Some physical and chemical properties of the murat river's section between Palu District and Gülüşkür Region

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Abstract

In this study, the water quality and diatoms of the Murat River's section between Palu district and Gülüşkür region were analyzed between March 2010 – February 2011. 4 stations were identified for the study. Water samples were collected from the stations to determine the chemical properties of the river. The analyses and measurements carried out for this thesis study have revealed that according to water quality criteria the Murat River has clean water characteristics. On the other hand, the total amount of phosphorus and the number of coliform bacteria have pointed to the danger of eutrophication in the Murat River according to the Water Pollution Control Regulation.

Keywords: Water Quality, Chemical parameters, Murat River, Elazığ

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Introduction

71% of the earth's surface is covered with water. Oceans hold 97% of the earth's water and 2,997% of the remaining 3% is frozen in glaciers or in very deep aquifers. The other 0.003% forms lakes, rivers and underground waters. Because of the fact that the water available for human use is very little, it is the most precious thing in the world today. Water quality assessment with chemical analysis methods alone is not enough to reveal changes in water quality. A biological approach for the determination of water quality has been developed complementary to chemical analyses. The presence of certain organisms or organism groups in water may indicate weekly or monthly water quality at a particular sampling point. The lack of these organism groups may indicate the presence of a waste discharge or contaminants, which may not be noticed in routine chemical samplings (Kelly and Whitton, 1998).

Studies on water quality in Turkey's rivers based on physicochemical data are not as many in number as those carried out in lakes and other waters. On the other hand, ecosystem analyses dealing with macro-invertebrates by physicochemical variables have recently gained importance (Barlas *et al*., 2000).

The studies on physical, chemical and biological properties of the rivers in our country are few in number, and more information is required to reveal the quality of our rivers. To this end, the water quality characteristics of the Murat River, which is the most important tributary of the Euphrates – and one of the most important rivers of our country - have been analyzed in this study.

Materials and methods

The Murat River is the longer one of the two tributaries of the Euphrates in Eastern Anatolia. Its length is 722 km (URL, 1). For the purpose of this study, four stations were identified on the Murat River between Palu district and Gülüşkür region (Fig. 1). In order to determine the physical and chemical properties of the water at the stations determined on the Murat River, between March 2010 and February 2011 samplings were made for each and every station, and the collected samples were subjected to various measurements and analyses in the field and in the laboratory. The pH, electrical conductivity, dissolved solid and temperature were measured by Hanna HI 8314 model pH meter and the dissolved oxygen was measured in situ by YSI 52 model dissolved oxygen meter. The total hardness was determined by EDTA titrimetric method and chloride (Cl^-) was determined by argentometric titration method. It was determined by adding potassium chromate indicator to the water and by titration with standard silver nitrate till the color turned tile red from yellow **(**APHA, 1985). The total alkalinity, bicarbonate and carbonate were determined by burette titration method.

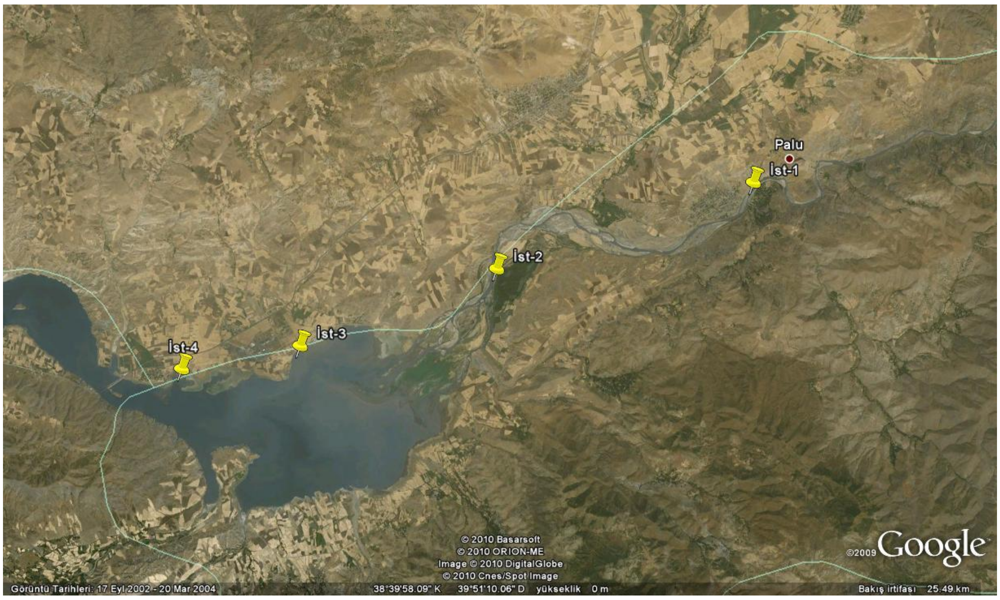

Figure 1: Sampling stations on the Murat River (URL, 2).

Using a pH meter, the filtered sample of specific volume was first titrated with a standard 0.01639 N sulfuric acid solution until a pH of 8.3 was obtained and the amount of standard sulfuric acid consumed was recorded (*A*). Then, in the same sample, titration with standard 0.01639 N sulfuric acid solution was continued until a pH of 4.5 was obtained, and the amount of standard sulfuric acid consumed was recorded (*B*). In calculation, correction was made by verification factor for the normality of the standard sulfuric acid solution used (*F* = normality of the standard sulfuric acid solution used / 0.01639), (Radtke *et al*., 1998).

Total alkalinity (mg $CaCO_3$/l)=

$$= \frac{(A+B)\ x\ 0{,}8202\ x\ F}{\ddot{o}rnek\ hacmi\ (mL)}\ x\ 1000$$

Results

In the Murat River, monthly changes in the surface water temperature, pH, dissolved oxygen, total hardness, and electrical conductivity, alkalinity and chlorine amounts were determined.The surface water temperature was measured monthly, and the monthly changes in the surface water temperature values recorded for each station are shown in Fig. 2.

No statistically significant difference was detected among the stations in terms of temperature values ($p> 0.05$), (Table 4). Monthly changes in the dissolved oxygen (DO) values recorded at the stations are shown in Fig. 3.

A statistically significant difference was detected among the stations in terms of dissolved oxygen values ($p<0.05$). No significant difference was recorded among the stations in terms of pH values ($p>0.05$). Monthly changes in the pH value at the stations throughout the study are shown in Fig. 4.

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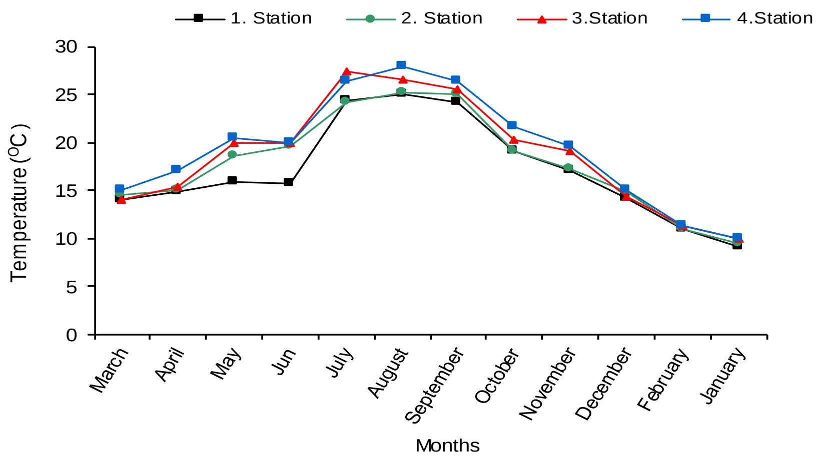

Figure 2: Monthly changes in surface water temperature values according to stations.

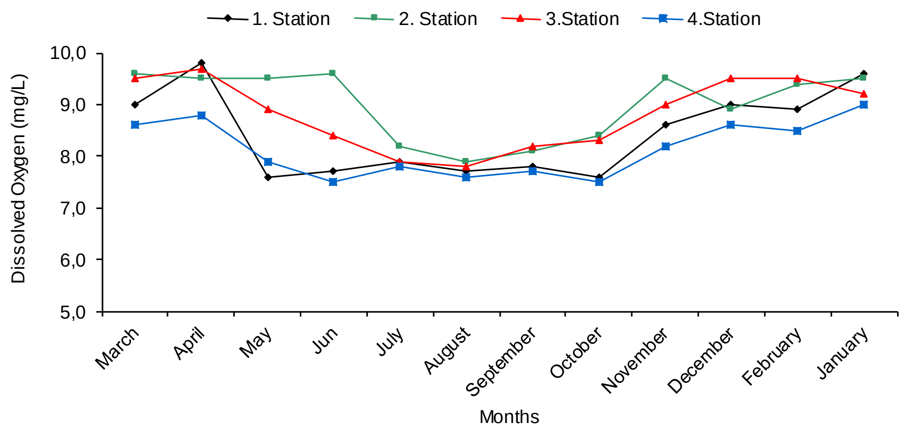

Figure 3: Monthly changes in dissolved oxygen content at the stations.

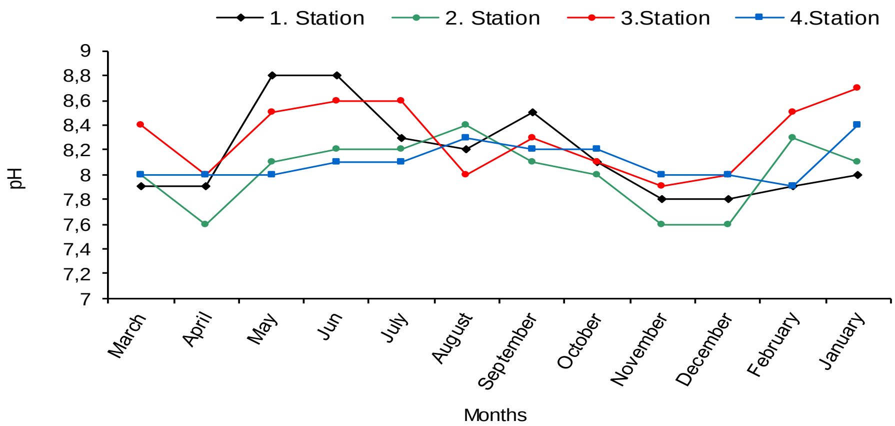

Figure 4: Monthly changes in pH at the stations.

The electrical conductivity values recorded for each station during the study and their seasonal changes are shown in Fig. 5.

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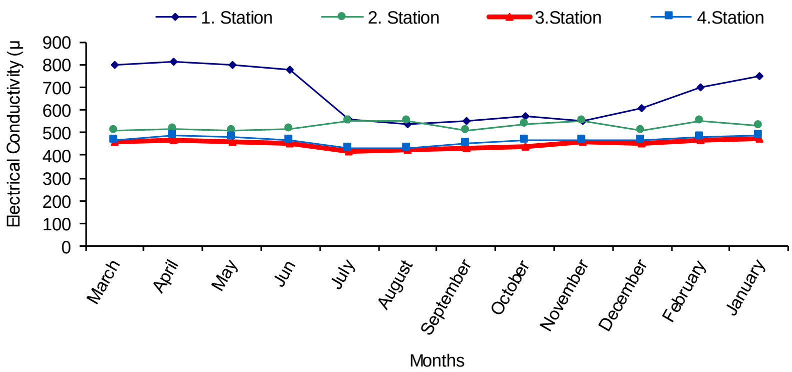

Figure 5: Monthly changes in electrical conductivity values at the stations.

The electrical conductivity values measured at all stations during the study varied between 420–810 µS/cm. Statistically significant differences were detected among the stations in terms of electrical conductivity values (p<0.05). Monthly changes in the dissolved solid values recorded for each station during the study are shown in Fig. 6.

During the study, dissolved solid values measured at all stations varied between 210–405 mg / L. Considering the dissolved solid values at all stations, the highest values were recorded at the 1st station and the lowest values were recorded at the 3rd and 4th stations. Monthly changes in the total amount of hardness for each station are shown in Fig. 7.

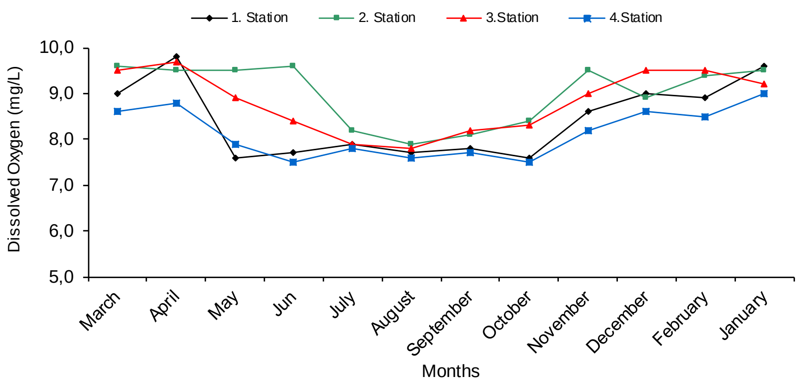

Figure 6: Monthly changes in dissolved solid values at the stations.

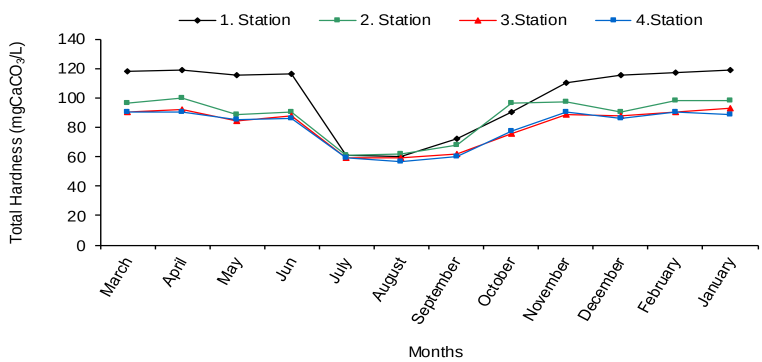

Figure 7: Monthly changes in total hardness amounts at the stations.

During the study, the total hardness values determined for all stations varied between 57–119 mg $CaCO_3$/L. Accordingly, the water of the Murat River has slightly hard water characteristics.A statistically significant difference was detected among the stations in terms of total hardness values (p<0.05).Monthly changes in the chlorine values recorded at the stations during the study are shown in Fig. 8.

A statistically significant difference was detected among the stations in terms of chlorine values (p<0.05). In the study, alkalinity values varied between 129–153 mg/L (Fig. 9). A statistically significant difference was detected among the stations in terms of alkalinity values (p<0.05).

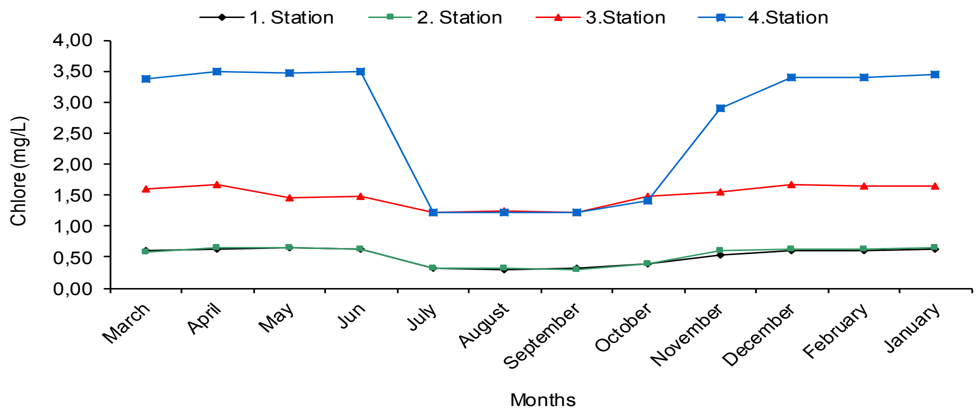

Figure 8: Monthly changes in chloride values at the stations.

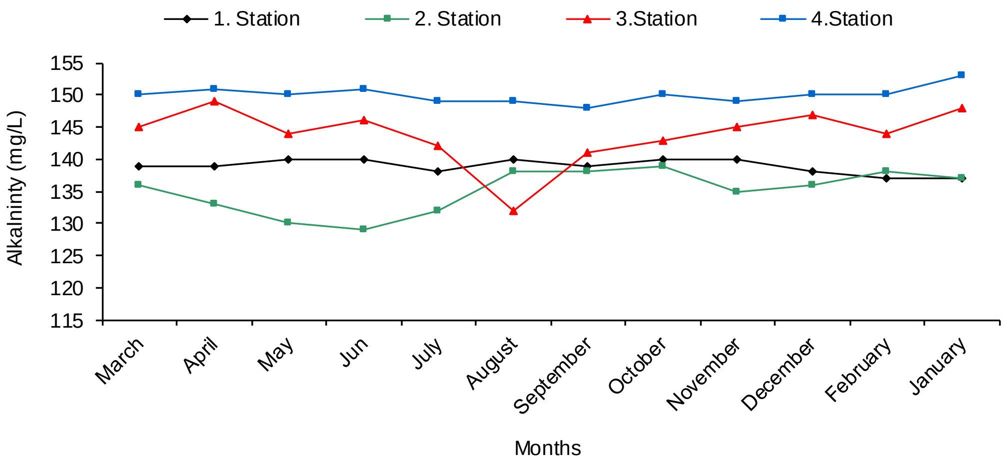

Figure 9: Monthly changes in alkalinity values at the stations.

Discussion and Conclusion

Some of the water quality parameters obtained from this research was compared with the standard values determined by the Regulation on Water Intended for Human Consumption (Anonymous, 2005). According to the quality classification of inland surface waters in the Water Pollution Control Regulation, high quality waters fall

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under the I. class, waters with low contamination fall under the II. class, contaminated waters fall under the III. class, and waters with high contamination fall under the IV. class (Anonymous, 2004). For this, the water quality classes of the Murat River have been determined considering the values shown in Table 1.

Table 1. Quality criteria of inland water resources according to their classes [8].

	Water Quality Classes			
Water Quality Parameters	**I**	**II**	**III**	**IV**
Temperature (^oC)	25	25	30	> 30
pH	6,5–8,5	6,5–8,5	6,0–9,0	other than 6,0–9,0
Dissolved oxygen (mg O_2/L)	8	6	3	< 3
Chloride ion (mg Cl^- /L)	25	200	400	> 400

In this study, it was observed that the water temperatures in the Murat River normally decreased or increased depending on the seasons. During winter months, the water temperature decreased considerably due to the snow falling especially in February, and from March on it started to increase with the warming of the air. During summer months, in parallel with the decreasing water flow and the increasing air temperature, the water temperature reached its maximum, and from October on it started to decrease again with the cooling of the air. Similar results were reported in the studies on the rivers in our city (Varol, 2010). These findings largely support those by Moore and Miner (1997) who put that the surface area of a stream is very important for solar energy transfer, and that a shallow and broad stream takes up more energy than a narrow and deep stream of the same volume and thus warms faster. The low water temperatures in the upper stream zone (I. station) and the high water temperature at the IV. station (downstream region) can be explained by the fact that in this region the stream expands getting more shallow and the flow is minimum. In addition, the fact that the temperature of the lake water is higher in this region where the dam lake water is mixed with the stream has had role in this.

It has been determined that all stations at which the study was carried out in the Murat River fall under the I. class of high quality waters according to the water quality classes defined in the Water Pollution Control Regulation (Anonymous, 2004).

The pH values measured at the stations during the study varied between 7.6–8.8. This shows that the Murat River also has mildly alkaline water. It has been reported also in the studies carried out in rivers in different regions of our country (Taşdemir and Göksu, 2001) that the average pH values varied between 8–9.

Hauraki (2003) reported that water pH is particularly determined by the

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soil structure and the geology of the river basin, and put that depending on the geology of the river basin, the pH in rivers generally varied between 6,0–9,0 and that the pH is quite high in waters passing through regions with limestone deposits. The fact that the pH values measured in the Murat River varied between 7, 6 and 8. 8 support Hurraki (2003) findings.

It has been determined that according to the water quality classes defined in the Water Pollution Control Regulation (Anonymous, 2004), in the Murat River the II. and IV. stations fall under the I. class water quality category, and the II. and III. stations fall under the I. class water quality category in terms of average pH values.

Although there was no difference between the electrical conductivity values of the stations in the same month, it was determined that the electrical conductivity values measured at the I. station were higher than those of the other stations. Environment Canada (1994) reported that there is an experimental relationship between specific electrical conductivity and total dissolved solids. In this study, in general, the lowest electrical conductivity values were measured when the amount of dissolved solids was low and the highest electrical conductivity values were measured when the amount of dissolved solids was high. These findings confirm that there is a relationship between the values of electrical conductivity measured during the study and the total dissolved solids concentration.

Kent and Belitz (2004) reported that the dissolved solid concentration in rivers may be related to the water source in their study on the amount of dissolved solids in some streams in the Santa Ana Basin in California. They also reported that the average amount of dissolved solids varied between 50–300 mg/L in mountain rivers and between 400–600 mg/L in valley rivers. This is supported by the fact that the average dissolved solid amounts in the Murat River, which is a mountain river, is between the values reported by Kent and Belitz (2004) and Ray and Vohden (1993).

Hem (1986) reported that the concentrations of dissolved oxygen in rivers are higher in winter and lower in summer as cold waters can hold more oxygen. This is supported by the fact that during this study the highest dissolved oxygen values (over 9 mg/L) were recorded in February-April and the lowest dissolved oxygen values (7.5 mg/L) were recorded in June-October. In their study on the dissolved oxygen characteristics of the rivers in Wisconsin, Greb and Graczyk (1993) reported that the rivers had the highest water temperatures in July, August and September, and that the dissolved oxygen concentration was 9 mg/L in this period when the average daily water temperature was 20°C. On the other hand, unlike Greb and Graczyk (1993), the oxygen values of 9 mg/L and above in the Murat River were recorded in winter and spring months

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when the water temperature was below 15°C. This seems to be due to water flow and course characteristics rather than water temperature. Indeed, in their comparative water quality study carried out in some rivers in Texas, Ging and Otero (2003) noted that there is an inversely proportional relationship between the water temperature and the oxygen concentrations. The concentration of dissolved oxygen in clean uncontaminated natural waters is generally around 10 mg/L. The fact that the dissolved oxygen concentrations measured in the Murat River varied between 7.5–9.8 mg/L shows that the river's water nearly has clean water characteristics. According to the water quality classes defined in the Regulation on Water Pollution Control Regulation (Anonymous, 2004), it has been determined that the Murat River falls under the I. class - high quality waters - in terms of average dissolved oxygen values.

During the study, in general, the total hardness and the total alkalinity concentrations increased and decreased in parallel with each other. The total hardness concentration varied between 57 mg $CaCO_3$/L and 119 mg $CaCO_3$/L. The highest total hardness concentration (119 mg $CaCO_3$/L) was observed in April and February at the I. station, and the lowest total hardness concentration (57 mg $CaCO_3$/L) was observed in August at the IV. station. USEPA (1997) categorized waters according to their hardness levels and stated that waters with a $CaCO_3$ concentration of >75 mg/L are soft, waters with a $CaCO_3$ concentration between 75-150 mg/L are slightly hard, waters with a $CaCO_3$ concentration between 150-300 mg/L are hard, and waters with a $CaCO_3$ concentration above 300 mg/L are very hard. According to this, it was determined that while the I. station of the Murat River has slightly hard water characteristics, the IV. Station has soft water characteristics.

The total alkalinity values of natural waters generally range between 20–300 mg/L (Egemen and Sunlu, 1996). The total alkalinity values range between 129–153 mg/L in this study. Jacobson (1997) reported that the total alkalinity in the Kuiseb River in Africa ranged between 166–173 mg/L. In the study on the water quality of the Shasta River, Gwynne (1993) reported that the total alkalinity concentrations in the river ranged between 128–474 mg/L. Studies carried out in the rivers in different regions of the world have revealed that total alkalinity values can be very different.

In the Murat River, chloride values ranged between 0.3–3.5 mg/L and the highest average chlorine values were recorded in the downstream region (IV. station). In the study on the Kuiseb River in Africa, Jacobson (1997) also stated that the chlorine concentration in the downstream region (79 mg/L) was much higher than the chloride concentration in the upstream region

[DOI: 10.18331/SFS2019.6.1.2]

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(17 mg/L). It has also been reported in some other studies that the average chlorine values showed changes from the source of the rivers to the downstream region. In their study carried out in the Hoseanna Creek (Alaska), Ray and Vohden (1993) calculated the average chloride concentrations as 30.7 mg/L at one of the stations and as 38.9 mg/L at the other station. The reason for the low chloride concentrations in the Murat River may have resulted from the geological structure of the streambed.

USEPA (2009) determined the maximum chloride concentration for drinking water as 250 mg/L. According to the Water Quality Control Regulation, in terms of inland water quality classes, waters with a chlorine concentration of 25 mg/L fall under the I. Class, waters with a chlorine concentration of 200 mg/L fall under the II. Class, waters with a chlorine concentration of 400 mg/L fall under the III. Class, and waters with a chlorine concentration of >400 mg/L fall under the IV. Class (Anonymous, 2004). According to these quality criteria, it has been determined that the Murat River falls under the I. Class - high quality waters - in terms of average chlorine values. According to the Regulation on Water Intended for Human Consumption (Anonymous, 2004), chlorine in water should be below 250 mg/L. The fact that the chlorine values recorded in the Murat River are well below this value increases the potential of the use of the Murat River's water for human consumption purposes.

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