

ΕΡΓΑΣΙΑ ΜΑΘΗΜΑΤΟΣ ΑΝΑΛ ΧΗΜ II

2020-21

ΟΝΟΜΑΤΕΠΩΝΥΜΟ (ΑΜ χχχχχ), χχχχχ (ΑΜ χχχχ), χχχχχ (χχχχ)

ΤΙΤΛΟΣ ΕΡΓΑΣΙΑΣ:

(Πχ. Antimony leaching from polyethylene terephthalate (PET) plastic used for bottled drinking water)

74 [Ar]3d ¹⁰ 4s ⁴ 4p 9.7886	51 4S _{3/2} Antimony 121.760	52 Te Tellurium 127.60
33 [Kr]4d ¹⁰ 5s ² 5p ³ 8.6084	83 4S _{3/2}	84 3P ₃ Po



ΔΙΑΤΥΠΩΣΗ ΤΗΣ ΕΡΩΤΗΣΗΣ/ΔΙΕΡΕΥΝΗΣΗ ΠΡΟΒΛΗΜΑΤΟΣ

ΠΟΙΑ Η ΣΥΓΚΕΝΤΡΩΣΗ ΑΝΤΙΜΩΝΙΟΥ ΣΕ ΕΜΦΙΑΛΩΜΕΝΑ ΝΕΡΑ?

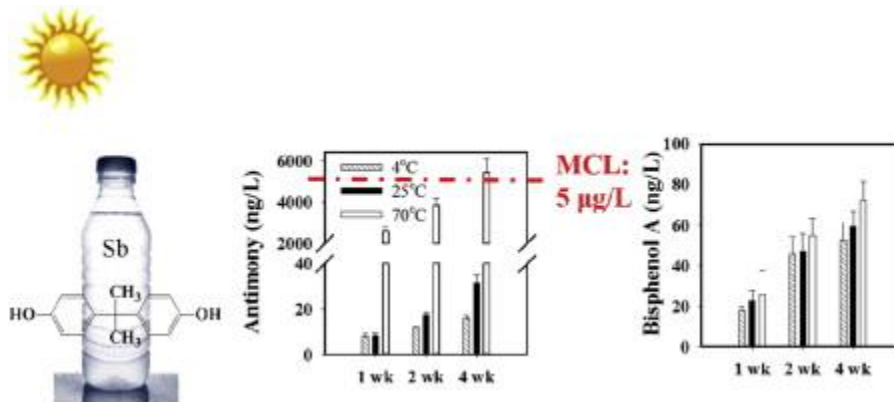
A close-up view of a section of the periodic table. The elements shown are Antimony (Sb, atomic number 51, atomic weight 121.760), Tellurium (Te, atomic number 52, atomic weight 127.60), and Polonium (Po, atomic number 84). The table also shows the element name in Greek (Antimōnio, Τηλλούριο, Πολώνιο) and the element symbol. The atomic number and atomic weight are also visible for each element.

n 8.710 $d^{10}5s^25p^2$ 8439	51 Sb Antimony 121.760 $[Kr]4d^{10}5s^25p^3$ 8.6084	52 Te Tellurium 127.60 $[Kr]4d^{10}5s^25p^4$ 9.0096
	83	84 Po



ΕΙΣΑΓΩΓΗ ΣΤΟ ΘΕΜΑ ...

Π.χ. ΠΩΣ ΠΡΟΚΥΠΤΕΙ ΤΟ ΠΡΟΒΛΗΜΑ ΚΑΙ ΠΩΣ ΑΥΤΟ ΑΝΤΙΜΕΤΩΠΙΖΕΤΑΙ ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ ΜΕΛΕΤΗ...



ΕΠΙΛΟΓΗ ΑΝΑΛΥΤΙΚΗΣ ΔΙΑΔΙΚΑΣΙΑΣ ...

The screenshot shows the HEAL LINK search interface. The search criteria are: (TITLE-ABS-KEY (antimony) AND TITLE-ABS-KEY (bottled AND water) AND TITLE-ABS-KEY (determination)). The results are displayed in a table with columns for Document title, Authors, Year, Source, and Cited by. Two results are visible:

Document title	Authors	Year	Source	Cited by
1 High Sensitivity Determination of Antimony with Application for the Characterization of Its Migration in Bottled Water by a Dielectric Barrier Discharge (DBD) Coupled with Hydride Generation-Atomic Fluorescence Spectrometry (HG-AFS)	Liu, M., Ding, L., Liu, J., Na, X., Mao, X.	2021	Analytical Letters 54(6), pp. 990-1004	0
2 Characterization of Antimony Leaching from Polyethylene Terephthalate Bottles by X-Ray Photoelectron Spectroscopy	Maria Kanuchova, Kozakova, L., Bakalar, T., Skvarla, J.	2020	Journal of Analytical Chemistry 75(10), pp. 1304-1309	0

ΜΕ ΒΑΣΗ ΤΙΣ ΛΕΞΕΙΣ «ΚΛΕΙΔΙΑ» ΑΝΤΙΜΩΝΙΟ ΚΑΙ ΕΜΦΙΑΛΩΜΕΝΟ ΝΕΡΟ ΕΜΦΑΝΙΣΤΗΚΑΝ ΣΤΗ ΒΙΒΛΙΟΓΡΑΦΙΑ 16 ΕΡΓΑΣΙΕΣ

ΕΠΙΛΕΧΘΗΚΕ ΑΥΤΗ ΜΕ ΤΙΤΛΟ «ANTIMONY LEACHING FROM POLYETHYLENE TEREPHTHALATE (PET) PLASTIC USED FOR BOTTLED DRINKING WATER»

ΔΕΙΓΜΑΤΟΛΗΨΙΑ ...

(2.1 COMMERCIAL BOTTLED SAMPLES)

2. Methods

2.1. Commercial bottled waters



Nine commercial brands (brand ID #) of bottled water were purchased in the summer of 2006 at stores in the southwestern US (Arizona): Tynant (1), Pure American (2), Aquafina (3), Refreshe (4), Smartwater (5), Hawaii Water (6), Albertsons Store Brand (7), Dasani (8), and Arrowhead (9). All bottles were labeled as being PET plastic. At least two bottles of each were purchased, sometimes from different store locations. A smaller number of samples were collected than in previous studies (Shotyk et al., 2006; Shotyk and Rachler, 2007) because those studies found relatively small variability among different brands, and because these were the major brands found



ΣΥΛΛΕΧΘΗΚΑΝ XXX ΔΕΙΓΜΑΤΑ ...

ΠΡΟΕΤΟΙΜΑΣΙΑ ΔΕΙΓΜΑΤΟΣ ...

(2.2 EXPERIMENTAL METHODS)



2.2. Experimental methods

Temperature-incubation experiments were conducted by placing the as-received bottles containing bottled water into ovens set at 40, 60 or 80 °C in a T12 Function Line Heraeus oven (Kendro Lab Products GmbH (now Thermo Fisher), Germany). Room-temperature incubation was conducted at 22 °C. After prescribed incubation times, water was removed from the bottles and transferred to clean HDPE bottles (prepared as described above).

Laboratory tests were conducted with one commercial bottled water (Brand 9). Three parameters were varied in a 3 × 4 experimental matrix: Three water pH levels were used with four experimental treatments. The pH was adjusted to 6.3, 7.3 or 8.3 with hydrochloric acid or sodium hydroxide. The four treatments were: (1) control sample held at room temperature; (2) sample frozen at -20 °C for 48 h; (3) sample heated to 80 °C for 48 h; (4) sample irradiated using a low-voltage UV-PEN (Fisher Scientific), which emits light at 254 nm; it operated inside the bottle for 6 h.

Sunlight exposure tests were conducted outdoors in Arizona (Tempe, AZ) on the roof of the laboratory building. Bottled waters, with labels removed, were exposed to sunlight for up to 7 days (August 9-16, 2006). Control samples wrapped in aluminum foil to prevent solar irradiation were placed on the roof to be exposed to the same air temperatures.

ΠΕΙΡΑΜΑΤΙΚΟ ΜΕΡΟΣ...

ΑΝΑΛΥΣΗ ...

(2.3 ANALYTICAL METHODS)

2.3. Analytical methods



Samples were analyzed for antimony using a Thermo Electron Element 2 single-collector double-focusing magnetic sector inductively coupled plasma mass spectrometer (ICP-MS) in low-resolution mode. Analytical accuracy and precision for the measurements were determined by analyses of river water standard reference materials NIST 1640, NIST 1643e, and NRC SRLS4. Precisions were within 3% (1σ). Measured and certified values for standards were within the quoted errors. The limit of detection and method reporting level are 0.004 and 0.028 ppb, respectively.



ΕΚΘΕΣΗ ΚΑΙ ΕΡΜΗΝΕΙΑ ΑΠΟΤΕΛΕΣΜΑΤΩΝ ...

(3. RESULTS)

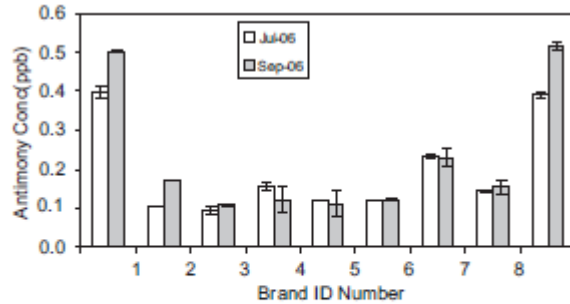


Fig. 1 – Antimony concentrations in purchased bottled water over a 3-month holding period at room temperature (22 °C). Averages of two water bottles are shown; error bars represent the difference between antimony analysis in the two water bottles.

Table 1 – Effect of pH, temperature, and UV-PEN irradiation of nanopure water inside Brand 9 PET bottles

Adjusted pH in Brand 9 bottles	Duplicate measurements of antimony concentration (ppb) at the end of treatment			
	Control (22 °C) for 48 h	Frozen (–20 °C) for 48 h	Heated (80 °C) for 48 h	UV irradiated for 6 h
6.3	0.64 0.55	0.57 0.58	8.3 7.8	3.0 2.4
7.3	0.50 –	0.52 0.53	9.6 8.5	2.4 2.5
8.3	0.52 0.50	0.54 0.54	8.9 9.7	3.1 2.1

The UV-PEN-irradiated sample was heated to ~45 °C. Measurements were precise to 3% (1σ).

ΕΚΘΕΣΗ ΚΑΙ ΕΡΜΗΝΕΙΑ ΑΠΟΤΕΛΕΣΜΑΤΩΝ ... (3. RESULTS)

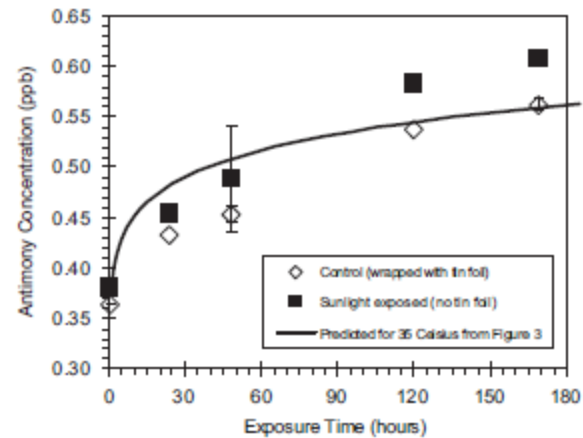


Fig. 5 – Exposure of Brand 9 water bottle to outdoor sunlight. Error bar represents one standard deviation based on triplicate experiments.

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ΕΞΑΓΩΓΗ ΣΥΜΠΕΡΑΣΜΑΤΩΝ ... (4. CONCLUSIONS)

4. Conclusions

Antimony can be released (i.e., leached) from the PET plastic used to make commercial and municipal water bottles. While the rate of leaching is low below storage temperatures of 60°C, above this temperature antimony release can occur rapidly. From personal experience, in the southwestern US the temperatures inside automobiles and garages, where bottled water is often stored, can exceed 60°C. Bottled water manufacturers should consider the shipping/storage conditions of the bottled waters, and possibly select plastics that do not leach antimony (e.g., PET made with titanium or



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