

## Photometric determination of total, Calcium and Magnesium hardness of tap water

### Description

The photometric determination of the total hardness of tap water is done by titration with Na<sub>2</sub>-EDTA together with the optical sensor OptiLine 6. For indication Eriochrome black T is used, the calcium hardness is indicated by Calconcarboxylic acid. Magnesium 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 <sub>2</sub> 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 <sub>2</sub> MgEDTA * H <sub>2</sub> 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**

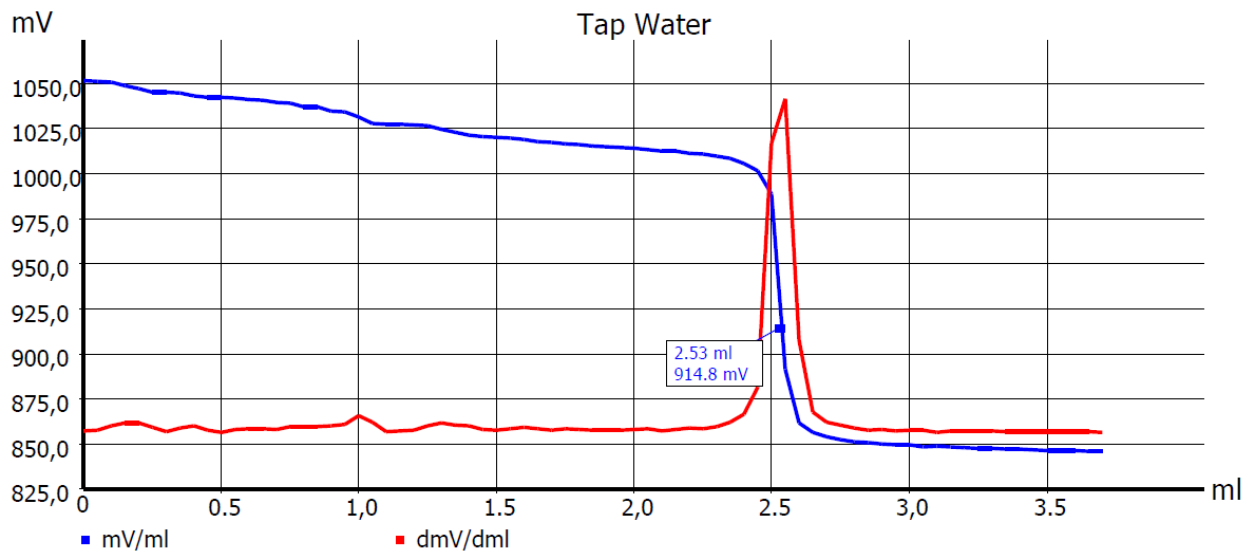
100 ml of the sample are added to a 150 ml beaker. The sample is adjusted to a pH of higher than 12.5 using NaOH. A spatula tip of Calconcarboxylic acid trituration is added (or a few drops of the indicator solution) and directly titrated.

### **Procedure Magnesium hardness**

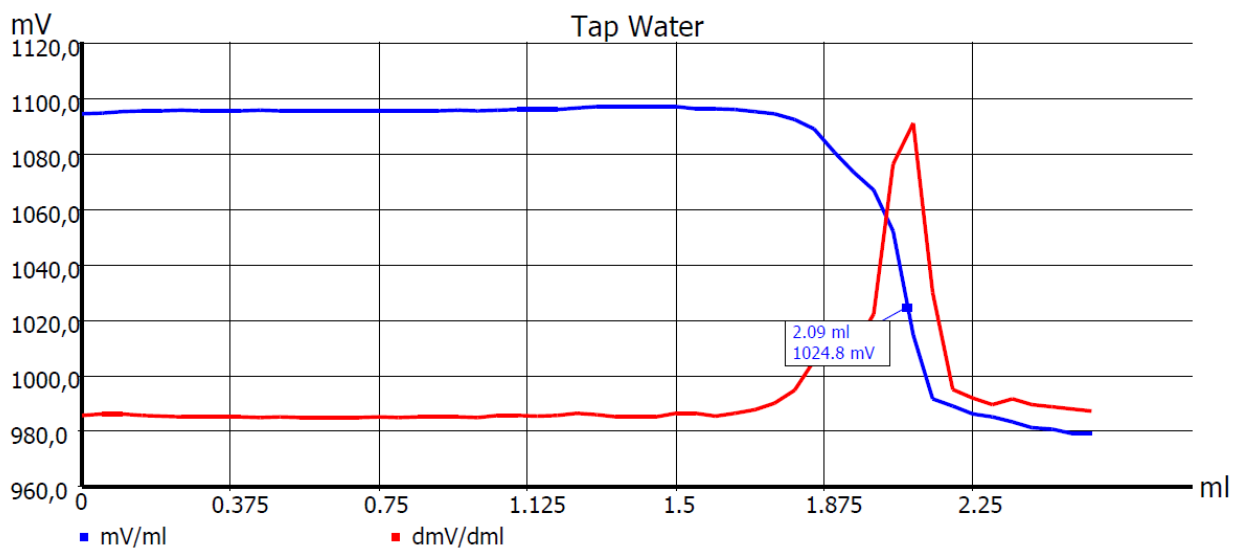
The Magnesium hardness is calculated by the difference of the total and Calcium hardness.

## 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:

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

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 <sub>3</sub>	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 using a vacuum or water jet pump is possible.
- Magnesium for the calcium hardness titration is masked by precipitation as Magnesium hydroxide. Big amounts of hydroxide may disturb the optical detection.

Any questions? Please contact the application team:

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