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DETERMINATION OF LEAD, CADMIUM AND MERCURY, IN ÖMERLİ DAM LAKE AND JOINED STREAMS*

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SUMMARY

The contents of lead, cadmium and mercury were measured by atomic absorption spectrophotometry in the water samples, taken from 3 different points in Ömerli Dam Lake, from 3 streams flow into the Dam Lake and from 3 water purification units 6 times in two month periods between September 1997 and August 1998. The analyses were performed in total water samples, in filtered water and in the suspended material. In the analyses, contaminant levels were in the range of <1.3-3.8 µg/l for lead, <0.1-0.4 µg/l for cadmium and <0.1 µg/l for mercury. The results has shown us that the lead, cadmium and mercury levels were too low in all water samples. Measured concentrations of three contaminants were always well under the established limits. According to our results, examined water sources meet the requirements of the water standard in Turkey, TS 266 and of the Turkish Food Codex for the heavy metals taken under investigation, and fall into Class I of the Turkish Water Pollution Control Regulation.

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ÖZET

İstanbul için yaşamsal önem taşıyan bir su kaynağı olan Ömerli Baraj Gölü sularında ve Ömerli Su Havzasından göle katılan ve su taşıyan derelerde insan sağlığı üzerinde etkili olabilecek ağır metallerden kurşun, kadmiyum ve cıva miktarının saptanması ve toksikolojik değerlendirilmesi amacıyla 2 aylık dönemlerde 6 kere Ömerli Baraj Gölünde 3 ayrı noktadan, katılan derelerde 3 ayrı noktadan ve 3 ayrı su tasfiye tesisi çıkışından alınan örneklerde atomik absorpsiyon spektrofotometrisi yöntemiyle analizler yapılmıştır. Örneklerde yapılan analizlerde kurşun miktarı <1.3-3.8 µg/l, kadmiyum miktarı <0.1-0.4 µg/l arasında değişen miktarda bulunmuş, cıva miktarı ise tüm örneklerde tayin sınırı olan 0.1 µg/l nin altında olarak saptanmıştır. Bulunan miktarlar incelenen örneklerin kurşun, kadmiyum ve cıva kirliliği bakımından minimuma yakın kirlilik içerdiğini göstermektedir. Bu genel sonuçlara göre inceleme altına alınan suların ağır metal içerikleri bakımından TS 266 ve Türk Gıda Kodeksinde içme suları için sözkonusu olan sınırların altında kalmakta olduğu görülmüştür. Su kaynaklarının kalite sınıflandırılmasına göre de ağır metal içerikleri I.Sınıf su kalifikasyonuna uymaktadır. Mevzuatımızda sınır değerlerinin dünyadaki örneklerinden düşük tutulmuş olmasına rağmen yapılan ölçümlerin hiçbirinde sular için konulmuş bulunan limit değerlerin üzerinde metal konsantrasyonu bulunmamış, bulunan değerlerin sınır değerlerin çok altında olduğu saptanmıştır. Ömerli Baraj Gölü suları şu anda çevre kirliliğinden ölçümünü yaptığımız metaller açısından etkilenmiş görünmemekte ve Ömerli suyunun tüketilmesiyle vücuda alınacak toksik metal miktarının günlük alımına müsaade edilen metal miktarlarına katkısının çok düşük düzeyde olacağı görülmektedir.

Key words: Lead, cadmium, mercury, AAS, Ömerli Dam Lake

INTRODUCTION

In the Anatolian part of the city, Ömerli Dam Lake is one of the most important water sources of Istanbul (Table 1, 2). Ömerli Dam Lake meets almost half of the water requirement of the city. This water source is confronted with a great risk of pollution due to heavily illegal housing activities and industrial establishments around streams and reservoir. It becomes necessary to protect this water catchment area from direct discharge of industrial and domestic waste water. It is also necessary to control the pollution parameters in water to detect the negative influence of the illegal discharges and environment. Although these issues are under the responsibility of ISKI (İstanbul Water and Sewerage Administration), and ISKI consumes a great effort to fulfill these duties, supportive research would be beneficial for the provision of safe and healthy water to our city.

Table 1 : Water Resources of Istanbul (1)

Water resource	Service Year	Annual yield Million m^3/year	
		Normal	Rainless periods
Small reservoirs and groundwater	1453-1893	10	10
Elmalı 1 ve 2	1893-1950	15	12
Terkos	1883	142	80
Alibeyköy	1972	36	21
Ömerli	1972	220	164
Darlık	1982	97	72
Büyükçekmece	1989	70	45
Yeşilvadi diversion structure	1992	10	6
Istranca 1st stage (3 stream)	1995	44	44
İstranca 2nd stage (4 stream)	1997-1998	191	191
Şile wells	1996	30	30
Sazlıdere dam	1998	55	55
Current annual total average		920	730

Table 2 : System Characteristics of Ömerli Dam (2)

Drainage area (km^2)	600
Yearly mean river basin precipitation (mm)	880
Yearly average of water entrance (million m^3 /year)	236
Runoff coefficient (%)	45
Gross capacity of reservoir (million m^3)	357
Dead volume of reservoir (million m^3)	122
Usable volume of reservoir (million m^3)	235
Reservoir height of full capacity (m)	62.0
Minimum reservoir height (m)	46.0
Reservoir area with full capacity (km^2)	20.0
Yearly safe yield (million m^3)	220

Heavy metals have recently come to the forefront of dangerous substances causing serious health hazards in human and other organisms. Pb, Cd and Hg are among the most dangerous of these elements. Human health data relating to cadmium has been extensively examinated and discussed (3, 4). The absorption of ingested cadmium is generally low in humans, ranging from 4.7 to 7%. The possible link between life-long, low-

dose Cd exposure and chronic human cardiovascular disease, especially hypertension, has long been controversial (5). The occurrence of lead in drinking water may be the result of contamination of the water source due to the atmospheric pollution. The absorption of ingested lead amounts to about 10% in adults, and about 53% in children (6).

The major source of mercury contamination in drinking water is natural mineralisation and discharges from various industrial activities (7). Due to the higher toxicity of organic forms of mercury, as demonstrated in the epidemics of poisoning, and as a result of the methylation of inorganic forms in the environment, estimates of health risks from exposure are largely based on methylmercury compounds (6). The exposure of the general population is generally low, but may occasionally be raised to the level of occupational exposure and can even be toxic (8).

In Turkey, there are three regulations, limiting these toxic metals in water, namely, Turkish Water Standard, TS 266 (9), Turkish Food Codex (10), and Turkish Water Pollution Control Regulation (11). Maximum allowable levels of lead, cadmium and mercury according to these regulations were given in Table 3.

Table 3 : Maximum allowable levels of lead, cadmium and mercury in water

	Lead µg/l	Cadmium µg/l	Mercury µg/l
TS 266	50	0.5	
Turkish Food Codex	10	5	1
Turkish Water Pollution Control Regulation I.Class	10	3	0.1
Turkish Water Pollution Control Regulation II. Class	20	5	0.5

In this study, the contents of lead, cadmium and mercury were measured by atomic absorption spectrophotometry in the water samples, taken from Ömerli Dam Lake. About this subject no finding exists in the literature. In their study about the contaminants in Ömerli Dam Lake, Kürüm and Kürüm (12) have made observations on many of parameters except heavy metal concentrations.

RESULTS AND DISCUSSION

The analyses were performed in total water samples, in filtered water and in the suspended material. In the analyses, contaminant levels were in the range of <1.3-3.8 µg/l for lead, <0.1-0.4 µg/l for cadmium (Table 4, 5) and <0.1 µg/l for mercury. The results has shown us that the lead, cadmium and mercury levels were too low in all water samples. Measured concentrations of three contaminants were always well under the established limits. According to our results, examined water source meet the requirements of the water standard in Turkey, TS 266 and of the Turkish Food Codex for the heavy metals taken under investigation in this study, and fall into Class I of the Turkish Water Pollution Control Regulation.

Although the water samples taken from the streams flow into the Ömerli Dam Lake had a dirtier appearance than the lakewater, their heavy metal concentration were found low and under the established limits. The average metal concentrations in the lakewater were found lower than those of streams. No significant changes in the heavy metal concentrations were observed after the conventional purification process in examined water samples.

Linnik et al. have reported that the lead and cadmium content of the surface water of the Dnieper reservoirs were in the range of 17.2-63.3 µg/l, and 0.5-3.9 µg/l respectively (13). It can be seen that these levels were higher than our findings in Ömerli Dam Lake. In a previous study, in the tap water of various cities in Europe, the concentrations of heavy metals were reported as 5-46 µg/l for lead, 0.2-4 µg/l for cadmium, and <0.1-0.84 µg/l for mercury, and 3.5-12 µg/l for lead, and 6 µg/l for cadmium for USA (14).

There were occasionally minor changes between the metal concentrations in the samples in the different periods, but these changes occured in low levels, has not been accepted as a level to endanger the utilisation of this source as a drinking water source. In the analysis of the samples, it is also found that the great portion of lead was in the suspended material, and great portion of cadmium was in the solution. These findings are also in accordance with the results of previous studies. Our investigation indicated that the consumption of the drinking water from Ömerli Dam, makes a very low contribution to the daily admissible intakes of lead, cadmium and mercury.

EXPERIMENTAL

The water samples were taken at 3 points in Ömerli Dam Lake, from 3 streams flow into the Dam Lake and from 3 water purification units, 6 times in two month periods between September 1997 and August 1998.

The sampling locations are: Ömerli Water Station (From the depth where the city water is drawn), Ömerli Dam Lake-Paşaköy, Ömerli Dam Lake-Emirli, Sultanbeyli Stream, Alemdağ Stream, Şalgamdere Stream, Muradiye Treatment Unit, Osmaniye Treatment Unit, Orhaniye Treatment Unit.

The collection bottles were rinsed with distilled water before use. Samples werecollected in polyethylene bottles (2 l each). The metals Cd, Pb and Hg were determined in the water samples according to the methods of AOAC (15). The metal contents of raw water, filtrate and filtrated water sample were separately determined. Lead and cadmium analyses were performed by flame AAS and mercury concentration was determined by flameless AAS technique (AAS, Shimadzu AA-670).

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Tablo 4 : Average content of lead in different periods (µg/l)

		Ömerli water station	Paşaköy	Emirli	Sultanbeyli Stream	Alemdağ Stream	Şalgam. Stream	Muradiye	Osmaniye	Orhaniye
I.Period	Raw water	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3			
	Dissolved	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3			
	Suspanded	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3			
II. Period	Raw water	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3			
	Dissolved	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3			
	Suspanded	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3			
III. Period	Raw water	2.0	1.8	1.7	3.0	2.8	2.0	2.2	2.4	<1.3
	Dissolved	1.3	1.3	1.3	1.5	1.4	1.7	2.1	2.0	<1.3
	Suspanded	<1.3	<1.3	<1.3	1.5	1.4	<1.3	<1.3	<1.3	<1.3
IV. Period	Raw water	2.7	1.6	1.5	2.5	2.7	2.2	2.4	2.5	<1.3
	Dissolved	2.4	1.3	1.3	1.8	1.5	1.8	2.4	1.3	<1.3
	Suspanded	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
V. Period	Raw water	1.3	<1.3	<1.3	1.3	2.2	2.2	<1.3	<1.3	<1.3
	Dissolved	1.3	<1.3	<1.3	1.3	2.0	1.8	<1.3	<1.3	<1.3
	Suspanded	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
VI. Period	Raw water	1.3	<1.3	<1.3	1.3	2.0	2.5	<1.3	<1.3	<1.3
	Dissolved	1.3	<1.3	<1.3	1.3	1.3	1.8	<1.3	<1.3	<1.3
	Suspanded	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
	Mean	1.22±1.08	0.57±0.88	0.53±0.83	1.35±1.24	1.62±1.29	1.48±1.16	1.15±1.33	1.23±1.42	<1.3

Tablo 5 : Average content of cadmium in different periods (µg/l)

		Ömerli water station	Paşaköy	Emirli	Sultanbeyli Stream	Alemdağ Stream	Şalgam. Stream	Muradiye	Osmaniye	Orhaniye
I.Period	Raw water	<0.10	<0.10	<0.10	0.22	0.15	<0.10			
	Dissolved	<0.10	<0.10	<0.10	0.20	0.10	0.10			
	Suspanded	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
II. Period	Raw water	<0.10	<0.10	<0.10	0.32	0.12	0.10			
	Dissolved	<0.10	<0.10	<0.10	0.20	<0.10	<0.10			
	Suspanded	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10			
III. Period	Raw water	<0.10	<0.10	<0.10	<0.10	0.10	0.10	<0.10	0.15	0.18
	Dissolved	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	<0.10	0.10	0.10
	Suspanded	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
IV. Period	Raw water	<0.10	<0.10	<0.10	<0.10	0.15	<0.10	<0.10	0.19	0.26
	Dissolved	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	<0.10	0.14	0.18
	Suspanded	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
V. Period	Raw water	<0.10	<0.10	<0.10	0.12	0.15	0.12	<0.10	<0.10	<0.10
	Dissolved	<0.10	<0.10	<0.10	0.10	0.10	0.10	<0.10	<0.10	<0.10
	Suspanded	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
VI. Period	Raw water	<0.10	<0.10	<0.10	0.13	0.12	<0.10	0.10	0.10	<0.10
	Dissolved	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Suspanded	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Mean	<0.10	<0.10	<0.10	0.13±0.12	0.13±0.02	0.07±0.05	<0.10	0.11±0.08	0.11±0.13

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