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Consulting Analytical Chemists and Geochemists

COMBINED AND RELATIVE MEASUREMENT UNCERTAINTY IN WEIGHING

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Application Note: 30

Weighing by Difference

Weighing by difference is the most accurate method to measure quantitatively the mass of a solid sample. This procedure involves repetitive weighing of a weighing bottle containing a quantity of solid reagent. As the solid is removed to another vessel, the mass of the weighing bottle contents decreases. Upon reweighing, a lower mass is found. The difference in the two masses represents the mass of solid reagent transferred to the vessel. Hence, the phrase "weighing by difference".

$$Weight\ of\ bottle + initial\ sample = 15.6784\ g$$
$$Final\ weight = 15.5237\ g$$
$$Weight\ of\ Sample = 0.1547\ g$$

The measurement uncertainty of the analytical balance used is ±0.0008 g at k=2, i.e., at a 95% level of confidence. Converting to standard uncertainty:

$$u_{mass} = \frac{0.0008}{2} = 0.0004$$

Therefore, the ***combined uncertainties*** in weighing are:

$$(15.6784 \pm 0.0004g) - (15.5237\ \pm 0.0004g) = 0.1547\ \pm combined\ uncertainty$$

$$combined\ uncertainty\ (u_c) = \sqrt{0.0004^2 + 0.0004^2} = 0.00056\ \text{g}$$

The uncertainty in weight is reported as:

$$0.1547 \pm 0.0006\ \text{g}$$

Calculating the ***relative standard uncertainty*** in terms of the weight of 0.1547g:

$$\frac{u_c}{0.1547g} = \sqrt{\left(\frac{0.0004g}{15.6784g}\right)^2 + \left(\frac{0.0004g}{15.5237g}\right)^2}$$

Multiplying both sides by 0.1547:

$$\frac{u_c}{0.1547g} = 0.1547\sqrt{\left(\frac{0.0004g}{15.6784g}\right)^2 + \left(\frac{0.0004g}{15.5237g}\right)^2}$$

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$$u_c = 0.1547\sqrt{1.31484\ x\ 10^{-9}}$$

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The combined relative standard uncertainty of 0.1547 g is:

$$u_c = 5.61\ x\ 10^{-6}\text{g}$$

0.1547±0.000006 g

Citation

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