

MACRO – MICRO ELEMENT CONCENTRATIONS IN WATER OF SAZLIDERE DAM LAKE (İSTANBUL, TÜRKİYE)

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Abstract

Sazlıdere Dam Lake is located in the north part of Marmara Region and meets the drinking water needs of İstanbul Province of Türkiye. Therefore, it has a significant effect on the health of many people. In this study, macro and micro element accumulations in water of Sazlıdere Dam Lake were investigated and the results were compared with the drinking water standards. For this purpose, surface water samples were collected from 3 stations selected on the Sazlıdere Dam Lake in winter (rainy) season of 2022. Boron (B), sodium (Na), magnesium (Mg), potassium (K), chromium (Cr), manganese (Mn), nickel (Ni), copper (Cu), zinc (Zn), arsenic (As), cadmium (Cd) and lead (Pb) levels in surface water samples were measured by using an ICP-MS device in the laboratory of Technology Research Development Application and Research Centre of Thrace University an internationally accredited centre. In addition, Cluster Analysis (CA) was applied to the data to classify the investigated locations in terms of similar water quality characteristics. According to the data obtained, it was determined that the macro and micro element concentration levels in the waters of Sazlıdere Dam Lake did not exceed the limit values reported for drinking water.

Keywords: Sazlıdere Dam Lake, İstanbul, Drinking Water, Macro – Micro Elements.

INTRODUCTION

It is known that only about 3% of water is fresh and suitable for human consumption. But numbers of organic and inorganic pollutants sourced from anthropogenic activities have been identified as strong contaminants found in both surface and groundwater resources. Therefore, assessment of freshwater quality has a critical importance both for human and ecosystem health [1 – 6].

Sazlıdere Dam Lake is located in the İstanbul Province of Türkiye and it meets the drinking water needs of the region. Therefore, the reservoir has a very important effect on the health of many people living in the İstanbul Province. The reservoir, which has a capacity of approximately 92 million m³, was built on the Sazlıdere Stream in 1996 by State Hydraulic Works (DSİ). The body volume of the Sazlıdere Dam Lake, which is a rock body

fill type, is 1.880.000 m³ and its height from the riverbed is 48 meters. The reservoir volume is about 92 hm³ and the reservoir area is about 11.81 km² at the normal water level [7 – 9].

The aim of the present investigation was to (1) evaluate the water quality of Sazlıdere Dam Lake in terms of macro and micro element concentrations and (2) compare the data with the drinking water standards.

MATERIAL AND METHODS

Water Collection

Water samples were collected from 3 stations selected on the reservoir in the winter (rainy) season of 2022 with a telescopic water sampling device approximately 3 meters from the shore into the pre – cleaned polyethylene bottles. The map of Sazlıdere Dam Lake and the selected locations is given in Figure 1

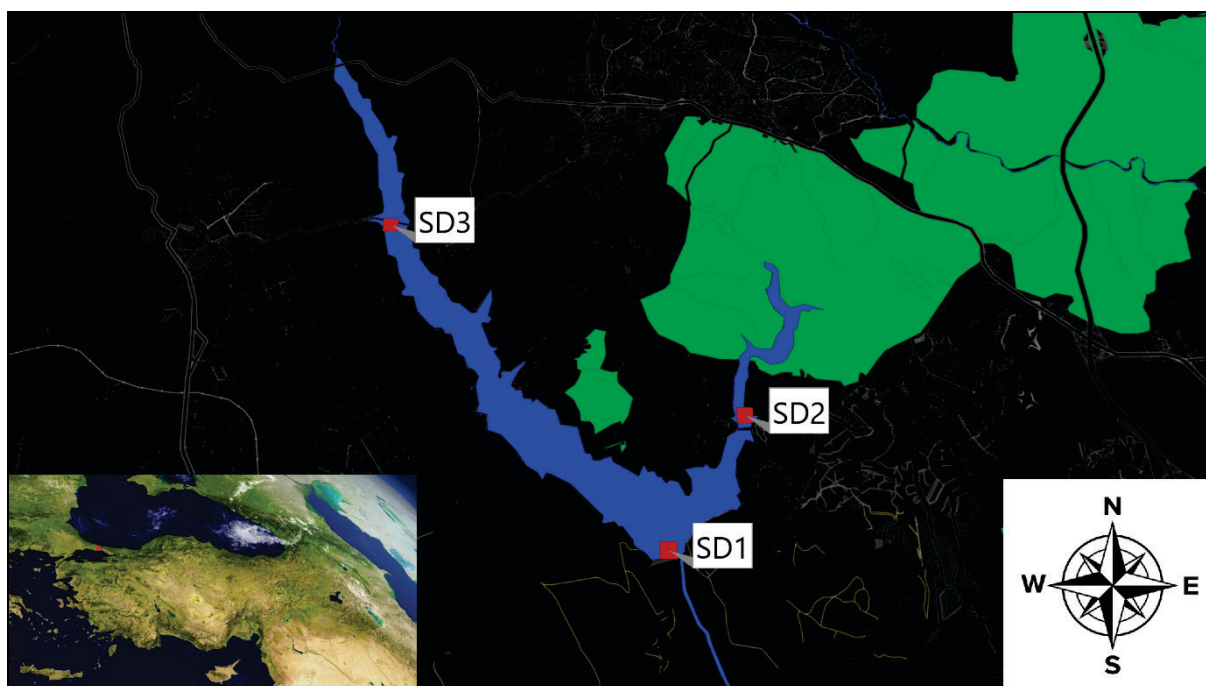


Fig. 1. Sazlıdere Dam Lake and selected station of the reservoir

Element Analysis

pH values of water samples were decreased to 2 by adding about 2 ml of nitric acid per 1 L into each. The samples were filtered by using a 0.45 μm – cellulose nitrate filter. The volumes of samples were made up to 50 ml with ultrapure water. In the acidic – filtered water samples, a total of 12 metal(loid)s (B, Na, Mg, K, Cr, Mn, Ni, Cu, Zn, As, Cd and Pb) were determined with an inductively coupled plasma – mass spectrometry (ICP – MS) in the laboratory of Technology Research Development Application and Research Centre of Trakya University – an international accreditation certificated institution.

All the element analyses were determined as means of triplicate reads (TS EN / ISO IEC 17025) [10, 11]. The accuracy of analytical method was controlled by using a certified reference material (CRM) (CPAchem – Ref Num: 110580.L1).

Statistical Analysis

Cluster Analysis (CA) was applied to the detected chemical data in order classify the investigated locations in terms of their similar water quality characteristics by using “PAST” package statistical program.

RESULTS AND DISCUSSIONS

Cluster Analysis (CA) is one of the most widely used statistical techniques to assess the surface water quality. It enables to classify the objects according to their similar characteristics [12 – 15]. CA was used to obtain the similarity groups among the investigated stations selected on the Sazlıdere Dam Lake according to similar water quality characteristics.

The diagram of CA calculated by using all the investigated metal(loid)s in water of Sazlıdere Dam Lake is given in Figure 2.

As a result of applied CA, 2 statistically significant clusters were formed. Cluster 1, which was named as "Relatively more contaminated zone", corresponded to the stations of SD2 and SD3 that were the input locations of the reservoir; and Cluster 2, which was named as "Relatively less contaminated zone", corresponded to the station of SD1 that was the output location of the reservoir.

According to the results of a similar investigation conducted in the Central Anatolian Region, as similar to the present research, Köse at al reported that [16] Porsuk Dam Lake (Porsuk Stream Basin) has an important cleaning capacity and water quality of the dam lake were significantly rising at the stations, which were close to the output of the reservoir.

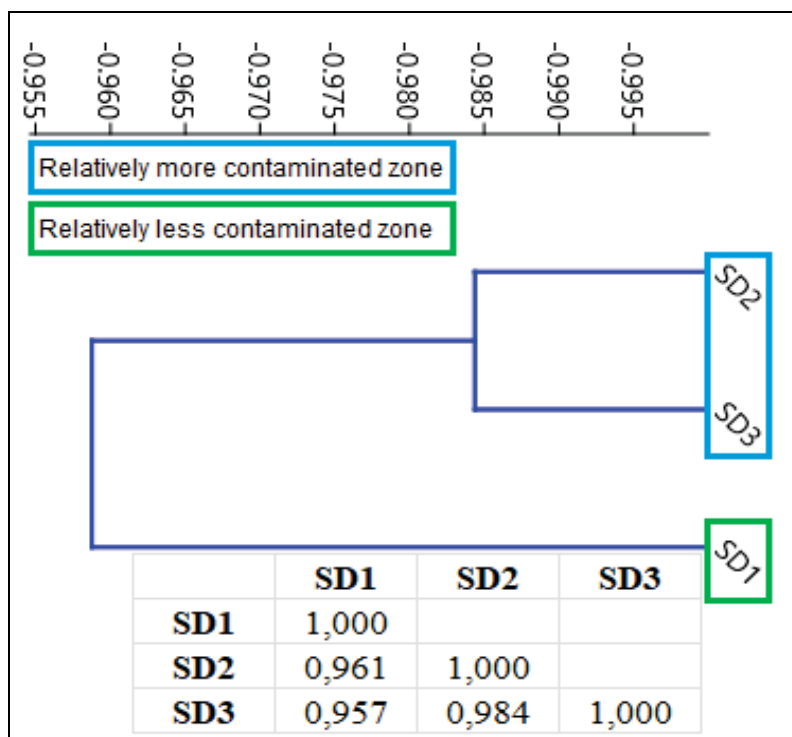


Fig. 2. CA diagram of Sazlıdere Dam Lake

Levels of investigated macro and micro elements in water of Sazlıdere Dam Lake are given in Figure 3 as GIS based distribution maps.

The order of investigated metal(loid)s in water of Sazlıdere Dam Lake in terms of average concentrations were as follows: Na (257.73076 ppm) > K (88.75135 ppm) > Mg (45.27275 ppm) > B (4.10467 ppm) > Cu (0.13871 ppm) > Ni (0.09675 ppm) > Cr (0.09403 ppm) > As (0.01129 ppm) > Mn (0.00731 ppm) > Zn (0.00606 ppm) > Pb (0.00142 ppm) > Cd (0.00117 ppm).

According to the Water Pollution Control Regulation criteria in Türkiye [17], all the investigated locations in the Sazlıdere Dam Lake have 1. Class water quality in terms of all the investigated trace and toxic element accumulations in water.

According to the data obtained in the present research, it was also determined that the macro and micro element concentration levels in the waters of Sazlıdere Dam Lake did not exceed the limit values reported for drinking water by World Health Organization [18], European Communities [19] and Turkish Standards Institute [20].

CONCLUSION

In the present investigation, macro and micro element accumulations in water of Sazlıdere Dam Lake were investigated and the results were compared with the drinking water standards. Also, Cluster Analysis (CA) was used to classify the investigated stations in terms of their similar water quality characteristics.

As a result of this research, water of the Sazlıdere Dam Lake has recorded as 1. Class water quality in terms of all the investigated elements and the macro – micro element concentration levels in the waters of Sazlıdere Dam Lake did not exceed the limit values reported for drinking water.

As a result of applied CA, 2 statistically significant clusters were formed. Cluster 1 was named as "Relatively more contaminated zone" and it was corresponded to the input locations of the reservoir; and Cluster 2 was named as "Relatively less contaminated zone" and it corresponded to the station of output location of the reservoir.

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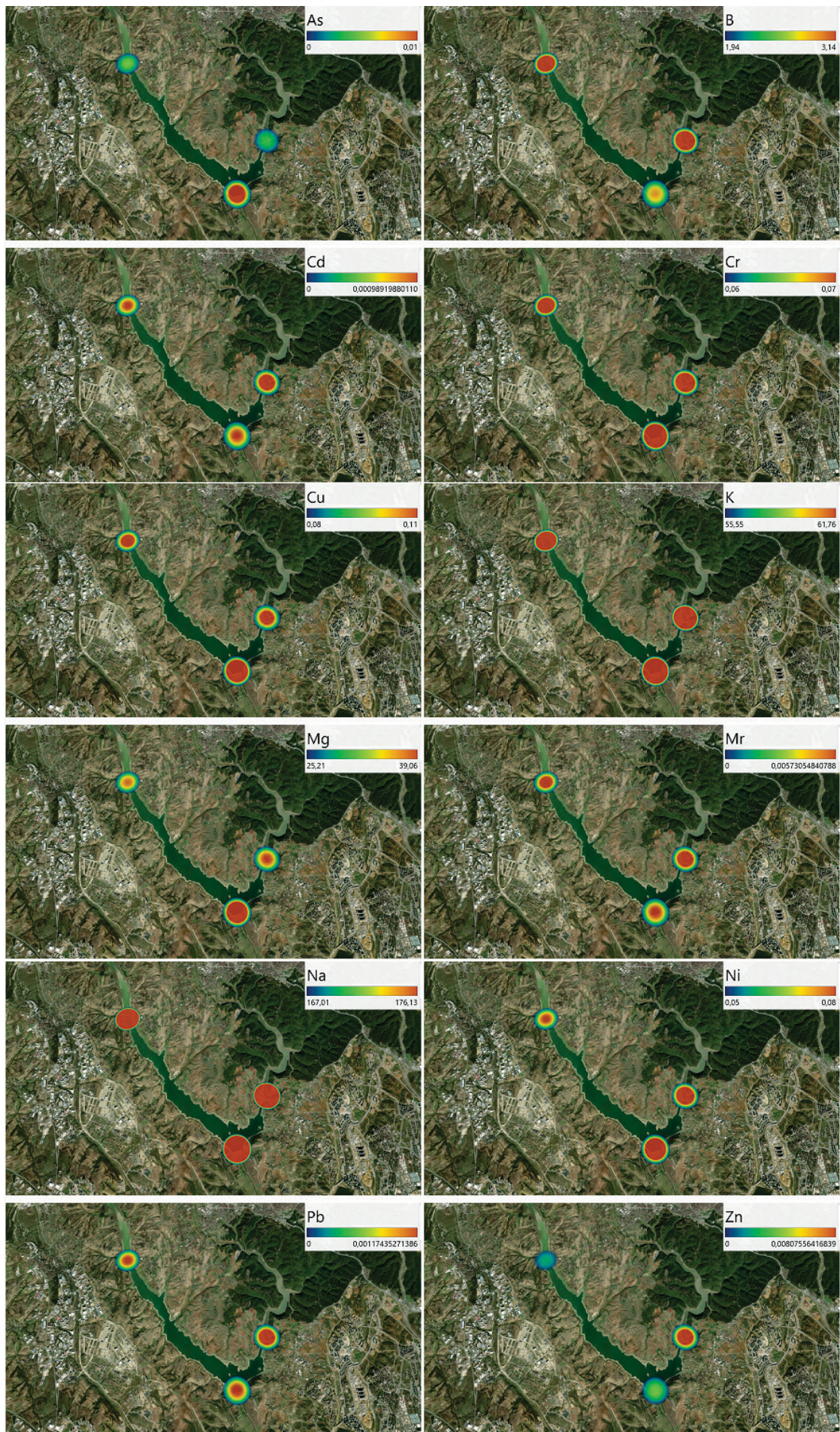


Fig. 3. Trace – toxic element accumulations in water of Sazhdere Dam Lake (ppb)

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