J. Int. Environmental Application & Science, Vol. 14(4): 172-176 (2019)

Measurements of Heavy Metal Concentrations in Tap Water

Mirela Alushllari*

Institute of Applied Nuclear Physics, University of Tirana, Tirana, Albania

Received October 05, 2018; Accepted November 14, 2019

Abstract: The presence of heavy metals pollution in water can move and reach to another environmental media that surrounds or contacts water, soil, aerosols, vegetation or the organisms under the influence of atmospheric conditions. The presences of heavy metals pollution and their exposure time in water have negative impacts to environment media and represent problems for human health. Metal pollution in water media affect in the quality of water in depend the use. The object of this study were the tap water samples are collected in the network of public water supply system, in Tirana city and the goal of this study was the analysis and identification of heavy metals in representative water samples from sources of water to consumers. During this survey we were collected samples at different points of the public water supply system, from sources of water, storage of water and finally in the consumer from different locations in Tirana city. The analyses of heavy metals in representatives sampling of tap water were performed at the Institute of Applied Nuclear Physics, University of Tirana. Water samples were analysed using graphite furnace atomic absorption spectrometry to determine the concentration of total heavy metals. The current study reports the presence of heavy metals in the analysed tap water samples, although it should be mentioned that their concentrations are quite low, compared with the Maximum Contaminant Levels recommended by the Environmental Protection Agency and World Health Organization.

Keywords: *Heavy Metals, Tap Water, Graphite Furnace, Atomic Absorption Spectrometry*

Introduction

The water is an important natural resource for development of life (Vanloon, & Duffy, 2005). Water quality depends on the purpose of its use. Industrial and agricultural development, influence in the natural processes and aquatic environments (Alushllari & Civici, 2014). The presence of heavy metals in water is hazardous because they have high toxicity at low concentrations (Censi *et al.*, 2006). In natural environment their concentration is low (Alushllari, 2013).

There are different types of sources of pollutants, where among the main we can mention: point sources where pollutants come from single (localized pollution) and no point sources, where pollutants come from dispersed (and often difficult to identify) sources. Pollutants and metals can exist in water in different states; they can be dissolved or can be in suspension (Alushllari *et al.,* 2012)

They can reach the food chain through the drinking water supply, respiration system and food consumption (Gazso, 2001). The exposure to lead in the environment results in a wide range of negative effects, depending from the level of lead and time of extended (Alushllari & Civici, 2014). The main sources of drinking water in Tirana are the source of Selita Shën-Mëri, groundwater and surface water of the Bovilla Lake (Italian-Albanian cooperation). Road of network distribution of drinking water is: 1. the source of water; 2. the storage of water; 3. the customers. Two main sources of water are mixed. Distribution of water in the public water system is not divided on the basis of water resources, because the different parts of network can communicate among themselves, said an expert. The presence of the contaminants in drinking water in the different parts of network from the source to the consumer has various reasons. Some of them are: There is no balance between the amount of water resources, the amount of water storage and the amount of water that the customers spend. Often water storage is emptied, their level is not sustainable over time; Supply of drinking water of consumer is part time, usually 2-3 times during the day. The passage of water from their storage of water to the consumers causes pressure changes; a part of the distribution network of drinking water is amortized. The pipeline material of network water supply is made of metal alloys. Network communication with

**Corresponding: E-Mail: m.alushllari@gmail.com; Tel: +355698140573; Fax: +35543451371*

the external environment and the absence of continues water along the network creates conditions for pollution problems; Damage and cracks in pipelines of drinking water network, crossing the tap water with sewage pipelines in some points, the residence time of water in the storage, etc., have created a risk to use tap water from consumers in some areas; New constructions especially in rural area, have made possible that often unauthorized people (not the water supply specialist) have intervened and damaging the parts of the distribution network of drinking water to the city of Tirana from the source-storage-consumers.

Environmental international Organizations, especially World Health Organization and Environmental Protection Agency have recommended specified maximum levels for the presence of heavy metals in water. The purpose of this study was: The evaluation of the distribution of heavy metals from the source of water to the consumer, through the public water supply system in the city of Tirana. The concentrations of heavy metals Cd, Cr, Cu and Pb that are found in tap water samples, their concentrations are compared with Maximal Concentration Level recommended by EPA and WHO for drinking water standard (EPA) and (WHO, 1993). The object of study: the water in source, storage water and consumers (from the public water supply system of Tirana). One of the most important techniques is used to determine the elements in the environment and especially in water is classified method of Atomic Absorption Spectrometry. Drinking water samples were analysed using Graphite Furnace Atomic Absorption Spectrometry for their Cd, Cr, Cu and Pb content.

Materials and Methods

The current study reports the analysis of heavy metals Cd, Cu, Cr and Pb in the drinking water supply system, through its distribution path in the Tirana City. We have chosen six sampling stations in the sources, six sampling stations in the storage water, seventeen samples station in consumers (when sixteen water samples were from tap water and one sampling station was filtered water. We have collected a total of 30 drinking water samples from public system. Sampling stations are presented in Table 1, where source water samples are 1- 6, storage water samples are 7-12 and consumers are 13-30. For each representative samples of drinking water supply were taken two parallel samples. Drinking water samples were analysed using Atomic Absorption Spectrometer, Aanalyst 800 Perkin Elmer, with Atomic Absorption Spectrometry Graphite Furnace method (Perkin Elmer, 1996), autosampler AS-800 and graphite tube THGA Perkin Elmer with number BO504-033 and end caps. Hollow cathode lamps is used as radiation source for the determination of Cr and Cu, while Electrodeless Discharge Lamps used for the determination of Cd and Pb according recommended conditions. Acids used for the treatment of samples, preparation of standard solutions have high grade purity; they were Merck, Darmstadt, Germany. Reagents are used for treatment, measured and control interference in Atomic Absorption Spectrometry for water samples are: nitric acid concentration 65%, hydrochloric acid concentration 33%, standard of cadmium 1000 ppm, standard of Chrome 1000 ppm, standard of cupper 1000 ppm, standard of lead 1000 ppm, bi distil water, Mg $(NO)_3$ and Palladium. Glass and Teflon vessels used were treated with solution 10% v/v nitric acid, for 24 hours and then washed with water bi distilled. Drinking water samples were collected in polyethylene bottles of 1L. All drinking water samples are filtered. PH was measured in 6.8-7.2 ranges. The samples were acidified with nitric acid until pH 2, after was added Methyl isobutyl ketone. 200 ml of water sample transferred in a glass of 400 ml, added 4ml HNO_3cc and digested in a hot plate for about 2 hours, until 1-3 ml. After, samples were cold in room temperature, add 1 ml HCl cc, transferred in a balloon of 25 ml and filled with bi-distil water. All samples are measured in the Atomic Absorption Spectrometer used graphite furnace method for determination concentration of metals. Three applications were carried out for the measurement of blank, calibration standards and samples. A calibration curve defined using this equation is forced to go through zero absorbance and zero concentration. Instrumental parameters, calculation of detection limit and sensitivity control is based on Analytical Methods of Atomic Absorption Spectrometry, from Perkin Elmer (1996). The correlation coefficient of the calibration curves, for the analyzed elements Cd, Cu, Cr and Pb were respectively: 0.99854; 0.99644; 0.99512; 0.99589. Reference standard solution "AA Test Mix by Perkin Elmer" was used for the analytical quality control of the analysis. For control of interference is used modifier matrix according standard conditions by Atomic Absorption Spectrometry Graphite Furnace. Matrix modifier 0.05 mg $NH_4H_2PO_4$ + $Mg(NO_3)_2$ used for determined Pb and Cd, for determination Cr used 0.015 mg $Mg(NO_3)_2$ matrix modifier and for determination of Cu used 0.005 mg Pd + 0.003 mg $Mg(NO_3)_2$ matrix modifier.

During the analyses were taken 20 micro litter solutions (blank, standard or sample) plus the volume of the specified chemical modifier. When used the method GFAAS for the correction of the background used Zeeman-Effect Background correction**.**

In the table 1 are presented concentration of elements Cd, Cr, Cu and Pb in representative drinking water samples and standard deviation. The concentration of heavy metals in tap water samples is compared with EPA and WHO specified maximum contaminant level recommended by Environmental Protection Agency and World Health Organization (EPA) and (WHO 1993).

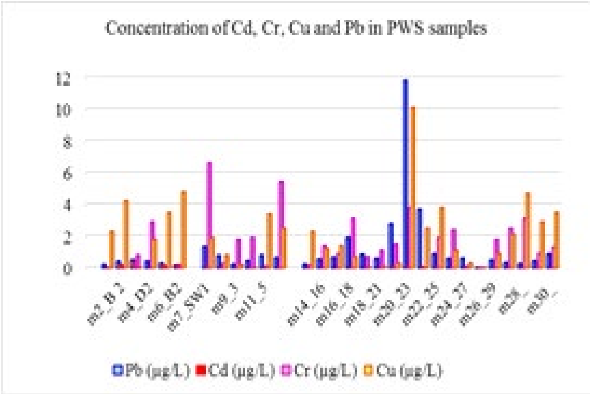
Table 1. Concentration of heavy metals Cd, Cr, Cu and Pb in public water system

Nr	Sampling points	Code	Pb (µg/L) ±SD	Cd(µg/L) ±SD	Cr(µg/L) ±SD	Cu(µg/L) ±SD
1	Shën Mëri 1	m1_B 1	0.22±0.03	0	0	2.3±1.21
2	Shën Mëri 2	m2_B 2	0.43±0.11	0.17±0.04	0.1±0.01	4.2±0.08
3	Tirana 1	m3_D1	0.51±0.25	0.42±0.01	0.8±0.02	0
4	Tirana 2	m4_D2	0.43±0.01	0	2.9±0.01	1.8±0.01
5	Bovilla 1	m5_B1	0.31±0.13	0.15±0.01	0.11±0.14	3.5±0.01
6	Bovilla 2	m6_B2	0.18±0.01	0.19±0.02	0.16±0.01	4.8±1.08
7	Tirana e Re	m7_SW1	1.35±1.11	0.063±0.02	6.6±1.98	1.9±0.03
8	Bërxull_B	m8_SW2	0.78±0.05	0.061±0.01	0.3±0.03	0.8±0.03
9	Globe-21 Dhjetori	m9_SW3	0.23±0.02	0.022±0.01	1.8±0.02	0.2±0.01
10	Laknas	m10_SW4	0.46±0.02	0	1.9±0.01	0
11	Laknas_w	m11_SW5	0.8±0.01	0.041±0.01	0.1±0.01	3.4±0.01
12	Kroi	m12_SW6	0.65±0.06	0.037±2.14	5.4±0.01	2.5±0.09
13	Libri Universitar	m13_C1	0.24±0.23	0	0.2±0.01	2.3±0.01
14	Pallati me shigjeta	m14_C2	0.56±0.32	0.013±0.04	1.4±0.03	1.2±0.01
15	Grand-M.Grameno	m15_C3	0.67±0.01	0	0.9±0.02	1.4±0.01
16	Pallati Kongreseve	m16_C5	1.9±0.01	0.032±0.01	3.1±0.02	0.7±0.03
17	Fakulteti Ekonomik	m17_C6	0.85±0.03	0	0.7±0.01	0
18	Pazari i Ri	m18_C7	0.6±0.01	0.015±0.01	1.1±0.01	0.1±0.01
19	Frigoriferi	m19_C8	2.8±2.34	0.064±0.02	1.5±0.01	0.30.01
20	Don_Bosko_Pipelines	m20_C9	11.8±1.76	0.082±0.01	3.8±0.07	10.1±2.35
21	Don_Bosko_Depo	m21_C10	3.7±0.01	0.032±0.01	0	2.5±0.01
22	Kombinat	m22_C11	0.88±0.01	0.027±0.01	1.9±0.03	3.8±0.08
23	Laprakë	m23_C12	0.6±0.07	0	2.4±0.01	1.1±0.05
24	Uje rrjeti Tirana e Re	m24_C13	0.62±0.01	0.018±0.09	0.1±0.01	0.3±0.02
25	Uje i filtruar (24)	m25_C13	0	0	0	0
26	IFBZ	m26_C14	0.5±0.01	0.023±0.04	1.8±0.01	0.9±0.02
27	Rr. Elbasanit_uje rrjeti	m27_C15	0.34±0.02	0.032±0.12	2.5±0.05	2.1±0.01
28	Rr. Elbasanit_depo	m28_C17	0.27±0.01	0.013±0.01	3.1±1.67	4.7±0.01
29	Sheshi Willsom	m29_C18	0.45±0.01	0.043±0.01	0.9±1.48	2.9±0.08
30	Rr. Vasil Shanto	m30_C19	0.87±0.01	0.011±0.87	1.3±0.05	3.5±1.39
31	MCL specified by WHO		10	50	50	2000
32	MCL specified by EPA		15	5	100	1300

Results and Discussion

The data of table 1 are presented in graphical forms. The graph in figure 1 is presented the dependence of the metals concentration Cd, Cr, Cu and Pb in public water system, while the graph in figure 2 is presented the dependence of the metals average concentration Cd, Cr, Cu and Pb, in public water system.

From results obtained after we analysed representative of tap water samples, is observed presence of Cd, Cr, Cu and Pb in most of the samples. The average concentration of Cd, Cr, Cu and Pb in public water supply system was found in the order respectively 0.05 µg/L; 1.56 µg/L; 2.11 µg/L; 1.13 µg/L. During the sampling we had taken at the same family two samples, where S_24 was tap water sample from public water supply system and S_25 was filtered water sample. While the graph in figure 3 is presented the plot for distribution of metals in tap water and the graph 4 is presented the tree diagram of Cd, Cr, Cu and Pb in tap water.



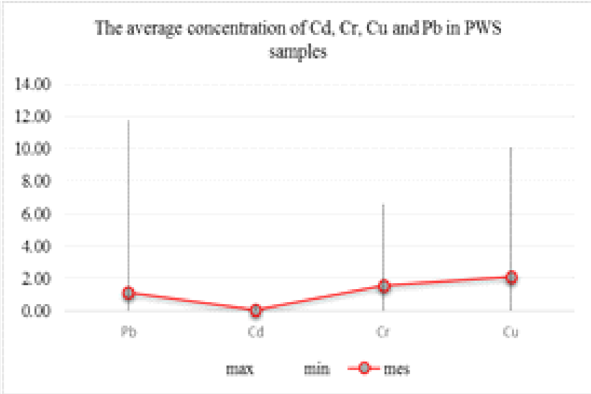
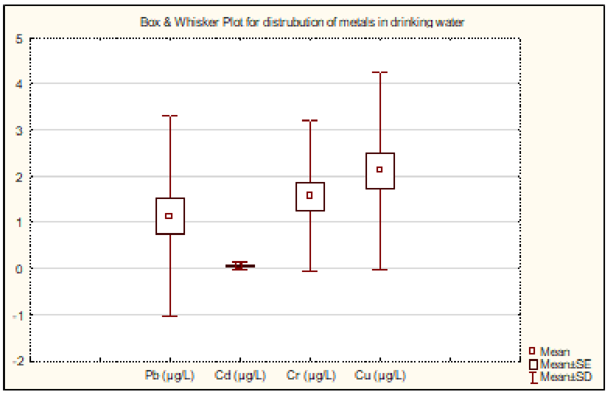


Figure 1. Variation of metals content in samples. **Figure 2**. Variation of average content in samples.

From analysis of these samples in this family is observed that the concentration of metals was under detection limit. The mean concentrations level of lead in Cd, Cr, Cu and Pb in tap water samples that are collected at different points from source to consumers in public water supply system of Tirana, are compared with (MCL) specified by WHO and EPA (table1). None of the analysed samples contained metals above MCL for drinking water standard.



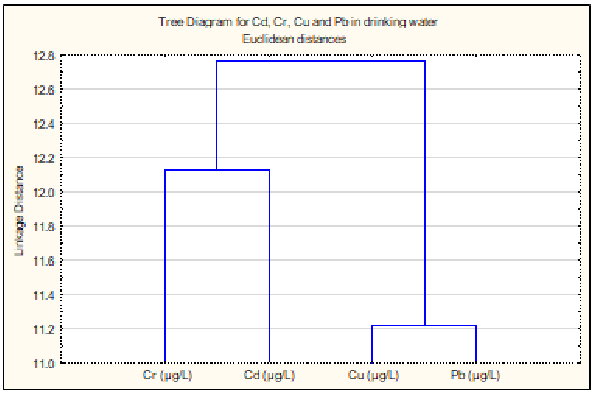


Figure 3. Plot for distribution of metals in water. **Figure 4**. Tree diagram of Cd, Cr, Cu and Pb.

Conclusion

From the obtained results after we analysed representative of public water system samples, we observed the presence of Cd, Cr, Cu and Pb in most of the samples. The average concentration of Cd, Cr, Cu and Pb in public water system was found in the order respectively 0.05 µg/L; 1.56 µg/L; 2.11 µg/L; 1.13 µg/L. During the sampling we had taken at the same family tow samples, where S_24 was tap water sample from public water system and S_25 was filtered water sample. From analysis of these samples in this family is observed the concentration of metals were under detection limit. The mean concentrations level of lead in Cd, Cr, Cu and Pb in tap water samples that are collected at different points from source to consumers in public water supply system of Tirana, are compared with maximum concentration level specified by WHO and EPA (table1). No of the analysed samples contained metals above maximum concentration level for drinking water standard. This work presented an assessment for a few metals, but the concentration of heavy metals in drinking water should be monitored continuously.

Acknowledgements: *This is a part of my work regarding the assessment of metals in the environmental media (soil, water, aerosols, vegetable, etc). My appreciation is sent to Institute of Applied Nuclear Physics, University of Tirana; to Faculty of Natural Sciences and to my Family.*

References

Alushllari M, Civici N, (2014) *Analyses of Lead in Water Depend the Weather, near the Ex-Factory Production of Batteries Region*, Berat, Albania. *Appl. Sci. Reports*, pp.122-125, Alushllari M, Civici N, (2014). Determination of Lead Accumulation by Leaves of Different Vegetation, Grow in Soil Pollution. *Europ. Sci. J.* **10**(12), 273-280.

Alushllari M, Civici N, Malollari I, (2012) Study and Verification of the Content of Arsenic (As), Cobalt (Co) and Copper (Cu) in Surface Water in the Region of Tirana City, Albania. *JIEAS*, **7**(2). 205-209. 2012.

Alushllari M, (2013) http://www.doktoratura.unitir.edu.al/wp-content/uploads/2013/10/Doktoratura-Mirela-Alushllari-Fakulteti-i-Shkencave-i Natyrore-Departamenti-i-Kimise-Industriale.pdf, pg 2

Anonymous (1993) *WHO, s drinking Water standard 1993*. http://WWW.lenntech.com/applications/drinking/standards/Who-s-drinking-Water-standards.htm

Anonymous, *EPA drinking Water standard*. http://Water.epa.gov/drink/contaminants/index. cfm#Inorganic.

Censi P, Spoto SE, Saiano F, Sprovieri M, Mazzola S, Nardone G, Di Geronimo SI, Punturo R, Ottonello D, (2006) Heavy metals in coastal Water system. *Chemosphere* **64**, 1167-1176.

Gazso LG (2001). The Key Microbial Processes in the Removal of Toxic Metals and Radionuclides from the Environment. A review. Cent. Eur. *J. Occup. Environ. Med.*, **7**(3), 178–185.

Perkin Elmer (1996) *Analytical Methods for Atomic Absorption Spectroscopy and Recommended conditions for THGA furnaces and recommended conditions for THGA furnaces* (Perkin – Elmer),

Vanloon, GW. Duffy SJ, (2005). *The Hydrosphere. In: Environmental Chemistry: A Global Perspective*. 2nd Ed. New York: Oxford University Press, pp: 197-211.