

Application News

Spectroscopy - AAS

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Determination of Antimony in Soft Drinks

In the last few years some studies prove an increased concentration level of antimony (Sb) in several mineral waters, softdrinks, and fruit beverages.^[1] This is an alarming aspect because almost all Sb-compounds are somehow toxic and harmful to the environment. It is assumed that the Sb in the beverages originates from their packing material polyethylene terephthalate bottles (PET), because antimony trioxide (Sb_2O_3) is used as a catalyst in the PET-production process. Whereat the drinking water used for the beverages are subjected to the European drinking water directive (Sb-limit value = $5 \mu\text{g/L}$)^[2] it is of equally interest to analyze the stored and ready-to-drink beverages.

This application segment describes how to analyse antimony in soft drinks, esp. in cola. The research is done with the AA-7000G Atomic Absorption Spectrophotometer with the high sensitivity graphite furnace GFA-7000 and the sample preparation station ASC-7000 as shown in figure 1.

Keywords such as system plus method parameters and use of modifier outline user expectations in this application segment.

■ Sb in bottle material

All the bottles of the soft drinks were examined concerning their content of Sb. Here the EDX-720-HS can with direct measurement of the solid samples. All the PET-material (bottles) in this research includes 200-300 mg/kg antimony.



Figure 1: AA-7000G with GFA-7000 and ASC-7000

■ Standard system Configuration

- AA-7000G with GFA-7000
- ASC-7000
- Teflon-tube pipette (for many samples)
- Omega platform tube

The omega platform tube (figure 2) is used because it has a more reproducible heating performance compared with conventional graphite tubes. The sample can be well placed on the inner concentric platform. The outer graphite tube is electrothermic heated and the omega platform underlies the uprisen thermal radiation of the outer tube.



Figure 2: Design of the omega platform tube

■ Matrix Modifier

Because the antimony is highly volatile and the present sample matrix is very heavy (e.g. high content of sugar in soft drinks), the measurement is not trivial. The first step to get better results is already done by using the omega platform tube. The second step is the use of a Modifier. Here the addition of 5 ng palladium and 3 ng magnesium (absolute) to each measurement (table 1) was very helpful to separate and ash the matrix without an early volatilization of the antimony.

Chemical	Amount (for 25 mL)
Pd-modifier (10g/L)	6,25 mL
Mg(NO ₃) ₂ ·6H ₂ O	395 mg
Deionised water	Up to the 25mL mark

Table 1: Composition of PdMg-Modifier

■ Method parameters

Choose the 217.6 nm line to analyse Sb in Soft drinks like cola. The corresponding temperature program is listed in table 2. Because of the platform tube and the modifier, here are higher temperatures used than in the normal temperature program. This is necessary because of the indirect platform heating plus the heavy matrix. The high temperatures are possible because of the modifier.

	Temp. [°C]	Time [sec.]	Heat Mode
1	150	20	RAMP
2	250	10	RAMP
3	1000	15	RAMP
4	1000	10	STEP
5	1000	3	STEP
6	2500	3	STEP
7	2600	2	STEP

Table 2: Temperature program

Method parameters	
Slit width	0.7 nm
Lamp current	
Backgroundcorr.	D2
Calibration range	5 – 20 µg/L

Table 3: Method parameters

The samples are measured in standard addition mode. In table 4 there is the volume scheme for one sample. The matrix of Sb-standards differs clearly in comparison to the sample. Thus, the standard addition mode should be used to get more secured results.

	MSA-1	MSA-2	MSA-3
1. Water	10	10	10
2. Sb 40 µg/L	10	5	0
3. Sample	0	5	10
4. Modifier	2	2	2

Table 4: Standard addition volumes

■ Results and Conclusion

Shimadzu's AA 7000G incl. GFA 7000 and ASC 7000 is an ideal tool for analysis of antimony in soft drinks. With the described parameters it was possible to examine cola of different brands. The determined Sb-amounts are listed in table 5. For each sample antimony was detected.

	c(Sb) [µg/L]
Cola 1	2.0 ± 0.1
Cola 2	2.0 ± 0.2
Cola 3	2.2 ± 0.2
Cola 4	5.4 ± 0.4

Table 5: Result overview

[1] Claus Hansen (2010) Elevated antimony concentrations in commercial juices. J. Environ. Monit. 12, page 822-824

[2] COUNCIL DIRECTIVE 98/83/EC (03.11.1998) on the quality of water intended for human consumption

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