

Determination of total amount of nonvolatile impurities in water

Total amount of nonvolatile impurities in water is defined as the sum of the amount of dissolved material and suspended material in the water.

Determination of total amount of impurities Carefully mixed sample is transferred to a porcelain dish which is previously heated to a constant weight at $(105 \pm 2) ^\circ\text{C}$. The sample is then evaporated to dryness. The dish is then wiped outside with a filter-paper moisturized with diluted HCl and then with a filter paper moisturized with distilled water. The dish with the precipitate is heated to a constant weight in a drying oven at $(105 \pm 2) ^\circ\text{C}$. The total amount of impurities in the sample is calculated according to the equation below:

$$X = (m_1 - m_0) / V_{\text{sample}},$$

where m_1 (mg) stands for the weight of empty porcelain dish, m_0 (mg) is the weight of the dish with precipitate and V_{sample} (L) is the amount of water taken for the analysis.

Model Equation:

{Total amount of impurities in the sample}

$$X = (m_1 - m_0) / V_{\text{sample}};$$

{Uncertainty of weighing

It is assumed that weighing has 3 uncertainty components (on the example of m_1):

-repeatability of weighing (m_{1_rep})

-drift of the balance (m_{1_drift})

-uncertainty due to rounding of the reading (m_{1_round})}

$$m_1 = m_{1_rep} + m_{1_drift} + m_{1_round};$$

$$m_0 = m_{0_rep} + m_{0_drift} + m_{0_round};$$

{Uncertainty of the sample volume}

$$V_{\text{sample}} = V_{\text{sample_rep}} + V_{\text{sample_cal}} + V_{\text{sample_tem}};$$

$$V_{\text{sample_tem}} = V_{\text{sample_cal}} \cdot dt \cdot y;$$

List of Quantities:

Quantity	Unit	Definition
X	mg/L	Total amount of impurities in the sample
m_1	mg	Weight of porcelain dish with precipitate
m_0	mg	Weight of empty porcelain dish
V_{sample}	L	The volume of sample taken for analysis
m_{1_rep}	mg	Value and repeatability uncertainty component of the weight of porcelain dish with precipitate

Quantity	Unit	Definition
m_{1_drift}	mg	Drift uncertainty component of the weight of porcelain dish with precipitate
m_{1_round}	mg	Rounding uncertainty component of the weight of porcelain dish with precipitate
m_{0_rep}	mg	Value and repeatability component of the weight of empty porcelain dish
m_{0_drift}	mg	Drift uncertainty component of the weight of empty porcelain dish
m_{0_round}	mg	Rounding uncertainty component of the weight of empty porcelain dish
V_{sample_rep}	L	Value and repeatability uncertainty component of the volume of sample taken for analysis
V_{sample_cal}	L	Calibration uncertainty component of the volume of sample taken for analysis
V_{sample_tem}	L	Temperature uncertainty component of the volume of sample taken for analysis
dt	°C	Difference of the actual laboratory temperature from 20 degrees centigrade
y	1/°C	The coefficient of volume expansion for water

X: Result

m_1 : Interim Result

m_0 : Interim Result

V_{sample} : Interim Result

m_{1_rep} : Type B normal distribution
 Value: 65556.2 mg
 Expanded Uncertainty: 0.077151675 mg
 Coverage Factor: 1

m_{1_drift} : Type B normal distribution
 Value: 0 mg
 Expanded Uncertainty: 0.037115375 mg
 Coverage Factor: 1

m_{1_round} : Type B rectangular distribution
 Value: 0 mg
 Halfwidth of Limits: 0.00005 mg

m_{0_rep} : Type B normal distribution
 Value: 65550 mg
 Expanded Uncertainty: 0.077151675 mg
 Coverage Factor: 1

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m_{0_drift}: Type B normal distribution
 Value: 0 mg
 Expanded Uncertainty: 0.037115375 mg
 Coverage Factor: 1

m_{0_round}: Type B rectangular distribution
 Value: 0 mg
 Halfwidth of Limits: 0.00005 mg

V_{sample_rep}: Type B normal distribution
 Value: 0.050 L
 Expanded Uncertainty: 0.000004933472 L
 Coverage Factor: 1

V_{sample_cal}: Type B normal distribution
 Value: 0 L
 Expanded Uncertainty: 0.000002466736 L
 Coverage Factor: 1

V_{sample_tem}: Interim Result

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

y: Type B rectangular distribution
 Value: 0.00021 1/°C
 Halfwidth of Limits: 0 1/°C

Uncertainty Budget:

Quantity	Value	Standard Uncertainty	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
m _{1_rep}	65556.2000 mg	0.0772 mg	normal	20	1.5 mg/L	40.6 %
m _{1_drift}	0.0 mg	0.0371 mg	normal	20	0.74 mg/L	9.4 %
m _{1_round}	0.0 mg	28.9·10 ⁻⁶ mg	rectangular	20	0.00058 mg/L	0.0 %
m _{0_rep}	65550.0000 mg	0.0772 mg	normal	-20	-1.5 mg/L	40.6 %
m _{0_drift}	0.0 mg	0.0371 mg	normal	-20	-0.74 mg/L	9.4 %
m _{0_round}	0.0 mg	28.9·10 ⁻⁶ mg	rectangular	-20	-0.00058 mg/L	0.0 %
V _{sample_rep}	0.05000000 L	4.93·10 ⁻⁶ L	normal	-2500	-0.012 mg/L	0.0 %
V _{sample_cal}	0.0 L	2.47·10 ⁻⁶ L	normal	-2500	-0.0061 mg/L	0.0 %
dt	0.0 °C	1.73 °C	rectangular	0.0	0.0 mg/L	0.0 %
y	0.00021 1/°C	0.0 1/°C	rectangular	0.0	0.0 mg/L	0.0 %
X	124.00 mg/L	2.42 mg/L				

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Result: Quantity: X
Value: 124.0 mg/L
Expanded Uncertainty: ± 4.8 mg/L
Coverage Factor: 2.00
Coverage: manual