Economic and hassle-free bromate analysis in drinking water

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Bromate – at a glance

Bromates are formed during the disinfection-process during ozonation:

- Bromide ions occur naturally in raw water, especially in ground water near to the sea.
- These are bonding with ozone and forming bromate.
- $Br^- + O_3 = BrO_3^-$
- Bromates are potentially carcinogenic.
- Thus, the values in drinking water are limited by e.g. WHO, EU, USEPA.

Drinking Water Limits

Parameter	WHO (2006) in mg/l	EU (2003) in mg/l	USEPA (2009) in mg/l
Bromate	0.01	0.01	0.01

Table Water Limits

Parameter	Germany in mg/l
Bromate	0.003

Bromate – at a glance

- Bromide concentrations are especially high in Seawater:
  - 65 mg/l to well over 80 mg/l
- Common desalination processes can reduce bromide to up to 1 mg/l
- The lack of minerals needs to be substituted by artificial salts.
- Only pure salts with low content of bromide should be used.

Source:
WHO guidelines for drinking water quality,
4th edition 2011

Bromate – IC vs. Photometry

Ion chromatography

- Often not available in drinking water labs
- Handling requires a high level of technical skills
- IC with high-capacity separation columns gave correct results for Bromate
- Interfering Cl^-, NO_3^- and SO_4^{2-} anions may lead to wrong, too low results

Photometry

- No additional investment, Photometers are needed anyway
- photometric application in the range of 0.003 to 0.120 mg/l available, more sensitive method under preparation
- Turbid sample (Ca) must be filtered
- Higher mineral contents (Ca, Sulfate…) may interfere

Source: FOOD-Lab International, Volume 1/12, Page 28 to 31
Bromate determination in water and drinking water
Photometric determination versus ion chromatography

Photometric determination with 3,3'-dimethylnaphtidine and iodide (1/2)

Bromate in water and drinking water	Application

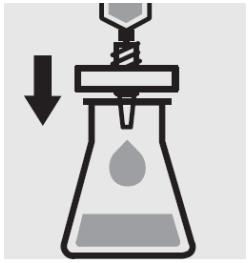
Measuring Range: 0.003 – 0.120 mg/l BrO_3

Cell Size: 50-mm rectangular cell

Wavelength: 550 nm

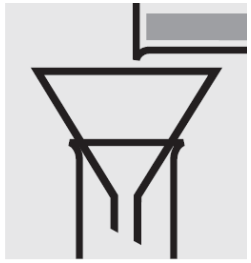
Blank: distilled water (Water for analysis EMSURE®, Cat.No. 116754 is recommended); reagents in an analogous manner

Pre-programmed on:
Spectroquant® Pharo spectrophotometer

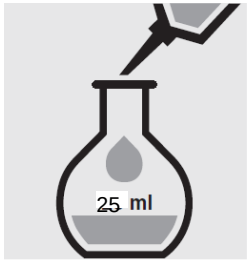


Filter turbid samples.

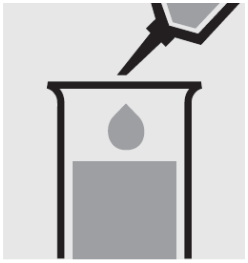
Evaporate 250 ml of sample solution in a glass beaker almost to dryness on the hob.



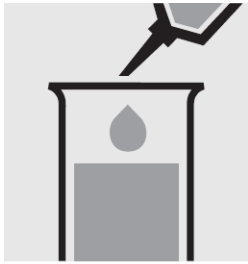
Transfer the residue to a 25 ml volumetric glass using a little distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended).



Make up the contents of the volumetric flask to the mark with distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) and mix thoroughly: **pretreated sample**.



Pipette 10 ml of the pretreated sample into a test tube.



Add 0.10 ml of **reagent 1** with pipette and mix.

Photometric determination with 3,3'-dimethylnaphtidine and iodide (2/2)

Bromate in water and drinking water	Application

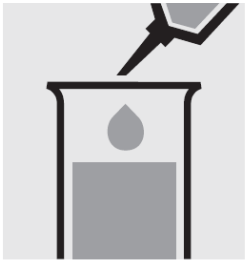
Measuring Range: 0.003 – 0.120 mg/l BrO_3

Cell Size: 50-mm rectangular cell

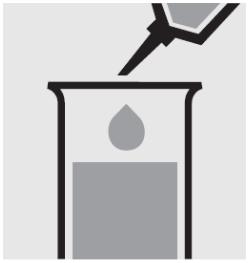
Wavelength: 550 nm

Blank: distilled water (Water for analysis EMSURE®, Cat.No. 116754 is recommended); reagents in an analogous manner

Pre-programmed on:
Spectroquant® Pharo spectrophotometer

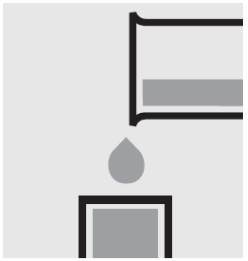


Add 0.20 ml of **reagent 2** with pipette and mix.



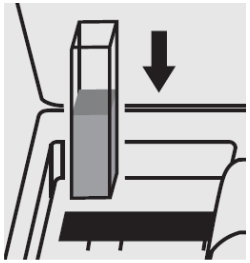
Add 0.20 ml **perchloric acid 70 - 72 % GR** (Cat.No. 100519) with pipette and mix.

Reaction time: 30 minutes



Transfer the solution into a cell.

Select method no. **195**.



Place the cell into the cell compartment. The measurement is performed automatically.

Method no. 195 on NOVA and Pharo

Bottled water - tests with real samples

Initial Questions:

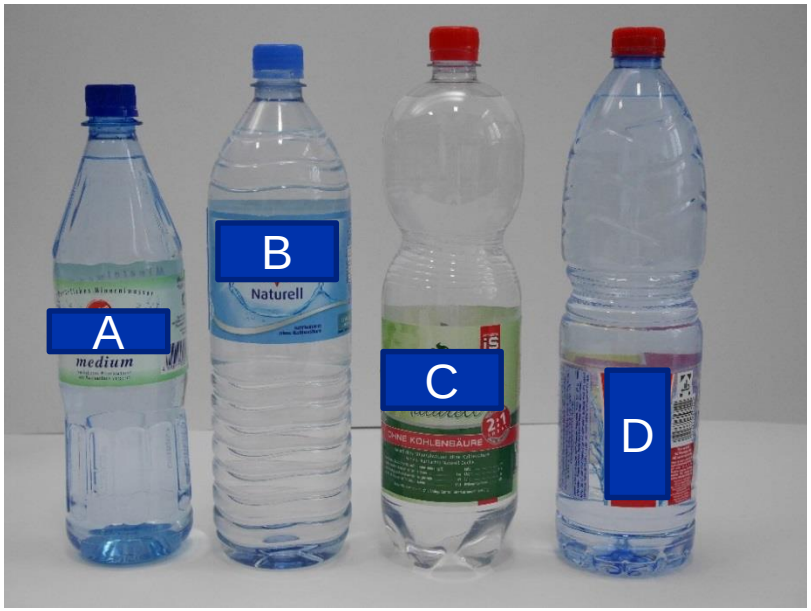
How do mineral contents interfere with the bromate determination?

Object Of Analysis:

4 Bottled Water with different mineral content

Analysis Accessoires:

- Spectroquant® Bromate Application
- 50-mm rectangular cell
- Pharo 300



Bottled Water

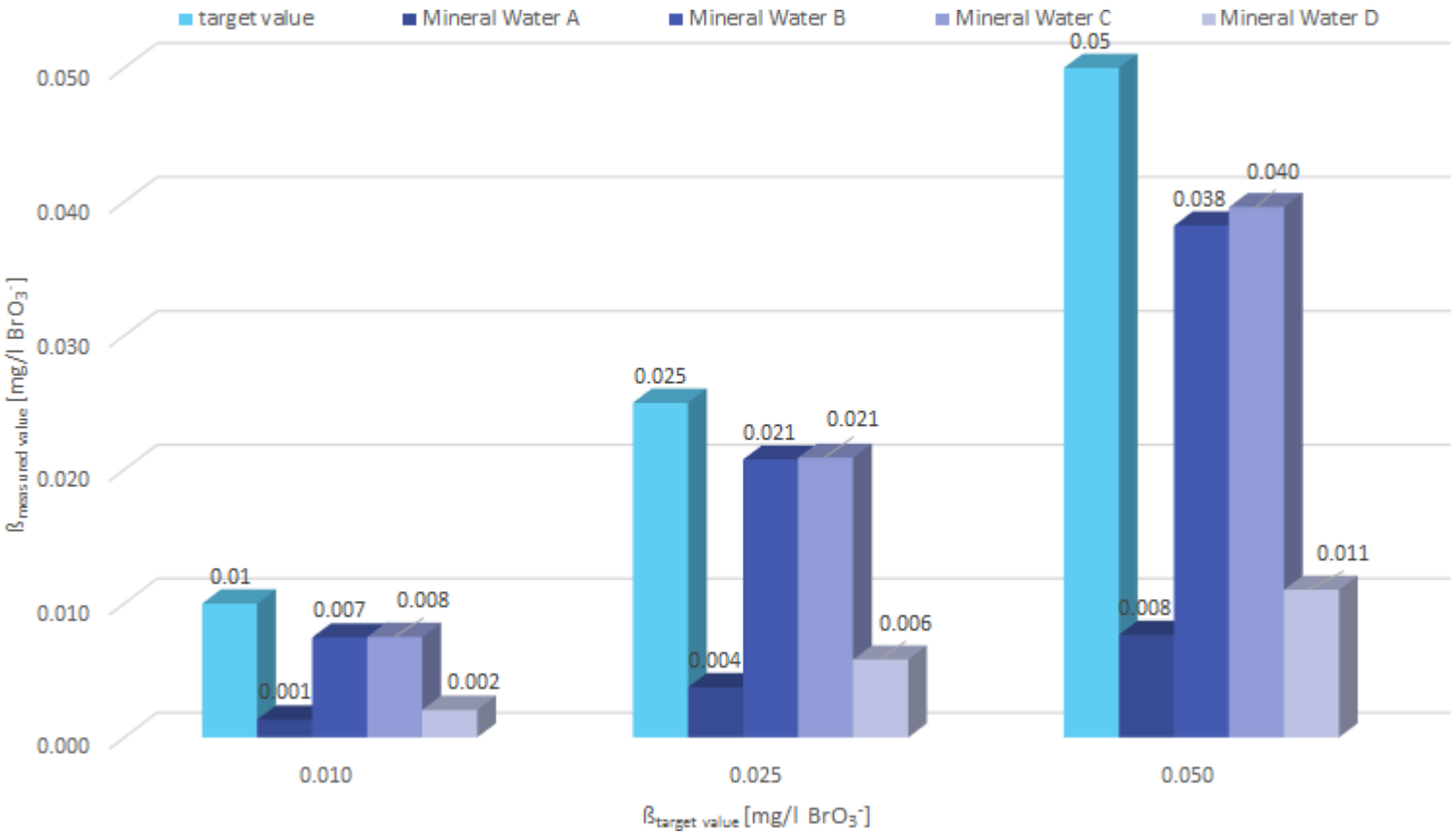
Mineral content of different bottled water examples:

Parameter	Mineral content [mg/l]			
	Mineral Water A	Mineral Water B	Mineral Water C	Mineral Water D
Calcium	72	140	156	94
Potassium	10.8	3	2.9	-
Magnesium	20	49	69	20
Sodium	4.2	12	47.4	7.7
Chloride	2.4	9	71.8	-
Hydrogencarbonate	162	652	810	248
Sulfate	143	20	16	120

B and C have low sulfate content

Analysis Comparison – Concentration

Summary:



Bottled Water Analysis – Conclusions

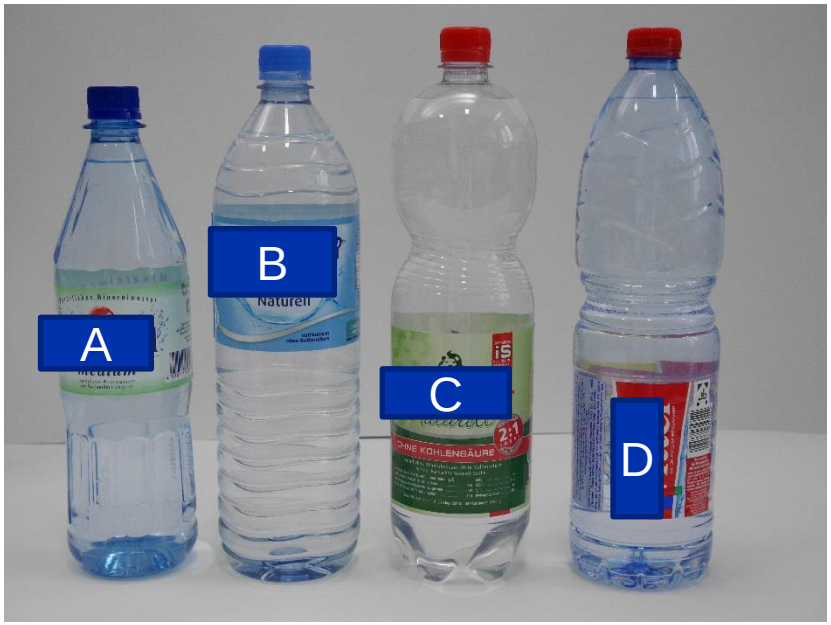
Conclusions:

- The bromate application with the 50 mm cuvette led to acceptable results for the bottled waters with lower sulfate content (e.g. B, C).
- The higher the mineral content, the higher the interference. Further investigations are under preparation.

100 mm Cuvette – Without Sample Reduction

Initial Question:

Does leaving out the sample reduction in combination with the new 100 mm cuvette lead to better results?



Object of Analysis:

The same 4 bottled waters as used before.

Analysis Accessories:

- Spectroquant® Bromate Application
- 100-mm cuvette
- Prove 600

Bromate Application – 100 mm Cuvette (1/2)

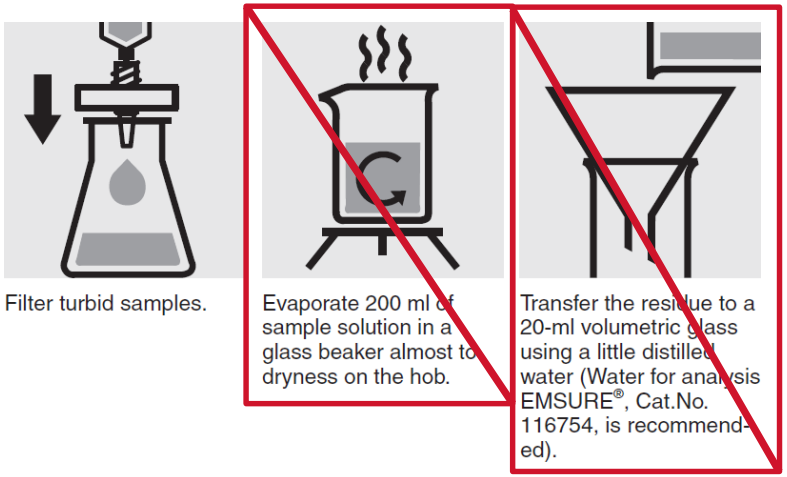
Bromate in water and drinking water	Application

Measuring Range: 2.5 – 100.0 µg/l BrO_3

Cell Size: 100-mm rectangular cell, in Prove 600

Wavelength: 550 nm, Method 308

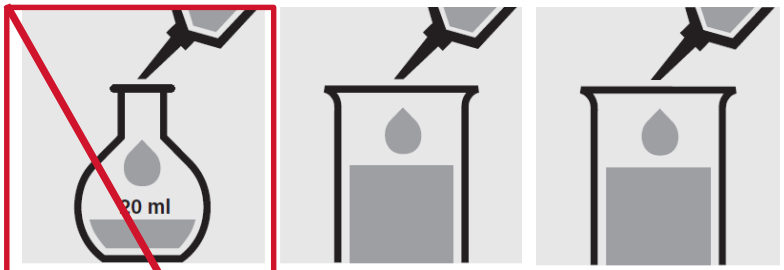
Blank: distilled water (Water for analysis EMSURE®, Cat.No. 116754 is recommended); reagents in an analogous manner



Filter turbid samples.

Evaporate 200 ml of sample solution in a glass beaker almost to dryness on the hob.

Transfer the residue to a 20-ml volumetric glass using a little distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended).



Make up the contents of the volumetric flask to the mark with distilled water (Water for analysis EMSURE®, Cat.No. 116754, is recommended) and mix thoroughly.

Pipette 10 ml of the pre-treated sample into a test tube.

Add 0.20 ml of **reagent 1** with pipette and mix.

pretreated sample.

Hint: Added reagents have twice the volume

Bromate Application – 100 mm Cuvette (2/2)

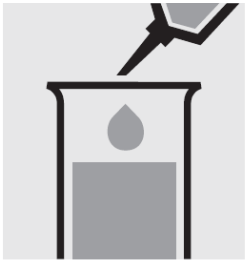
Bromate in water and drinking water	Application

Measuring Range: 2.5 – 100.0 µg/l BrO_3

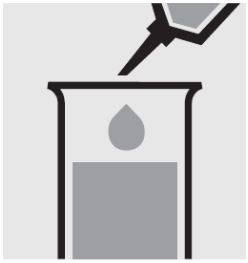
Cell Size: 100-mm rectangular cell, Prove 600

Wavelength: 550 nm, Method 308

Blank: distilled water (Water for analysis EMSURE®, Cat.No. 116754 is recommended); reagents in an analogous manner



Add 0.40 ml of **reagent 2** with pipette and mix.



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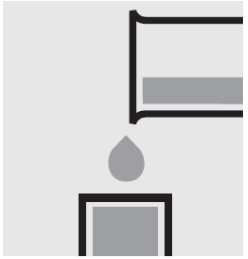
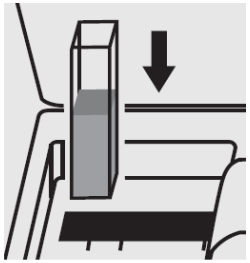
Reaction time: 30 minutes



Transfer the solution into a cell.

Select method no 308

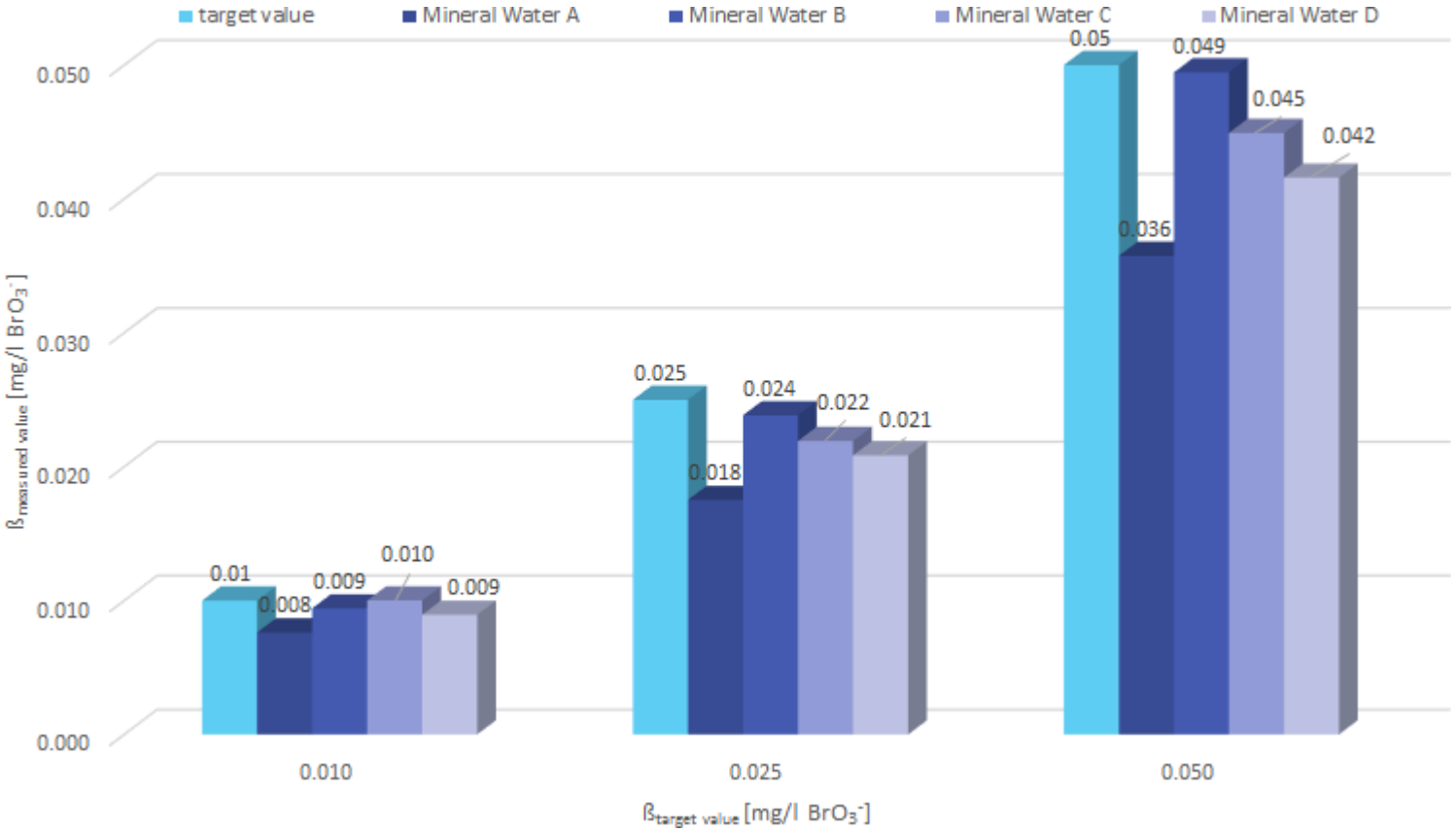


Place the cell into the cell compartment. The measurement is performed automatically.

Hint: Added reagents have twice the volume

100 mm without Sample Reduction – Concentration

Summary:



Bromate application is pre-programmed on Prove spectrophotometers

Spectroquant® Prove 100

Ord. No. 1.73016.0001

For routine applications

Prove 100 is the best choice for those who primarily use our broad range of Spectroquant® test kits,
or only perform Vis measurements. High quality and great value for money for your daily analyses.

Spectroquant® Prove 300

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For sensitive measurements

Thanks to its long-lasting xenon lamp, Prove 300 is ideal for more intensive use. What's more, it is capable of both UV and Vis measurements, so you have greater flexibility for more intricate analyses.

Spectroquant® Prove 600

Ord. No. 1.73018.0001

For complex analyses

Designed for high-end UV/Vis optics, **and cuvettes of up to 100 mm,** Prove 600 packs great power into a compact size. Excellent resolution and sensitivity for use with test kits, complex kinetics or spectral measurements.

Bromate application on Prove

Bromat ULR (ultra low range), Method 307 available for update in dec. 2015

50 mm rectangular cell, Measuring range 1,0 – 40,0 µg/l

100 mm rectangular cell, Measuring range 0,5 – 20,0 µg/l (only Prove 600)

Bromat LR (low range), Method 308 available for update in dec. 2015

50 mm rectangular cell, Measuring range 5,0 – 200,0 µg/l

100 mm rectangular cell, Measuring range 2,5 – 100,0 µg/l (only Prove 600)

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How to request a copy of the bromate application?

1) Go to www.merckmillipore.com/bromate or www.emdmillipore.com/bromate

2) Click on the link : „request your copy of the application“

3) Fill out all the information into the form

4) Add the serial number of your NOVA, Pharo or Prove instrument, if you have already an instrument in your lab

5) Submit the request form

6) You will be contacted via e-mail