

Photometric determination of total, Calcium and Magnesia hardness of tap water

Description

The photometric determination of the total hardness of tap water is done by titration with Na₂-EDTA together with the optical sensor OptiLine 6. For indication eriochrome black T is used, the calcium hardness is indicated by Calconcarboxylic acid. Magnesia hardness is calculated by the difference of the total hardness and calcium hardness.

Instrumentation

Titration	TL 7000 or higher
Electrode	OptiLine 6
Wavelength	625 nm

Reagents

1	Na ₂ EDTA 0.1 mol/l
2	Ammonia solution 25%
3	Ammonium chloride
4	Eriochrome Black T indicator
5	Calconcarboxylic acid indicator
6	Deionized water
7	Na ₂ MgEDTA * H ₂ O (optional)
8	Sodium hydroxide
9	Sodium chloride
All reagents should be of analytical grade or better.	

Titration Procedure

Reagents

Buffer solution pH 10

54.0 g Ammonium chloride are dissolved in a small amount of water in a volumetric flask. 350 ml of Ammonia solution 25% is added. Fill up with water to the 1.0 L mark.

Eriochrome Black T indicator

For Indication of total hardness an Eriochrome Black T/NaCl trituration (1:100) is used. Alternatively 50 to 500 mg of Eriochrome Black T can be dissolved in 100 ml of Ethanol. This solution is not stable.

Calconcarboxylic acid indicator

For Indication of calcium hardness a Calconcarboxylic acid /NaCl trituration (1:100) is used. Alternatively 400 mg of Calconcarboxylic acid can be dissolved in 100 ml of Ethanol. This solution is not stable.

Procedure total Hardness

100 ml of the sample are added to a 150 ml beaker. 10 ml of the pH 10 buffer solution and a spatula tip of Eriochrome Black T is added (or a few drops of the indicator solution). The titration is performed with 0.1 mol/l $\text{Na}_2\text{-EDTA}$. In case of very hard water samples the sample amount can be reduced, in case of soft water less concentrated EDTA solution can be used.

Procedure Calcium hardness

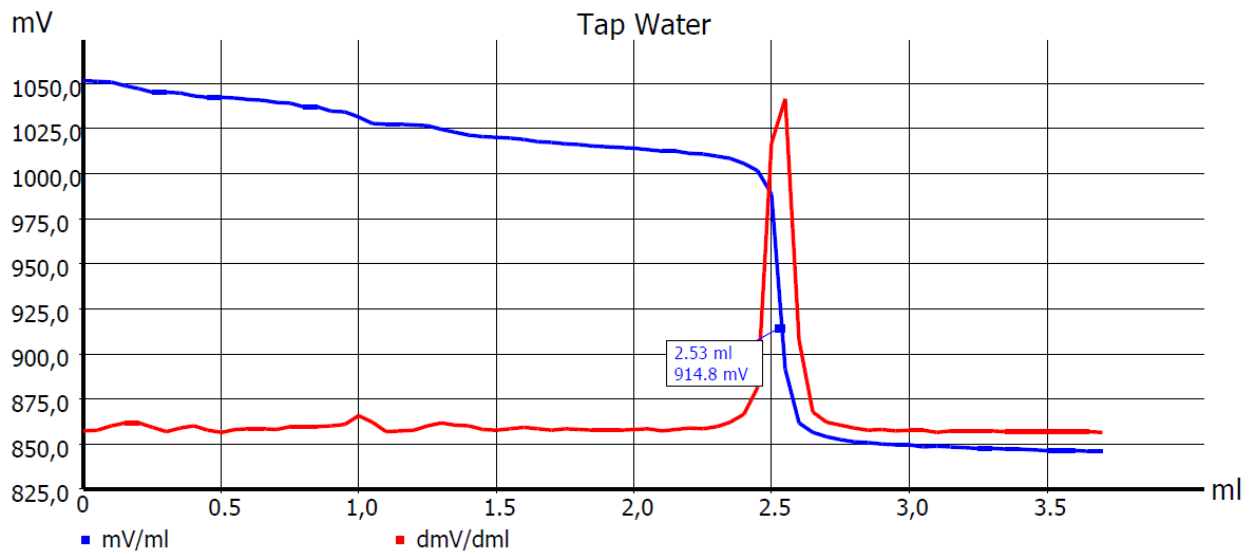
100 ml of the sample are added to a 150 ml beaker. The sample is adjusted to a pH of higher than 12.5 using NaOH. A spatula tip of Calconcarboxylic acid trituration is added (or a few drops of the indicator solution) and directly titrated.

Procedure Magnesia hardness

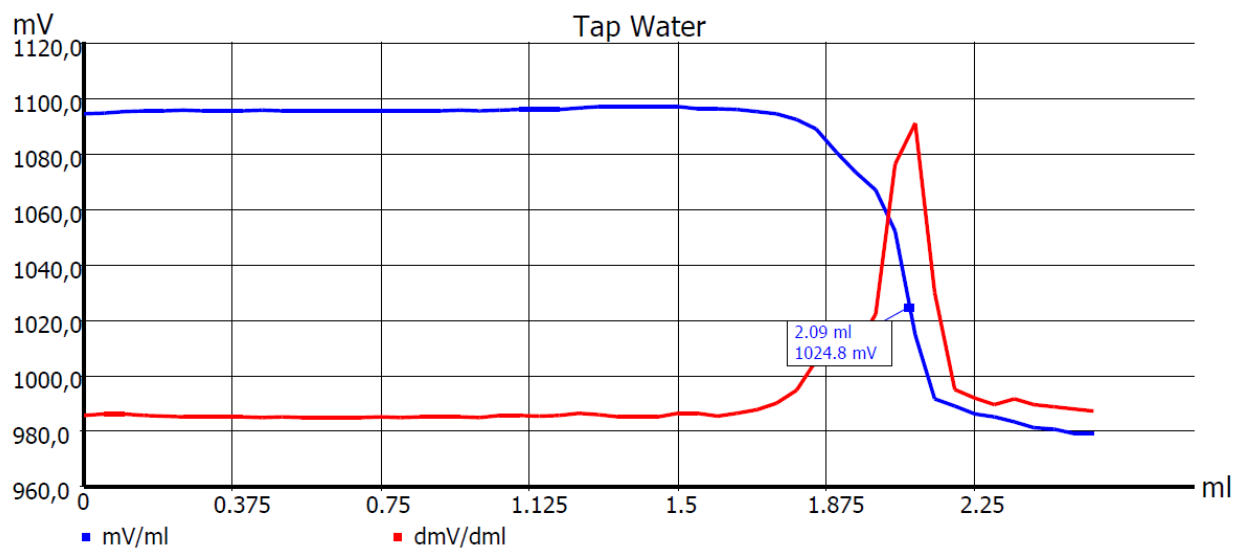
The Magnesia hardness is calculated by the difference of the total and Calcium hardness.

Titration Parameter

Sample titration total Hardness



Sample titration Calcium hardness



Default method	-		
Method type	Automatic Titration		
Mode	Linear		
Titration value	mV (E)		
Measuring speed	Individual	Minimum time	05 s
		Maximum time	15 s
		Measuring time	4 s
		Drift	5 mV/min
Initial waiting time	0 s	Wavelength	625 nm
Linear step size	0.05 ml	Intensity	average(approx. 1000 mV at the beginning)
		Smoothing	Strong
Pre-titration	Off		
End value	Off	Titration direction	decrease
EQ	On (1EQ)	Slope value	120
Max. titration volume	20 ml		
Dosing speed	100%	Filling speed	30 s

Calculation:

$$Result [mmol/l] = \frac{EQ1 * T * F1}{W * F2}$$

EQ1		Consumption of titration reagent at the first EQ
T	WA	Exact concentration of the Titration reagent
V	man	Sample volume [ml]
F1	1000	Conversion factor 1
F2	1	Conversion factor 2

If the result should not be expressed in mmol/L the following conversion factors can be used. Use these factors as F2 in the equation above.

Unit		F2
mmol/l	mmol/l	1
German hardness	°dH	0,1783
french Hardness	°fH	0,1
ppm CaCO ₃	ppm	0,01

Notes

- A sharper jump of the total hardness titration can be reached by adding 0.1 g of Mg-EDTA to the sample.
- Air bubbles disturb the measurement of the optical sensor. Therefore it is recommendable to degas the sample before titration. Degassing by use of a vacuum or water jet pump is possible.
- Magnesia for the calcium hardness titration is masked by precipitation as Magnesia hydroxide. Big amounts of hydroxide may disturb the optical detection.