APPLICATION

AAS 15

Determination of Sodium, Potassium, Calcium and Magnesium in Mineralwater

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Sodium, Potassium, Calcium, and Magnesium belong to the essential Mineralsubstances in the human organism.
These elements take influence in the generation of enzymes and hormones, control the osmotic pressure in tissues and body fluids and are important for the exchange procedures in the cell membranes [1].
The recommended daily amounts (Na: 550, K: 2000, Ca: 800-1000, Mg: 350 mg / L [1]) are possible to be partly covered by consumption of mineral waters. But the composition of mineral waters according to the essential elements has a wide variety. Additionally, there is no recommendations of these elements in the german mineral- and table water regulation, and in the EU waterregulation either [2 a,b]. The control of Na, K, Ca and Mg in four different mineral waters is explained in the following procedure, according to the german DIN -regulations [3], with the new Shimadzu atomic absorption flame emission spectrophotometer AA-6200. In order to control the accuracy of the analytical results two different certified reference waters with the elements of interest have been measured additionally in the analytical multielement cycle.

	Na	K	Ca	Mg
Lampcurrent	12 mA	10 mA	10 mA	8 mA
Wavelength	589,0 nm	766,5 nm	422,7 nm	285,2 nm
Slitwidth	0,2 nm	0,7 nm	0,7 m	0,7 nm
Mode	NON-BGC	NON-BGC	BGC-D_2	BGC-D_2
Flame	Air-C_2H_2	Air-C_2H_2	Air-C_2H_2	Air-C_2H_2
Fuelflow	1,8 l/min	2,0 l/min	2,0 l/min	1,8 l/min
Prespraytime	3 s	3 s	3 s	3 s
Integrationtimet	5 s	5 s	5 s	5 s
Repetitions	2 max.3 (CV=1%)	2 max.3 (CV=1%)	2 max.3 (CV=1%)	2 max.3 (CV=1%)
Calibration	0,1 - 0,6 ppm	0,1 - 0,6 ppm	0,5 - 5,0 ppm	0,025 - 0,25 ppm

Table 1: Experimental Parameters

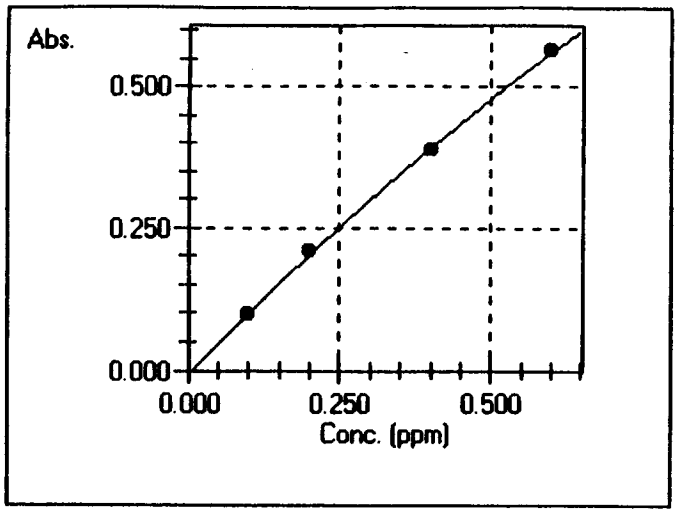
Experimental Part

The samples have been diluted according to the expected concentration range and DIN corresponding reagents have been added. In case of Sodium and Potassium 10 ml of CsCl- solution (12,65 g CsCl + 50 ml HCl (d=1,16) filled up to 500 ml volume with H_2O) has been used for each 100 ml of standard and sample solution. In case of Calcium and Magnesium a La_2O_3-solution (5,875 g La_2O_3 + 50 ml HCl (d=1,12) filled up to 250 ml volume with H_2O) has beeen used.

The instrumental parameters and measuring conditions have been listed in Table 1. These conditions are automatically set from software. Only slit width and gas flow rates have to be changed manually.

The measurement has been performed in the manual mode in this experiment. Automatisation is possible with the optional autosampler ASC-6100. In the Figures 1 - 4 all resulting calibration curves are displayed.

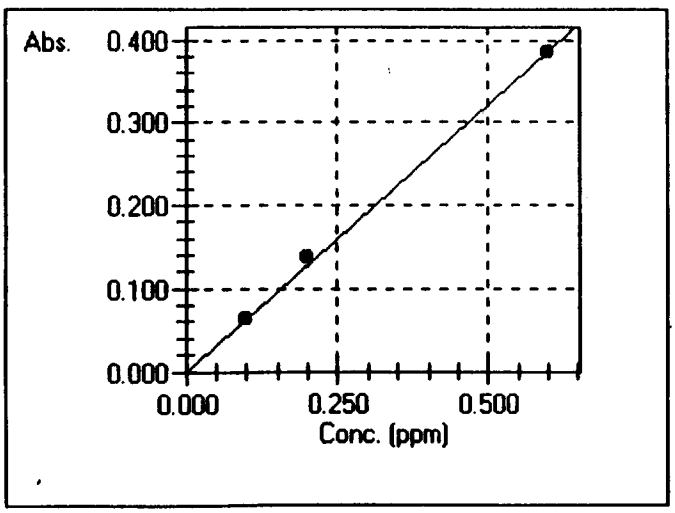
It is possible to key in the dilution factor to the measured results table. Then, after finishing the analytical sequence all final results will be listed in the summary report.



Abs.=-0.250417Conc^2+ 1.0974Conc+-0.00507819

r=0.9996

Fig. 1: Calibration curve of Sodium



Abs.=0.645739Conc

r=0.9997

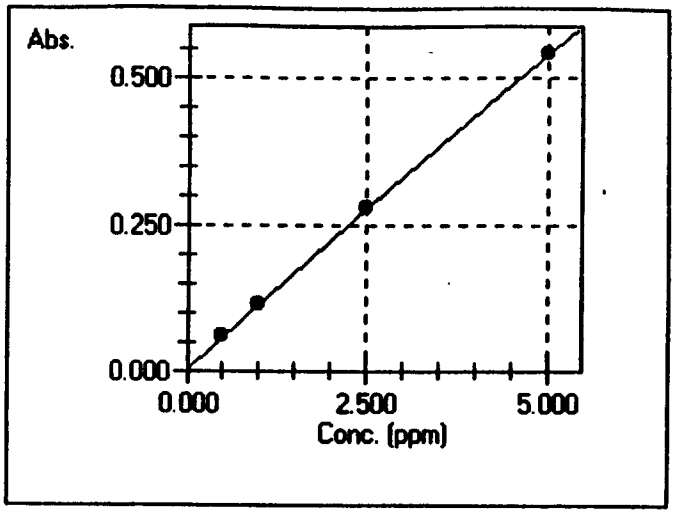
Fig. 2: Calibration curve of Potassium

Results and Preview

The results of all reference waters are in good correlation with the certified values, which prooves the accuracy of our method (Table 2).

The comparison of our results from mineral water samples with the element concentrations listed on the labels (Institut Fresenius, Taunusstein) shows deviations up to 30 %. The reason for these deviations is a very poor and not frequently performed control of mineral waters in comparison to the normal drinking water. The analytical data listed on the labels are a couple of years old, and do not represent the actual concentrations.

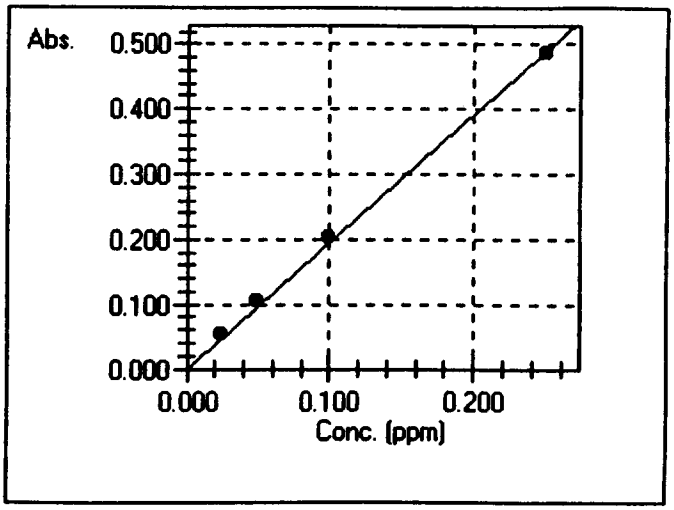
The new AA-6200 is well suited for an accurate and simple determination of mineral contents in waters. The flexibility of this system can be expanded by using a high temperature burner or a hydride system (HVG-1). The HVG-1 for example allows the accurate determination of Arsenic in mineral waters, which has been already published earlier [4] in combination with the Shimadzu flame atomic absorption spectrophotometer AA-6601F.



Abs.=-0.00118628Conc^2+0.114324Conc+0.00177164

r=1.0000

Fig. 3: Calibration curve of Calcium



Abs.=1.96872Conc

r=0.9999

Fig. 4: Calibration curve of Magnesium

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Content in mg/l	Na	K	Ca	Mg
SRM 1643d (NIST)				
measured	22,6601	2,3645	31,4277	7,9862
certified	22,07 ± 0,64	2,356 ± 0,035	31,04 ± 0,50	7,989 ± 0,035
SLRS 3 (NCR-CNRC, Canada)				
measured	2,4166	0,7139	5,7768	1,5412
certified	2,3 ± 0,2	0,7 ± 0,1	6,0 ± 0,4	1,6 ± 0,2
Gerolsteiner Sprudel				
measured	149,6	13,2	339,5	103,7
Analysis acc. Institut Fresenius	119	11	347	108
St. Gero Heilwasser				
measured	107,3	10,8	299,9	92,3
Analysis acc. Institut Fresenius	121,0	10,2	331,0	109,4
Schönborn Quelle				
measured	17,7	1,8	158,2	20,1
Analysis acc. Institut Fresenius	11,2	2,3	192	22,3
Römerwall Quelle				
measured	304,5	4,1	1,3	0,62
Analysis acc. Institut Fresenius	260	4,8	1,4	0,58

Table 2: Results

Literature:

[1] Mineralstoffe und Spurenelemente
Verlag Bertelsmann Stiftung, 1991

[2] Das neue Wasserrecht für die betriebliche Praxis
WEKA Fachverlag für technische Führungskräfte
a) Mineral- und Tafelwasserverordnung. Band 4, Teil 07/4.4.3
b) EG-Wasserrecht: Band 1, Teil 02/8

[3] Deutsche Einheitsverfahren (DEV) zur Wasser-, Abwasser- und Schlammuntersuchung
Verlag Chemie, Weinheim
DIN 38406-E14 (Natrium), DIN 38406-E13 (Kalium), DIN 38406-E3-1 (Calcium, Magnesium)

[4] Dr. A. Klose, U. Oppermann
Shimadzu Application note: AAS 9

Instrumentation

Atomic Absorption Spektrophotometer: AA-6200

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