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QUALITY CONTROL ALONG THE BAKU PIPELINE: CHEMICAL PROFILING OF WATER SAMPLES

Dr. Farid Aliyev, Prof. Leyla Hasanovna Mammadova, Dr. Elchin Jafarov and Prof. Nigar Guliyeva
Baku State University, Azerbaijan

Abstract: Water pollution is a major environmental problem that can have a significant impact on human health and the environment. This paper reviews the causes, effects, and prevention of water pollution. The paper also discusses the importance of water quality monitoring and management.
Keywords: water pollution, environmental pollution, human health, environmental impact, water quality, water management

1. Introduction

Environment is an essential element of human existence. It is a result of interference of natural elements – earth, air, water, climate, biosphere – with elements created by human activity. All these interact with/and influence the existential conditions and the possibilities for future development of society.

To protect the environment, mainly affected areas must be identified, assessed the degree of damage, and determined the causes that have produced these imbalances.

It is necessary to preserve the quality of the environment mainly throughout reducing negative effects of human activities. Potentially toxic metals resulting from anthropogenic activities cause severe disturbance of ecosystems [1, 2]. Water pollution is a complex process that leads to changes in water composition, aquatic flora and fauna, and may result in a poor condition, water quality for economic and recreational use, being dangerous to human health [3-4].

Importance of trace metal concentrations evidence in natural waters and/or environment is growing for the pollution monitoring studies. Traces of metal ions have important roles in a wide spectrum of functions of life. Some of these toxic trace metal levels are high, such as poisoning by Fe, Pb and Ni affects the central nervous system. Heavy metals presence in nature usually is not dangerous for the environment because they are present only in very small quantities [5]. Heavy metals are pollutants in the environment only if it's present in large quantities (this fact is usually attributed to industrial activities).

The natural water analysis for physical, chemical properties including trace element contents are very important for public health studies. These studies are also a main part of pollution studies in the environment [1-5]. Also, investigations of the quality of drinking water samples have been continuously performed by researchers around the world. The determinations in drinking water have been performed using classical analytical techniques including titrimetric, gravimetric and modern instrumental techniques such as atomic absorption spectrometry (AAS), inductively coupled plasma-mass spectrometry (ICP-MS), UV-Vis spectrophotometer, etc.

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Because of the low cost and easiness in usage, inductively coupled plasmamass spectrometry is the main instrument for the determinations of the trace heavy metal ions in drinking waters in the analytical chemistry laboratories [6-7]. Now ICP method is sensitive and convenient method for the determination of metals in water and wastewater samples.

2. Experimental

2.1. Apparatus

An ICP source consists of a flowing stream of argon gas ionized by an applied radio frequency field typically oscillating at 27.1 MHz this field is inductively coupled to the ionized gas by a water-cooled coil surrounding a quartz "torch" that supports and confines the plasma. The sample aerosol is injected directly into the ICP, Subjecting the constituent atoms to temperatures of about 6000 to 8000°K. Inductively coupled plasma mass spectrometer includes a mass spectrometer, detector, an ICP source, mass flow controllers for regulating ICP gas flows, a peristaltic pump for introducing samples and a computerized data acquisition and instrument control system.

2.2. General Discussion

In this method, analysts introduce sample material to an argon-based, hightemperature radio frequency plasma, usually via pneumatic nebulization. As energy transfers from the plasma to the sample stream the target elements dissolves, atomizes and ionizes. The resulting ions are extracted from the plasma through a differential vacuum interface and separated based on their mass-to-charge (m/z) ratio by a mass spectrometer.

This method has been demonstrated to be suitable for aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, strontium and zinc. (Table 1.)

Table 1: Recommended Analyte Masses and İnternal Standards

Element	Analytical Mass	Recommended Internal Standards	Interference Calculation
Beryllium	9	Li	C*6
Aluminum	27	Sc	C27
Chromium	52	Sc	C52
Manganese	55	Sc	C55
Cobalt	59	Sc	C59
Nickel	60	Sc	C62
Copper	63	Sc	C63
Zinc	66	Ge	C66
Arsenic	75	Ge	C75-3.127(C77-0.815*C82)
Selenium	82	Ge	C82-1.008696*C83
Silver	107	In	C107

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Cadmium	111	In	C111-1.073-C108-0.712*C106
Antimony	121	In	C121
Barium	137	Th	C135
Lead	208	Th	C208+C206+C207

2.3. Materials and reagents

This study proposes to investigate the quality of drinking waters used for human. Samples were taken from Oguz-Gabala-Baku water pipeline that supplies Absheron-Peninsula with drinking water. Water samples were collected in high density polyethylene containers previously Water samples were stabilized with ultrapure nitric acid (0.5%)

Reagents and standards

a. Acids:

1. Nitric acid HNO_3,
2. Nitric acid HNO_3, 1+1: Add 500 ml HNO_3, 500 ml deionized water
3. Nitric acid (v/v) 2%: 20 ml HNO_3 100 ml deionized water and dilute to 1L
4. Nitric acid (v/v) 1%: 20 ml HNO_3 100 ml deionized water and dilute to 1L b. Reagent water

c. Stock, standard and other required solutions

1. Internal standard stock solution: germanium, indium, lithium, scandium and thorium are suggested as internal standards add enough internal standards to all samples, Standards and quality control (QS) samples.
2. Instrument optimization/tuning solution: containing Beryllium, Cadmium, Cobalt, Copper, Germanium, Indium, Rhodium, Scandium, Terbium, Thallium, Barium, Cerium, Magnesium and Lead. Prepare this solution in 2% nitric acid. This mix includes all common elements used to optimize and tune various ICP_MS operating parameters. It may be possible to use fewer elements in this solution, depending on the instrument manufacturer's recommendations.
3. Calibration standards: a five standard calibration is recommended from 0 to 100 µg/l e. Argon: Use a pre purified grade of argon unless it can be demonstrated that other grades can be used successfully. Pre purified argon is usually necessary because technical argon often contains significant levels of impurities.

3. Results and Discussion

3.1. Calibration curve

A five standard calibration is recommended from 0 to 100 µg/l. Other calibration regimens are acceptable if the full suite of quality assurance samples and standards is run to validate any method changes. Fewer standards may be used and a two-point blank/mid-range calibration technique commonly used in ICP optical methods should also produce acceptable results. Calibrate all analyses using the selected concentrations. Prepare all calibration standards and blanks in a matrix of 2% nitric acid. Add internal standard mix to all calibration standards to provide appropriate count rates for interference correction.

Table 2 presents the concentrations of metals that were determined in water samples taken from the Oguz-Gabala-Baku water pipeline.

Sample	**Metal concentrations µg/l**

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	Al	Cr	Fe	Co	Ni	Cu	Zn	As	Cd	Ba	Pb
Sample 1	16.79	0.53	13.57	0.19	1.89	3.89	14.2	1.21	0.57	95.6	1.63
Sample 2	11.7	0.46	6.99	0.018	1.83	1.46	2.93	0.19	-	123.3	3.0

The drinking water samples were analyzed by inductively coupled mass spectrometry. The concentrations of metals ions give in Table 1. The lowest and highest levels of elements detected ranged between 0.19 µg/l for cobalt and 1357.3 µg/l for iron. The highest levels of trace heavy metals ions were found in the first sample/ as can be seen in Table 1. In this sample Al, Cr, Fe, Co, Zn, As concentrations were found to be 167.9 µg/l, 0.53 µg/l, 1357.3 µg/l, 0.19 µg/l, 14.2 µg/l, 1.21 µg/l.

Arsenic is widely distributed in the environment because of its natural and anthropogenic source [8]. Concentrations in the drinking water samples were in the range 0.19-1.21 µg/l. The lowest and highest values were in second sample and first sample.

The highest iron level was found in first sample as 1357.3 µg/l.

Lead is one of the most abundant heavy metals in nature. It is an essential nutrient but could be also toxic for humans [12]. Most important anthropogenic source of lead in the environment is combustion of gasoline with lead. Lead is discharged by vehicles into air them adsorbed from the air by environmental samples such as soil and plants [9-10]. In environmental lead suffers lead changes and find that the Pb^{2+} ion or as insoluble lead compounds. Maximum permissible limit for lead in drinking water is 0.01 µg/l and 10µg/l(for WHO and EC 98/83 must be added). The levels of lead in the samples were in range of 1.63-3 µg/l. The highest concentrations were in second sample. Aluminum is an essential nutrient for humans. Water analysis showed concentration in the 11.7-167.9 µg/l. Zinc is present in natural waters in concentrations lower than the sewer water, which comes from human activities related to galvanizing zinc and copper alloys or other metals.

Recommending that zinc concentration in drinking water to be less than 3 µg/l. Concentrations in the drinking water samples were in the range 2.93-14.2 µg/l. Chromium is another omnipresent element, not only because of its nature, but also due to its several anthropogenic sources, mainly coming from its large application in industrial fields. The concentration of Cr was in the range of 0.46-0.53 Concentrations in the drinking water samples were in the range 0.19-1.21 µg/l.Copper could be present in water in ionic form or in complex organ mineral.

The highest concentrations of copper were obtained in first sample (up to 3.89 µg/l.) Comparison the concentrations of metals in the samples have been shown in Figure 1. The highest concentration of cadmium, arsenic, copper, and zinc were obtained in first sample. But the highest concentrations of lead were obtained in second sample.

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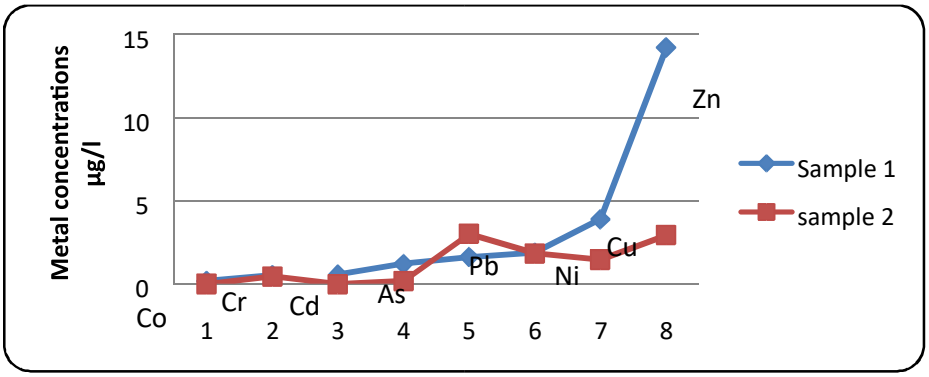

Figure 1: Comparison the concentrations of metals

The concentrations of metal ions in the drinking water samples from OguzGabala-Baku were within the permissible limits of the World Health Organization.

The permissible limits of metals ions for 98/83/EC and WHO were given in Table 3.

Table 3: The permissible limits of metals ions in the drinking water (For 98/83/EC and WHO)

Elements	Unit	Concentration (98/83/EC)	Concentration (WHO)
Cobalt	µg/l	-	-
Chromium	µg/l	50	50
Cadmium	µg/l	5	3
Arsenic	µg/l	10	10
Lead	µg/l	10	10
Nickel	µg/l	20	70
Copper	µg/l	2	2
Zinc	µg/l	-	3

4. Conclusions

ICP-MS method is available and adequate to identify and quantify metals present in natural and drinking waters at trace levels, which are of particular relevance for toxicity control regions, may have been contaminated by toxic metals. Comparison the concentrations of metals in the drinking water samples with permissible limits of the World Health Organization show that concentrations of Co, Cr, Cd, in the both example under permissible limits. Concentrations of copper and zinc contained in 1.46-3.89 µg/l and 14.2-2.93 µg/l. In the first sample concentration of copper, nickel and lead is high from permissible limit. Concentration of zinc in the first sample is high from permissible limit, but in the second sample below the limit. (Figure 2)

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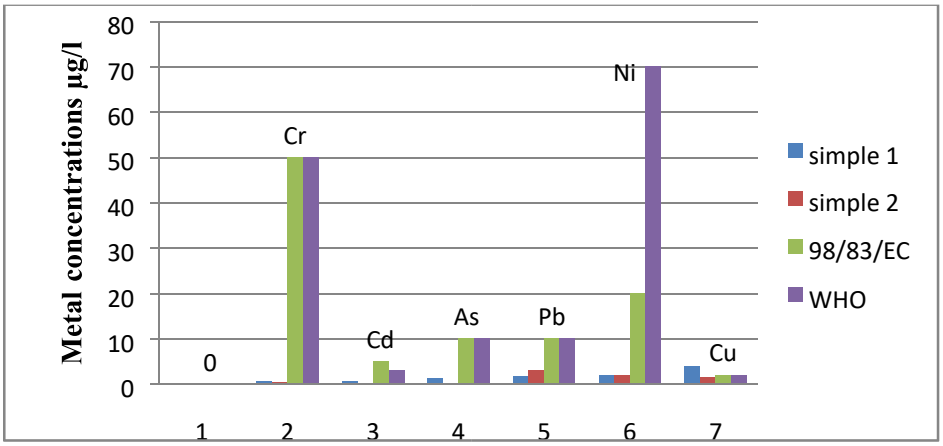

Figure 2: Comparison the concentrations of metals with 98/83/EC Directive and WHO

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