ammonium standard solution taken for preparing the 2. ammonium calibration standard solution
V_{2_50}	ml	Volume of the 2. ammonium calibration standard solution
C_3	mg/l	Concentration of the 3. ammonium calibration standard solution
V_{3_st}	ml	Volume of ammonium standard solution taken for preparing the 3. ammonium calibration standard solution
V_{3_50}	ml	Volume of the 3. ammonium calibration standard solution
C_4	mg/l	Concentration of the 4. ammonium calibration standard solution
V_{4_st}	ml	Volume of ammonium standard solution taken for preparing the 4. ammonium calibration standard solution
V_{4_50}	ml	Volume of the 4. ammonium calibration standard solution
C_5	mg/l	Concentration of the 5. ammonium calibration standard solution
V_{5_st}	ml	Volume of ammonium standard solution taken for preparing the 5. ammonium calibration standard solution
V_{5_50}	ml	Volume of the 5. ammonium calibration standard solution
$V_{1\_st\_cal}$	ml	Volume and the calibration uncertainty component of the pipette used for preparing the 1. ammonium calibration standard solution
$V_{1\_st\_rep}$	ml	Repeatability uncertainty component of the pipette used for preparing the 1. ammonium calibration standard solution.
$V_{1\_st\_temp}$	ml	Temperature uncertainty component of the pipette used for preparing the 1. ammonium calibration standard solution.
$V_{2\_st\_cal}$	ml	Volume and the calibration uncertainty component of the pipette used for preparing the 2. ammonium calibration standard solution
$V_{2\_st\_rep}$	ml	Repeatability uncertainty component of the pipette used for preparing the 2. ammonium calibration standard solution.
$V_{2\_st\_temp}$	ml	Temperature uncertainty component of the pipette used for preparing the 2. ammonium calibration standard solution.

Quantity	Unit	Definition
$V_{3\_st\_cal}$	ml	Volume and the calibration uncertainty component of the pipette used for preparing the 3. ammonium calibration standard solution.
$V_{3\_st\_rep}$	ml	Repeatability uncertainty component of the pipette used for preparing the 3. ammonium calibration standard solution.
$V_{3\_st\_temp}$	ml	Temperature uncertainty component of the pipette used for preparing the 3. ammonium calibration standard solution.
$V_{4\_st\_cal}$	ml	Volume and the calibration uncertainty component of the pipette used for preparing the 4. ammonium calibration standard solution.
$V_{4\_st\_rep}$	ml	Repeatability uncertainty component of the pipette used for preparing the 4. ammonium calibration standard solution.
$V_{4\_st\_temp}$	ml	Temperature uncertainty component of the pipette used for preparing the 4. ammonium calibration standard solution.
$V_{5\_st\_cal}$	ml	Volume and the calibration uncertainty component of the pipette used for preparing the 5. ammonium calibration standard solution.
$V_{5\_st\_rep}$	ml	Repeatability uncertainty component of the pipette used for preparing the 5. ammonium calibration standard solution.
$V_{5\_st\_temp}$	ml	Temperature uncertainty component of the pipette used for preparing the 5. ammonium calibration standard solution
$V_{1\_50\_cal}$	ml	Volume and the calibration uncertainty component of the 1. ammonium calibration standard solution
$V_{1\_50\_rep}$	ml	Repeatability uncertainty component of the volume of the 1. ammonium calibration standard solution.
$V_{1\_50\_temp}$	ml	Temperature uncertainty component of the volume of the 1. ammonium calibration standard solution.
$V_{2\_50\_cal}$	ml	Volume and the calibration uncertainty component of the 2. ammonium calibration standard solution
$V_{2\_50\_rep}$	ml	Repeatability uncertainty component of the volume of the 2. ammonium calibration standard solution.
$V_{2\_50\_temp}$	ml	Temperature uncertainty component of the volume of the 2. ammonium calibration standard solution.
$V_{3\_50\_cal}$	ml	Volume and the calibration uncertainty component of the 3. ammonium calibration standard solution
$V_{3\_50\_rep}$	ml	Repeatability uncertainty component of the volume of the 3. ammonium calibration standard solution.
$V_{3\_50\_temp}$	ml	Temperature uncertainty component of the volume of the 3. ammonium calibration standard solution.
$V_{4\_50\_cal}$	ml	Volume and the calibration uncertainty component of the 4. ammonium calibration standard solution
$V_{4\_50\_rep}$	ml	Repeatability uncertainty component of the volume of the 4. ammonium calibration standard solution

Quantity	Unit	Definition
$V_{4\_50\_temp}$	ml	Temperature uncertainty component of the volume of the 4. ammonium calibration standard solution
$V_{5\_50\_cal}$	ml	Volume and the calibration uncertainty component of the 5. ammonium calibration standard solution
$V_{5\_50\_rep}$	ml	Repeatability uncertainty component of the volume of the 5. ammonium calibration standard solution.
$V_{5\_50\_temp}$	ml	Temperature uncertainty component of the volume of the 5. ammonium calibration standard solution.
V_{50}	ml	Volume of the sample flask
V_{40}	ml	Volume of sample solution taken for the spectrophotometric measurement
V_{50_cal}	ml	Value and the calibration uncertainty component of the volume of the sample flask
V_{50_rep}	ml	Repeatability uncertainty component of the volume of sample flask
V_{50_temp}	ml	Temperature uncertainty component of the volume of sample flask
V_{40_cal}	ml	Value and the calibration uncertainty component of the volume of the sample solution taken for the measurement.
V_{40_rep}	ml	Repeatability uncertainty component of the volume of sample solution taken for the measurement.
V_{40_temp}	ml	Temperature uncertainty component of the volume of the sample solution taken for the measurement.
A_{sample_rep}	AU	
A_{sample_drift}	AU	
A_{sample_round}	AU	
A_{sample_chem}	AU	
A_1	AU	Absorbance of the 1. ammonium calibration standard solution
A_{1rep}	AU	Value and repeatability uncertainty component of the absorbance of the 1. ammonium calibration standard solution
A_{1drift}	AU	Drift uncertainty component of the absorbance of the 1. ammonium calibration standard solution
A_{1round}	AU	Rounding uncertainty component of the absorbance of the 1. ammonium calibration standard solution.
A_{1_chem}	AU	
A_2	AU	Absorbance of the 2. ammonium calibration standard solution
A_{2rep}	AU	Value and repeatability uncertainty component of the absorbance of the 2. ammonium calibration standard solution
A_{2drift}	AU	Drift uncertainty component of the absorbance of the 2. ammonium calibration standard solution

Quantity	Unit	Definition
A_{2round}	AU	Rounding uncertainty component of the absorbance of the 2. ammonium calibration standard solution
A_{2_chem}	AU	
A_3	AU	Absorbance of the 3. ammonium calibration standard solution
A_{3rep}	AU	Value and repeatability uncertainty component of the absorbance of the 3. ammonium calibration standard solution
A_{3drift}	AU	Drift uncertainty component of the absorbance of the 3. ammonium calibration standard solution
A_{3round}	AU	Rounding uncertainty component of the absorbance of the 3. ammonium calibration standard solution
A_{3_chem}	AU	
A_4	AU	Absorbance of the 4. ammonium calibration standard solution
A_{4rep}	AU	Value and repeatability uncertainty component of the absorbance of the 4. ammonium calibration standard solution
A_{4drift}	AU	Drift uncertainty component of the absorbance of the 4. ammonium calibration standard solution
A_{4round}	AU	Rounding uncertainty component of the absorbance of the 4. ammonium calibration standard solution
A_{4_chem}	AU	
A_5	AU	Absorbance of the 5. ammonium calibration standard solution
A_{5rep}	AU	Value and repeatability uncertainty component of the absorbance of the 5. ammonium calibration standard solution
A_{5drift}	AU	Drift uncertainty component of the absorbance of the 5. ammonium calibration standard solution
A_{5round}	AU	Rounding uncertainty component of the absorbance of the 5. ammonium calibration standard solution
A_{5_chem}	AU	
ΣAC	AU*mg/l	Interim quantity for regression statistics calculation
AvgC	mg/l	Interim quantity for regression statistics calculation
n	unitless	Number of points on the calibration line
AvgA	AU	Interim quantity for regression statistics calculation
ΣCC	mg^2/l^2	Interim quantity for regression statistics calculation

ΔC_{cont_decomp}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: d29 = 0.0 mg/l
Standarduncertainty Cell: d30 = $4.00 \cdot 10^{-3}$ mg/l

P_{NH4Cl}: Type B rectangular distribution
Value: 0.998 unitless
Halfwidth of Limits: 0.002 unitless

f: Constant
Value: =(14.0067+4*1.0079)/(14.0067+4*1.0079+35.4527)

V_{500_cal}: Type B rectangular distribution
Value: 500 ml
Halfwidth of Limits: 0.4 ml

The volumetric flask is not calibrated in our laboratory, the uncertainty of the stated volume of the volumetric flask is used instead

V_{500_rep}: Type B rectangular distribution
Value: 0 ml
Halfwidth of Limits: 0.03 ml

This uncertainty corresponds more or less to the uncertainty ± 1 drop.

Δt: Type B rectangular distribution
Value: 0 C
Halfwidth of Limits: 3 C

γ: Constant
Value: 0.00021 1/C

m_{NH4Cl_0}: Type B normal distribution
Value: 2.9654 g
Expanded Uncertainty: 0.00017 g
Coverage Factor: 1

m_{NH4Cl_drift}: Type B rectangular distribution
Value: 0 g
Halfwidth of Limits: 0.0002 g

m_{NH4Cl_round}: Type B rectangular distribution
Value: 0 g
Halfwidth of Limits: 0.00005 g

V_{1000_cal}: Type B rectangular distribution
Value: 1 L
Halfwidth of Limits: 0.0006 L

The volumetric flask is not calibrated in our laboratory, the uncertainty of the stated volume of the volumetric flask is used instead

V_{1000_rep}: Type B rectangular distribution
Value: 0 L
Halfwidth of Limits: 0.00003 L

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V_{1_cal}: Type B rectangular distribution
Value: 1 ml
Halfwidth of Limits: 0.01 ml

V_{1_rep}: Type B normal distribution
Value: 0 ml
Expanded Uncertainty: 0.008 ml
Coverage Factor: 1

$V_{1\_st\_cal}$: Type B rectangular distribution
Value: 1 ml
Halfwidth of Limits: 0.01 ml

$V_{1\_st\_rep}$: Type B normal distribution
Value: 0 ml
Expanded Uncertainty: 0.004 ml
Coverage Factor: 1

Estimate of uncertainty due to repeatability of volume of the ammonium standard solution is taken as 0.4% of the volume of the pipette.

$V_{2\_st\_cal}$: Type B rectangular distribution
Value: 5 ml
Halfwidth of Limits: 0.02 ml

$V_{2\_st\_rep}$: Type B normal distribution
Value: 0 ml
Expanded Uncertainty: 0.02 ml
Coverage Factor: 1

Estimate of uncertainty due to repeatability of volume of the ammonium standard solution is taken 0.4% of the volume of pipette

$V_{3\_st\_cal}$: Type B rectangular distribution
Value: 10 ml
Halfwidth of Limits: 0.03 ml

$V_{3\_st\_rep}$: Type B normal distribution
Value: 0 ml
Expanded Uncertainty: 0.04 ml
Coverage Factor: 1

Estimate of uncertainty due to repeatability of volume of the ammonium standard solution is taken 0.4% of the volume of pipette

$V_{4\_st\_cal}$: Type B rectangular distribution
Value: 15 ml
Halfwidth of Limits: 0.04 ml

$V_{4\_st\_rep}$: Type B normal distribution
Value: 0 ml
Expanded Uncertainty: 0.06 ml
Coverage Factor: 1

Estimate of uncertainty due to repeatability of volume of the ammonium standard solution is taken 0.4% of the volume of pipette

$V_{5\_st\_cal}$: Type B rectangular distribution
Value: 25 ml
Halfwidth of Limits: 0.04 ml

$V_{5\_st\_rep}$: Type B normal distribution
Value: 0 ml
Expanded Uncertainty: 0.1 ml
Coverage Factor: 1

Estimate of uncertainty due to repeatability of volume of the ammonium standard solution is taken 0.4% of the volume of pipette

$V_{1\_50\_cal}$: Type B rectangular distribution
Value: 50 ml
Halfwidth of Limits: 0.09 ml

$V_{1\_50\_rep}$: Type B rectangular distribution
Value: 0 ml
Halfwidth of Limits: 0.03 ml

This uncertainty corresponds more or less to the uncertainty ± 1 drop.

$V_{2\_50\_cal}$: Type B rectangular distribution
Value: 50 ml
Halfwidth of Limits: 0.09 ml

$V_{2\_50\_rep}$: Type B rectangular distribution
Value: 0 ml
Halfwidth of Limits: 0.03 ml

This uncertainty corresponds more or less to the uncertainty ± 1 drop

$V_{3\_50\_cal}$: Type B rectangular distribution
Value: 50 ml
Halfwidth of Limits: 0.09 ml

$V_{3\_50\_rep}$: Type B rectangular distribution
Value: 0 ml
Halfwidth of Limits: 0.03 ml

This uncertainty corresponds more or less to the uncertainty ± 1 drop

$V_{4\_50\_cal}$: Type B rectangular distribution
Value: 50 ml
Halfwidth of Limits: 0.09 ml

$V_{4\_50\_rep}$: Type B rectangular distribution
Value: 0 ml
Halfwidth of Limits: 0.03 ml

This uncertainty corresponds more or less to the uncertainty ± 1 drop

$V_{5\_50\_cal}$: Type B rectangular distribution
Value: 50 ml
Halfwidth of Limits: 0.09 ml

$V_{5\_50\_rep}$: Type B rectangular distribution
Value: 0 ml
Halfwidth of Limits: 0.03 ml

This uncertainty corresponds more or less to the uncertainty ± 1 drop

V_{50_cal}: Type B rectangular distribution
Value: 50 ml
Halfwidth of Limits: 0.09 ml

V_{50_rep}: Type B rectangular distribution
Value: 0 ml
Halfwidth of Limits: 0.03 ml

This uncertainty corresponds more or less to the uncertainty ± 1 drop

V_{40_cal}: Type B rectangular distribution
Value: 40 ml
Halfwidth of Limits: 0.05 ml

V_{40_rep}: Type B normal distribution
Value: 0 ml
Expanded Uncertainty: 0.16 ml
Coverage Factor: 1

Estimate of uncertainty due to repeatability of the volume of the sample solution is taken 0.4% of the volume of pipette ruumalast

A_{sample_rep}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: d22 = 0.186000 AU
Standarduncertainty Cell: d23 = $612 \cdot 10^{-6}$ AU

A_{sample_drift}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: d24 = $1.26 \cdot 10^{-3}$ AU

A_{sample_round}: Type B rectangular distribution
Value: 0 AU
Halfwidth of Limits: 0.0005 AU

A_{sample_chem}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: d25 = $3.00 \cdot 10^{-3}$ AU

A_{1rep}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: D7 = 0.055000 AU
Standarduncertainty Cell: e7 = $533 \cdot 10^{-6}$ AU

A_{1drift}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: f7 = $1.19 \cdot 10^{-3}$ AU

A_{1round}:
Type B rectangular distribution
Value: 0 AU
Halfwidth of Limits: 0.0005 AU

A_{1_chem}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: g7 = $275 \cdot 10^{-6}$ AU

A_{2rep}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: d8 = 0.214000 AU
Standarduncertainty Cell: e8 = $628 \cdot 10^{-6}$ AU

A_{2drift}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: f8 = $1.28 \cdot 10^{-3}$ AU

A_{2round}:
Type B rectangular distribution
Value: 0 AU
Halfwidth of Limits: 0.0005 AU

A_{2_chem}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: g8 = $1.07 \cdot 10^{-3}$ AU

A_{3rep}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: d9 = 0.412000 AU
Standarduncertainty Cell: e9 = $747 \cdot 10^{-6}$ AU

A_{3drift}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: f9 = $1.39 \cdot 10^{-3}$ AU

A_{3round}: Type B rectangular distribution
Value: 0 AU
Halfwidth of Limits: 0.0005 AU

A_{3_chem}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: g9 = $2.06 \cdot 10^{-3}$ AU

A_{4rep}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: d10 = 0.600000 AU
Standarduncertainty Cell: e10 = $860 \cdot 10^{-6}$ AU

A_{4drift}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: f10 = $1.50 \cdot 10^{-3}$ AU

A_{4round}: Type B rectangular distribution
Value: 0 AU
Halfwidth of Limits: 0.0005 AU

A_{4_chem}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: g10 = $3.00 \cdot 10^{-3}$ AU

A_{5rep}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: d11 = 0.99700 AU
Standarduncertainty Cell: e11 = $1.10 \cdot 10^{-3}$ AU

A_{5drift}: Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: f11 = $1.73 \cdot 10^{-3}$ AU

A_{5round}: Type B rectangular distribution
Value: 0 AU
Halfwidth of Limits: 0.0005 AU

A_{5_chem}:
Import from Excel
Filename: NH4.xls
Worksheet: Sheet1
Value Cell: h24 = 0.0 AU
Standarduncertainty Cell: g11 = $4.98 \cdot 10^{-3}$ AU

n:
Constant
Value: 5 unitless

Interim Results:

Quantity	Value	Standard Uncertainty	Degrees of Freedom
A_{sample}	0.18600 AU	$3.32 \cdot 10^{-3}$ AU	72
L	1.25000 unitless	$5.26 \cdot 10^{-3}$ unitless	61
C_{st_0}	$1.99599 \cdot 10^{-3}$ g/ml	$2.60 \cdot 10^{-6}$ g/ml	infinity
m_{NH4Cl}	2.965400 g	$208 \cdot 10^{-6}$ g	110
V_{500}	500.000 ml	0.294 ml	infinity
V_{500_temp}	0.0 ml	0.182 ml	infinity
C_{st}	1.9960 mg/l	0.0199 mg/l	120
V_1	1.00000 ml	$9.87 \cdot 10^{-3}$ ml	120
V_{1000}	1.000000 L	$503 \cdot 10^{-6}$ L	infinity
V_{1000_temp}	0.0 L	$364 \cdot 10^{-6}$ L	infinity
V_{1_temp}	0.0 ml	$364 \cdot 10^{-6}$ ml	infinity
C_1	0.039920 mg/l	$488 \cdot 10^{-6}$ mg/l	260
V_{1_st}	1.00000 ml	$7.03 \cdot 10^{-3}$ ml	480
V_{1_50}	50.0000 ml	0.0577 ml	infinity
C_2	0.19960 mg/l	$2.20 \cdot 10^{-3}$ mg/l	170
V_{2_st}	5.0000 ml	0.0232 ml	89
V_{2_50}	50.0000 ml	0.0577 ml	infinity
C_3	0.39920 mg/l	$4.36 \cdot 10^{-3}$ mg/l	160
V_{3_st}	10.0000 ml	0.0437 ml	71
V_{3_50}	50.0000 ml	0.0577 ml	infinity
C_4	0.59880 mg/l	$6.52 \cdot 10^{-3}$ mg/l	160
V_{4_st}	15.0000 ml	0.0645 ml	66
V_{4_50}	50.0000 ml	0.0577 ml	infinity
C_5	0.9980 mg/l	0.0108 mg/l	160
V_{5_st}	25.000 ml	0.103 ml	56
V_{5_50}	50.0000 ml	0.0577 ml	infinity
$V_{1\_st\_temp}$	0.0 ml	$364 \cdot 10^{-6}$ ml	infinity
$V_{2\_st\_temp}$	0.0 ml	$1.82 \cdot 10^{-3}$ ml	infinity
$V_{3\_st\_temp}$	0.0 ml	$3.64 \cdot 10^{-3}$ ml	infinity
$V_{4\_st\_temp}$	0.0 ml	$5.46 \cdot 10^{-3}$ ml	infinity
$V_{5\_st\_temp}$	0.0 ml	$9.09 \cdot 10^{-3}$ ml	infinity
$V_{1\_50\_temp}$	0.0 ml	0.0182 ml	infinity
$V_{2\_50\_temp}$	0.0 ml	0.0182 ml	infinity

Quantity	Value	Standard Uncertainty	Degrees of Freedom
$V_{3\_50\_temp}$	0.0 ml	0.0182 ml	infinity
$V_{4\_50\_temp}$	0.0 ml	0.0182 ml	infinity
$V_{5\_50\_temp}$	0.0 ml	0.0182 ml	infinity
V_{50}	50.0000 ml	0.0577 ml	infinity
V_{40}	40.000 ml	0.163 ml	54
V_{50_temp}	0.0 ml	0.0182 ml	infinity
V_{40_temp}	0.0 ml	0.0145 ml	infinity
A_1	0.05500 AU	$1.36 \cdot 10^{-3}$ AU	82
A_2	0.21400 AU	$1.80 \cdot 10^{-3}$ AU	130
A_3	0.41200 AU	$2.61 \cdot 10^{-3}$ AU	100
A_4	0.60000 AU	$3.48 \cdot 10^{-3}$ AU	84
A_5	0.99700 AU	$5.40 \cdot 10^{-3}$ AU	67
ΣAC	1.5637 AU*mg/l	0.0173 AU*mg/l	170
AvgC	0.44710 mg/l	$4.58 \cdot 10^{-3}$ mg/l	130
AvgA	0.45560 AU	$1.46 \cdot 10^{-3}$ AU	190
ΣCC	1.5553 mg²/l²	0.0323 mg²/l²	140

Uncertainty Budgets:

C: **Concentration of NH4+ in the sample solution**

Quantity	Value	Standard Uncertainty	Degrees of Freedom	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
A_{sample}	0.18600 AU	$3.32 \cdot 10^{-3}$ AU	72				
b_0	0.01709 AU	$2.15 \cdot 10^{-3}$ AU	310				
b_1	0.9808 AU*l/mg	0.0120 AU*l/mg	220				
L	1.25000 unitless	$5.26 \cdot 10^{-3}$ unitless	61				
ΔC_{cont_decomp}	0.0 mg/l	$4.00 \cdot 10^{-3}$ mg/l	50		1.0	$4.0 \cdot 10^{-3}$ mg/l	37.9 %
C_{st_0}	$1.99599 \cdot 10^{-3}$ g/ml	$2.60 \cdot 10^{-6}$ g/ml	infinity				
m_{NH4Cl}	2.965400 g	$208 \cdot 10^{-6}$ g	110				
V_{500}	500.000 ml	0.294 ml	infinity				
P_{NH4Cl}	0.99800 unitless	$1.15 \cdot 10^{-3}$ unitless	infinity	rectangular	0.22	$250 \cdot 10^{-6}$ mg/l	0.1 %
f	0.3372212147838 unitless						
V_{500_cal}	500.000 ml	0.231 ml	infinity	rectangular	$-430 \cdot 10^{-6}$	$-99 \cdot 10^{-6}$ mg/l	0.0 %
V_{500_rep}	0.0 ml	0.0173 ml	infinity	rectangular	$-430 \cdot 10^{-6}$	$-7.5 \cdot 10^{-6}$ mg/l	0.0 %
V_{500_temp}	0.0 ml	0.182 ml	infinity				
Δt	0.0 C	1.73 C	infinity	rectangular	$-45 \cdot 10^{-6}$	$-78 \cdot 10^{-6}$ mg/l	0.0 %
γ	$210.0 \cdot 10^{-6}$ 1/C						
m_{NH4Cl_0}	2.965400 g	$170 \cdot 10^{-6}$ g	50	normal	0.073	$12 \cdot 10^{-6}$ mg/l	0.0 %
m_{NH4Cl_drift}	0.0 g	$115 \cdot 10^{-6}$ g	infinity	rectangular	0.073	$8.4 \cdot 10^{-6}$ mg/l	0.0 %
m_{NH4Cl_round}	0.0 g	$28.9 \cdot 10^{-6}$ g	infinity	rectangular	0.073	$2.1 \cdot 10^{-6}$ mg/l	0.0 %
C_{st}	1.9960 mg/l	0.0199 mg/l	120				
V_1	1.00000 ml	$9.87 \cdot 10^{-3}$ ml	120				

Quantity	Value	Standard Uncertainty	Degrees of Freedom	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
V_{1000}	1.000000 L	$503 \cdot 10^{-6}$ L	infinity				
V_{1000_cal}	1.000000 L	$346 \cdot 10^{-6}$ L	infinity	rectangular	-0.22	$-75 \cdot 10^{-6}$ mg/l	0.0 %
V_{1000_rep}	0.0 L	$17.3 \cdot 10^{-6}$ L	infinity	rectangular	-0.22	$-3.7 \cdot 10^{-6}$ mg/l	0.0 %
V_{1000_temp}	0.0 L	$364 \cdot 10^{-6}$ L	infinity				
V_{1_cal}	1.00000 ml	$5.77 \cdot 10^{-3}$ ml	infinity	rectangular	0.22	$1.2 \cdot 10^{-3}$ mg/l	3.7 %
V_{1_rep}	0.0 ml	$8.00 \cdot 10^{-3}$ ml	50	normal	0.22	$1.7 \cdot 10^{-3}$ mg/l	7.0 %
V_{1_temp}	0.0 ml	$364 \cdot 10^{-6}$ ml	infinity				
C_1	0.039920 mg/l	$488 \cdot 10^{-6}$ mg/l	260				
V_{1_st}	1.00000 ml	$7.03 \cdot 10^{-3}$ ml	480				
V_{1_50}	50.0000 ml	0.0577 ml	infinity				
C_2	0.19960 mg/l	$2.20 \cdot 10^{-3}$ mg/l	170				
V_{2_st}	5.0000 ml	0.0232 ml	89				
V_{2_50}	50.0000 ml	0.0577 ml	infinity				
C_3	0.39920 mg/l	$4.36 \cdot 10^{-3}$ mg/l	160				
V_{3_st}	10.0000 ml	0.0437 ml	71				
V_{3_50}	50.0000 ml	0.0577 ml	infinity				
C_4	0.59880 mg/l	$6.52 \cdot 10^{-3}$ mg/l	160				
V_{4_st}	15.0000 ml	0.0645 ml	66				
V_{4_50}	50.0000 ml	0.0577 ml	infinity				
C_5	0.9980 mg/l	0.0108 mg/l	160				
V_{5_st}	25.000 ml	0.103 ml	56				
V_{5_50}	50.0000 ml	0.0577 ml	infinity				
$V_{1\_st\_cal}$	1.00000 ml	$5.77 \cdot 10^{-3}$ ml	infinity	rectangular	0.020	$120 \cdot 10^{-6}$ mg/l	0.0 %
$V_{1\_st\_rep}$	0.0 ml	$4.00 \cdot 10^{-3}$ ml	50	normal	0.020	$80 \cdot 10^{-6}$ mg/l	0.0 %

Quantity	Value	Standard Uncertainty	Degrees of Freedom	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
$V_{1\_st\_temp}$	0.0 ml	$364 \cdot 10^{-6}$ ml	infinity				
$V_{2\_st\_cal}$	5.0000 ml	0.0115 ml	infinity	rectangular	0.016	$190 \cdot 10^{-6}$ mg/l	0.0 %
$V_{2\_st\_rep}$	0.0 ml	0.0200 ml	50	normal	0.016	$320 \cdot 10^{-6}$ mg/l	0.2 %
$V_{2\_st\_temp}$	0.0 ml	$1.82 \cdot 10^{-3}$ ml	infinity				
$V_{3\_st\_cal}$	10.0000 ml	0.0173 ml	infinity	rectangular	0.011	$190 \cdot 10^{-6}$ mg/l	0.0 %
$V_{3\_st\_rep}$	0.0 ml	0.0400 ml	50	normal	0.011	$450 \cdot 10^{-6}$ mg/l	0.5 %
$V_{3\_st\_temp}$	0.0 ml	$3.64 \cdot 10^{-3}$ ml	infinity				
$V_{4\_st\_cal}$	15.0000 ml	0.0231 ml	infinity	rectangular	$6.1 \cdot 10^{-3}$	$140 \cdot 10^{-6}$ mg/l	0.0 %
$V_{4\_st\_rep}$	0.0 ml	0.0600 ml	50	normal	$6.1 \cdot 10^{-3}$	$370 \cdot 10^{-6}$ mg/l	0.3 %
$V_{4\_st\_temp}$	0.0 ml	$5.46 \cdot 10^{-3}$ ml	infinity				
$V_{5\_st\_cal}$	25.0000 ml	0.0231 ml	infinity	rectangular	$-3.6 \cdot 10^{-3}$	$-83 \cdot 10^{-6}$ mg/l	0.0 %
$V_{5\_st\_rep}$	0.0 ml	0.100 ml	50	normal	$-3.6 \cdot 10^{-3}$	$-360 \cdot 10^{-6}$ mg/l	0.3 %
$V_{5\_st\_temp}$	0.0 ml	$9.09 \cdot 10^{-3}$ ml	infinity				
$V_{1\_50\_cal}$	50.0000 ml	0.0520 ml	infinity	rectangular	$-400 \cdot 10^{-6}$	$-21 \cdot 10^{-6}$ mg/l	0.0 %
$V_{1\_50\_rep}$	0.0 ml	0.0173 ml	infinity	rectangular	$-400 \cdot 10^{-6}$	$-6.9 \cdot 10^{-6}$ mg/l	0.0 %
$V_{1\_50\_temp}$	0.0 ml	0.0182 ml	infinity				
$V_{2\_50\_cal}$	50.0000 ml	0.0520 ml	infinity	rectangular	$-1.6 \cdot 10^{-3}$	$-84 \cdot 10^{-6}$ mg/l	0.0 %
$V_{2\_50\_rep}$	0.0 ml	0.0173 ml	infinity	rectangular	$-1.6 \cdot 10^{-3}$	$-28 \cdot 10^{-6}$ mg/l	0.0 %
$V_{2\_50\_temp}$	0.0 ml	0.0182 ml	infinity				
$V_{3\_50\_cal}$	50.0000 ml	0.0520 ml	infinity	rectangular	$-2.2 \cdot 10^{-3}$	$-120 \cdot 10^{-6}$ mg/l	0.0 %

Quantity	Value	Standard Uncertainty	Degrees of Freedom	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
$V_{3\_50\_rep}$	0.0 ml	0.0173 ml	infinity	rectangular	$-2.2 \cdot 10^{-3}$	$-39 \cdot 10^{-6}$ mg/l	0.0 %
$V_{3\_50\_temp}$	0.0 ml	0.0182 ml	infinity				
$V_{4\_50\_cal}$	50.0000 ml	0.0520 ml	infinity	rectangular	$-1.8 \cdot 10^{-3}$	$-96 \cdot 10^{-6}$ mg/l	0.0 %
$V_{4\_50\_rep}$	0.0 ml	0.0173 ml	infinity	rectangular	$-1.8 \cdot 10^{-3}$	$-32 \cdot 10^{-6}$ mg/l	0.0 %
$V_{4\_50\_temp}$	0.0 ml	0.0182 ml	infinity				
$V_{5\_50\_cal}$	50.0000 ml	0.0520 ml	infinity	rectangular	$1.8 \cdot 10^{-3}$	$93 \cdot 10^{-6}$ mg/l	0.0 %
$V_{5\_50\_rep}$	0.0 ml	0.0173 ml	infinity	rectangular	$1.8 \cdot 10^{-3}$	$31 \cdot 10^{-6}$ mg/l	0.0 %
$V_{5\_50\_temp}$	0.0 ml	0.0182 ml	infinity				
V_{50}	50.0000 ml	0.0577 ml	infinity				
V_{40}	40.000 ml	0.163 ml	54				
V_{50_cal}	50.0000 ml	0.0520 ml	infinity	rectangular	$4.3 \cdot 10^{-3}$	$220 \cdot 10^{-6}$ mg/l	0.1 %
V_{50_rep}	0.0 ml	0.0173 ml	infinity	rectangular	$4.3 \cdot 10^{-3}$	$75 \cdot 10^{-6}$ mg/l	0.0 %
V_{50_temp}	0.0 ml	0.0182 ml	infinity				
V_{40_cal}	40.0000 ml	0.0289 ml	infinity	rectangular	$-5.4 \cdot 10^{-3}$	$-160 \cdot 10^{-6}$ mg/l	0.0 %
V_{40_rep}	0.0 ml	0.160 ml	50	normal	$-5.4 \cdot 10^{-3}$	$-860 \cdot 10^{-6}$ mg/l	1.8 %
V_{40_temp}	0.0 ml	0.0145 ml	infinity				
A_{sample_rep}	0.186000 AU	$612 \cdot 10^{-6}$ AU	50		1.3	$780 \cdot 10^{-6}$ mg/l	1.4 %
A_{sample_drift}	0.0 AU	$1.26 \cdot 10^{-3}$ AU	50		1.3	$1.6 \cdot 10^{-3}$ mg/l	6.1 %
A_{sample_round}	0.0 AU	$289 \cdot 10^{-6}$ AU	infinity	rectangular	1.3	$370 \cdot 10^{-6}$ mg/l	0.3 %
A_{sample_chem}	0.0 AU	$3.00 \cdot 10^{-3}$ AU	50		1.3	$3.8 \cdot 10^{-3}$ mg/l	34.6 %
A_1	0.05500 AU	$1.36 \cdot 10^{-3}$ AU	82				
A_{1rep}	0.055000 AU	$533 \cdot 10^{-6}$ AU	50		-0.51	$-270 \cdot 10^{-6}$ mg/l	0.2 %

Quantity	Value	Standard Uncertainty	Degrees of Freedom	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
A_{1drift}	0.0 AU	$1.19 \cdot 10^{-3}$ AU	50		-0.51	$-610 \cdot 10^{-6}$ mg/l	0.9 %
A_{1round}	0.0 AU	$289 \cdot 10^{-6}$ AU	infinity	rectangular	-0.51	$-150 \cdot 10^{-6}$ mg/l	0.0 %
A_{1_chem}	0.0 AU	$275 \cdot 10^{-6}$ AU	50		-0.51	$-140 \cdot 10^{-6}$ mg/l	0.0 %
A_2	0.21400 AU	$1.80 \cdot 10^{-3}$ AU	130				
A_{2rep}	0.214000 AU	$628 \cdot 10^{-6}$ AU	50		-0.41	$-260 \cdot 10^{-6}$ mg/l	0.2 %
A_{2drift}	0.0 AU	$1.28 \cdot 10^{-3}$ AU	50		-0.41	$-530 \cdot 10^{-6}$ mg/l	0.7 %
A_{2round}	0.0 AU	$289 \cdot 10^{-6}$ AU	infinity	rectangular	-0.41	$-120 \cdot 10^{-6}$ mg/l	0.0 %
A_{2_chem}	0.0 AU	$1.07 \cdot 10^{-3}$ AU	50		-0.41	$-440 \cdot 10^{-6}$ mg/l	0.5 %
A_3	0.41200 AU	$2.61 \cdot 10^{-3}$ AU	100				
A_{3rep}	0.412000 AU	$747 \cdot 10^{-6}$ AU	50		-0.29	$-210 \cdot 10^{-6}$ mg/l	0.1 %
A_{3drift}	0.0 AU	$1.39 \cdot 10^{-3}$ AU	50		-0.29	$-400 \cdot 10^{-6}$ mg/l	0.4 %
A_{3round}	0.0 AU	$289 \cdot 10^{-6}$ AU	infinity	rectangular	-0.29	$-82 \cdot 10^{-6}$ mg/l	0.0 %
A_{3_chem}	0.0 AU	$2.06 \cdot 10^{-3}$ AU	50		-0.29	$-590 \cdot 10^{-6}$ mg/l	0.8 %
A_4	0.60000 AU	$3.48 \cdot 10^{-3}$ AU	84				
A_{4rep}	0.600000 AU	$860 \cdot 10^{-6}$ AU	50		-0.16	$-140 \cdot 10^{-6}$ mg/l	0.0 %
A_{4drift}	0.0 AU	$1.50 \cdot 10^{-3}$ AU	50		-0.16	$-240 \cdot 10^{-6}$ mg/l	0.1 %
A_{4round}	0.0 AU	$289 \cdot 10^{-6}$ AU	infinity	rectangular	-0.16	$-46 \cdot 10^{-6}$ mg/l	0.0 %
A_{4_chem}	0.0 AU	$3.00 \cdot 10^{-3}$ AU	50		-0.16	$-480 \cdot 10^{-6}$ mg/l	0.5 %
A_5	0.99700 AU	$5.40 \cdot 10^{-3}$ AU	67				

Quantity	Value	Standard Uncertainty	Degrees of Freedom	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
A_{5rep}	0.99700 AU	$1.10 \cdot 10^{-3}$ AU	50		0.092	$100 \cdot 10^{-6}$ mg/l	0.0 %
A_{5drift}	0.0 AU	$1.73 \cdot 10^{-3}$ AU	50		0.092	$160 \cdot 10^{-6}$ mg/l	0.0 %
A_{5round}	0.0 AU	$289 \cdot 10^{-6}$ AU	infinity	rectangular	0.092	$27 \cdot 10^{-6}$ mg/l	0.0 %
A_{5_chem}	0.0 AU	$4.98 \cdot 10^{-3}$ AU	50		0.092	$460 \cdot 10^{-6}$ mg/l	0.5 %
ΣAC	1.5637 AU*mg/l	0.0173 AU*mg/l	170				
AvgC	0.44710 mg/l	$4.58 \cdot 10^{-3}$ mg/l	130				
n	5.0 unitless						
AvgA	0.45560 AU	$1.46 \cdot 10^{-3}$ AU	190				
ΣCC	1.5553 mg²/l²	0.0323 mg²/l²	140				
C	0.21527 mg/l	$6.50 \cdot 10^{-3}$ mg/l	180				

Results:

Quantity	Value	Expanded Uncertainty	Coverage factor	Coverage
C	0.215 mg/l	0.013 mg/l	2.00	manual
b_0	0.0171 AU	$4.3 \cdot 10^{-3}$ AU	2.00	manual
b_1	0.981 AU*l/mg	0.024 AU*l/mg	2.00	manual

Result Correlation:

	b_0	b_1
b_0	1	-0.48
b_1	-0.48	1