Study on the Dynamics of Chromium and Total Manganese Concentration of Prahova River During the Period 2006-2008

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Abstract: Monitoring of total chromium and total manganese on Prahova river was made over a period of three years, but without registering significantly exceeded the maximum allowable rate. Analyses were conducted in collaboration with the Romanian Waters Ialomita-Buzau. During those three years were recorded a total of five exceeded the maximum allowable rate (a chromium one -52.1 µg/l in collection point Adancata and three overall manganese exceeded in collection points Floresti- 0.137 mg/l, Adancata-0.119 mg/l and Tinosu-0.153 mg/l). Results of tests carried out showed no serious pollution on the river flow. Clean water is classified in grades I and II, which is very good and smooth.

Key-Words: chromium, manganese, analyses, MAR (maximum allowable rate), clean water.

1 Introduction

Environmental evaluation concerning the pollution of an aquifer involves quantitative estimate of exposure (human exposure, route and time of exposure) and adverse effects on human health.[1]

Unlike the early days of industrialization when sources of environmental pollution by its size and its intensity had a local influence and didn’t pose major problems of environmental protection, nowadays pollutant emission and dispersion of pollutants are produced as large-scale that environmental factors are affected at regional, national and international level.

Transport and dispersion of pollutants do not respect borders between states. Environmental pollution has become a matter that concern and it should concern the governments of all countries and whole human community. Special efforts are made by most countries of the world engaged in bilateral and international agreements to reduce pollution, to limit it to values that shouldn’t affect the natural recovery of environment, its ability to withstand, and values allowable for the health of ecosystems and human health.

Heavy metals are those having a density δ kg/m³ higher than 5 (five) and known as having a toxic action on organism if their concentration exceeds some tolerance limits: Cd, Cr, Cu, Hg, Ni, Pb, Mn, Zn. They have wide use in industry[2].

Inorganic salts lead to increased water salinity and some of them can cause hardness increase. The bioaccumulation of heavy metals has toxic effects on aquatic organism, also inhibiting self-purification processes.

2 Problem Formulation

Geographical Description of the River.

Prahova is a river in southern Romania, which rises from the Bucegi Mountains and it flows in Ialomita river to Adancata. It has 183 kilometers, through the counties Brasov (6 km), Prahova (161 km) and Ilfov (16 km). 75% of Prahova county area is part of river basin.

Upper Prahova upstream of confluence with Azuga is also known as Prahovita.

The main tributaries of the river are: Doftana, Teleajan, Cricovul Sarat.

Cities on his course: Predeal, Azuga, Busteni, Sinaia, Comarnic, Breaza, Campina.

Prahova river has an average flow of 28.3 m³/s.

The method used for determining concentrations of heavy metals in river water.

Measurements of total chromium and total manganese concentrations in Prahova river water were made according to SR ISO 15586/2004.
The method used is by flame atomic absorption spectroscopy, with atomic absorption spectrometer existing at Romanian Waters Directorate Ialomița-Buzau in 2006-2008.

Atomic absorption spectrophotometry (AAS) is part of the optical methods UV-VIS and it is based on the measurement of radiant power absorbed by a population of free atoms.

Figure 1 shows the general structure of an atomic absorption spectrophotometer, which uses a flame as atomization source.

![Figure 1. Atomic absorption spectrophotometer](image)

Due to the flame temperature, the solvent is evaporated and decomposed to atoms phase. Also, depending on flame temperature, atoms can remain on the primary energy level or it can undergo a process of arousal, in which case go on one or more excited levels.

Since the flame is used as a source of atomization and due to its lower temperature, most atoms remain in ground state, giving a special sensitivity to atomic absorption.

In other words, in absorption, the main role is sample atomization. The source of radiation, usually a hollow cathode lamp (HCL), emits a narrow spectral line, characteristic to the element which is used for analysis. Emitted light beam, mechanically or electronically modulated, crosses the flame containing atomic vapors of analyte.

Atoms, being on the fundamental energy level, absorb a part of the radiation source, which causes a decrease in radiant power transmitted through the flame. Light signal transmitted through the flame is turned by a photodetector into an electrical signal, which is then amplified. After demodulation, the signal is recorded or converted into a displayed digital size.

Monochromizer serves to isolate the spectral bandwidth and to place it on the maximum analytical line issued by hollow cathode lamp.

Hollow cathode lamp is selected based on analytical data. This gives to the atomic absorption besides sensitivity and increased selectivity. Usually, the resonance line is selected from the emission spectrum of the lamp. Also, monochromizer fixes spectral interferences that may arise between the resonance line and spectral fund emitted by flame.

In conclusion, we can state that the atomic absorption sensitivity depends on two factors: the degree of sample atomization and absorption of radiations from the hollow cathode lamp, by atoms in the ground state.

Measurements of the two metals concentrations, total chromium and total manganese, in Prahova river water, were made in accordance with SR ISO 15586/2004 standard.

Control sections were:

- Section no.1: Predeal
- Section no.2: downstream Sinaia
- Section no.3: downstream Breaza
- Section no.4: Floresti
- Section no.5: Nistoresti
- Section no.6: Adancata
- Section no.7: downstream Nedelea
- Section no.8: Tinosu

3 Problem Solution

**Chromium** – Hexavalent chromium compounds are more toxic compared to hexavalent chromium.

Maximum allowable concentrations of hexavalent chromium in water is 0,05 mg/l and trivalent chromium – 0,5 mg/l.

Enlarged concentrations of compounds containing chromium can be highly toxic to humans, because in this case chromium becomes an allergen and a carcinogen.

Hexavalent chromium compounds are more toxic compared to hexavalent chromium.

The degree of oxidation can distinguish: Cr\(^{2+}\), Cr\(^{3+}\) and Cr\(^{6+}\), Cr\(^{3+}\) being the most stable.

In humans, exposure to hexavalent chromium salts for periods of 2-26 years has been implicated as a cause of cancer of the digestive tract.

In plants, high levels of Chromium supply can inhibit seed germination and seedling growth stage.

A major source of increase in level of Chromium in shoots plants is the foliar fertilizer of Chromium. Interestingly, research has shown that when Cr(III) or Cr(VI) is applied through the surface of leaves, on the lettuce or bean plants, they were not translocated from the leaves of plants elsewhere. Surprisingly, Cr(III) was absorbed faster than Cr(VI).
Lack of transport of Cr in plant tissues could be the cause for the localization of Cr in leaf cells and also Cr ions tendency to hasten in an insoluble form[3].

Manganese is an essential trace in all forms of life. For an adult daily requirement is 2-3 mg. If the content of manganese in drinking water exceeds 0.1 mg/l can occur different bone diseases. Manganese compounds are less toxic than iron, nickel or copper. However, in large quantities, manganese is toxic. For its toxicity, exposure to manganese dust or fumes should not exceed 5mg/m3 for even short periods.

There are numerous data indicating adverse neurological effects of inhalation of manganese powder and manganese dioxide. This can lead to motoric disorders and psychiatric disorders. [4]

The test results of the concentrations of total Chromium and total Manganese in the three years studied are presented in tables 1, 2 and 3.

Concentrations of total Cr (mg/l) and total Mn (mg/l) in Prahova river water in 2006

<table>
<thead>
<tr>
<th>No. unit</th>
<th>Control Section</th>
<th>Specified value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Chromium (µg/l)</td>
</tr>
<tr>
<td>1</td>
<td>Predeal</td>
<td>4.00</td>
</tr>
<tr>
<td>2</td>
<td>Downstream Sinaia</td>
<td>7.50</td>
</tr>
<tr>
<td>3</td>
<td>Downstream Breaza</td>
<td>8.00</td>
</tr>
<tr>
<td>4</td>
<td>Florești</td>
<td>5.00</td>
</tr>
<tr>
<td>5</td>
<td>Nistorești</td>
<td>5.00</td>
</tr>
<tr>
<td>6</td>
<td>Adâncata</td>
<td>5.00</td>
</tr>
<tr>
<td>7</td>
<td>Downstream Nedelea</td>
<td>6.00</td>
</tr>
<tr>
<td>8</td>
<td>Tinosu</td>
<td>10.00</td>
</tr>
</tbody>
</table>

As we can see from Table 1, during the year 2006 there were not registered exceeded of the maximum allowable rate of any metal taken for study.

From Table 2 results that there was a single total Chromium exceeded in Adâncata control section, the water being classified as second grade of quality.

In the year 2008, as result of Table 3, there were a number of three total manganese exceeded in the sections Floresti(0.137), Adâncata (0.119) and Tinosu (0.153).

Following these exceeded, water was classified in grades 2(downstream Nedelea and downstream Sinaia) and 3(Florești and Tinosu).

4 Conclusion

 Monitoring of total chromium and total manganese on Prahova river was made over a period of
three years, but without registering significantly exceeded the maximum allowable rate.

- Analyses were conducted in collaboration with the Romanian Waters Ialomita-Buzau.
- During those three years were recorded a total of five exceeded the maximum allowable rate (a chromium one -52,1 µg/l in collection point Adancata and three overall manganese exceeded in collection points Floresti- 0,137 mg/l, Adancata-0,119 mg/l and Tinosu-0,153 mg/l).
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References:

