

# Analysis of Multiple Trace Elements in Bleach by ICP-OES

Accurate results using an Agilent ICP-OES with automatic fitted background correction

## Author

John Talbott

Agilent Technologies, Inc.

## Avoid discoloration and breakdown of bleach-based cleaning products

Bleach is a powerful disinfectant that is widely used on hard surfaces to kill bacteria, fungi, and viruses, such as SARS-CoV-2, the coronavirus responsible for the COVID-19 pandemic (1). Global sales of many household bleach products, which contain 5 to 9% sodium hypochlorite (NaClO), have skyrocketed during the pandemic as households and businesses have increased the frequency of cleaning (2).

NaClO is produced by passing chlorine ( $\text{Cl}_2$ ) gas into cold dilute sodium hydroxide (NaOH) solution. However, the quality and stability of NaClO solutions can be affected by inorganic impurities introduced from the raw materials, manufacturing equipment, or storage containers. Metals such as Ni and Co and some other elements form insoluble metal oxides, which act as catalysts, causing the product to decompose. Also, trace levels of Ni, Co, Fe, Ca, and Mg can form a sediment that discolors the bleach solution. As discoloration and breakdown of NaClO can be costly for manufacturers, elemental analysis is part of bleach-product quality control/quality assurance (QC/QA) programs.

## Analysis of bleach samples using ICP-OES

Bleach samples (5.0 g in 10–20 mL de-ionized water) were prepared by reaction with 1 mL of 30%  $\text{H}_2\text{O}_2$  and 2.5 mL HCl. The solutions were made up to 50 mL volume with DIW, which yielded a 10-fold dilution of the samples. Al, Ca, Co, Cr, Fe, Mg, Mn, Ni, and Zn were then determined using an Agilent 5110\* Vertical Dual View (VDV) ICP-OES configured with an SPS 4 autosampler. The sample introduction system consisted of a SeaSpray glass concentric nebulizer, double-pass glass cyclonic spray chamber, and an Easy-fit VDV demountable 1.8 mm injector torch. Scandium and yttrium at 2 ppm were used as internal standards.

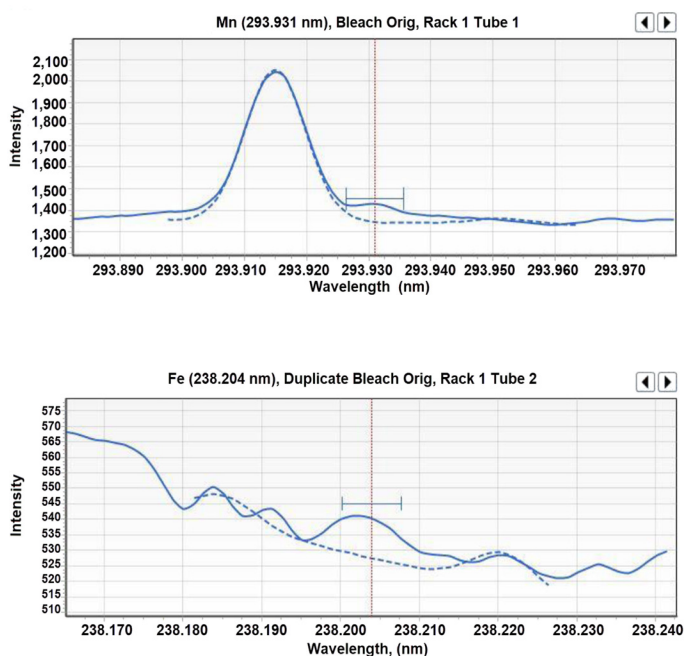
Verified for Agilent  
5800 VDV ICP-OES



\*The Agilent 5110 has been superseded by the 5800 ICP-OES, which can also perform this analysis.

## Automatic background correction

The variation in analytes present in the bleach samples was automatically corrected using Fitted Background Correction (FBC)—a correction technique included in ICP Expert software. Unique to Agilent, FBC removes background structures and applies peak-shaping functions to the analyte peak to create a model of the measured spectrum. As FBC does not require any input from the user or any method development, it ensures reproducible and reliable results irrespective of the analyst. Figure 1 shows the effectiveness of FBC for the correction of interference peaks on Mn and Fe.



**Figure 1.** Automatic Fitted Background Correction enabling the measurement of Mn and Fe in bleach.

## Sensitivity and spike accuracy

Method Detection Limits (MDL) were determined by analyzing a 50 ppb standard solution in the 5% HCl matrix eight times during the run. The MDLs shown in Table 1 were calculated as three sigma of the spiked measurement.

Matrix spikes of a bleach sample were prepared at 0.25 ppm in solution (2.5 ppm after correction for the 10-fold dilution) and analyzed in the run. As shown in Table 1, excellent recoveries of the matrix spike and spike duplicate were achieved.

[www.agilent.com/chem](http://www.agilent.com/chem)

RA44214.0311458333

This information is subject to change without notice.

© Agilent Technologies, Inc. 2021  
Printed in the USA, February 22, 2021  
5994-2973EN

**Table 1.** Average quantitative data acquired for a bleach sample, spike recoveries, and relative percent difference of spike measurements.

Element Wavelength (nm)	MDL (µg/kg)	Average Measured Chlorox-Conc (µg/kg)	Matrix Spike Measured (µg/kg)	Spike Recovery (%)	Matrix Spike Duplicate (µg/kg)	Spike Recovery (%)	Difference of Duplicate Spikes (%)
Al 394.401	1.7	77	2790	109%	2770	108%	1%
Ca 393.366	1.8	1910	4440	101%	4390	99%	1%
Co 230.786	1.7	<MDL	2290	91%	2240	90%	2%
Cr 267.716	1.0	38	2410	95%	2370	93%	2%
Fe 238.204	0.7	3	2330	93%	2270	91%	2%
Mg 383.829	1.1	35	2690	106%	2620	103%	3%
Mn 293.931	1.3	16	2370	94%	2320	92%	2%
Ni 230.299	0.9	3.0	2240	89%	2220	88%	2%
Zn 213.857	1.7	4.5	2560	102%	2510	100%	2%

Benefits of Agilent ICP-OES for the QA/QC analysis of bleach:

- The vertical ICP plasma handles samples with high dissolved solids, enabling long runs with good stability.
- The CCD detector measures all wavelengths simultaneously providing accurate and precise results with the fastest speed of analysis.
- FBC allows accurate sample results to be obtained for bleach samples at single digit ppb levels, without any operator evaluation of spectra or backgrounds.

## References

1. Centers for Disease Control and Prevention, <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/disinfecting-your-home.html#disinfect> (accessed Jan 27, 2021).
2. HIS Markit, <https://ihsmarkit.com/research-analysis/the-biocides-market-in-the-times-of-coronavirus.html> (accessed Jan 27, 2021).