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EVALUATION OF WATER QUALITY PARAMETERS FOR SHATT AL-BASRAH CANAL IN BASRAH AUTHORITIES

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ABSTRACT:
A significant increase in freshwater demand has been reported recently due to several factors such as population growth, industrialization, rising living standards and global warming effects. As a direct result of that, numerous water crises have occurred around the world especially in downstream countries such as Iraq. Due to the previous reasons, water in terms of quality and quantity considered as a first priority by the Iraqi government. This study focuses on Basrah city, which is located in the south region. The purpose of this research is evaluating the physicochemical qualities of water from the Shatt Al-Basrah Canal to evaluate its suitability to be used for domestic or industrial uses. Data gathered from two sampling stations located on the canal to measure the physicochemical characteristics of the water such as pH, Ca, Mg, PO4, Cl, SO4, DO, NO3, TDS, and EC. With this specific purpose, water samples were collected from the study area, and the water quality has been evaluated. Water samples were collected during six months period during 2013 for assessment purposes. The results of the analysis were assessed according to international water standards for drinking water. From these results of this study, it is often asserted that there is a water pollution in the Shatt Al-Basrah canal and therefore immediate protective actions need to be utilized to minimize the pollution and improve water quality.

KEYWORDS: Water Quality, Physicochemical parameters, Shatt Al-Basrah Canal, Basrah.

1. INTRODUCTION

Water is the vital artery of human societies. According to the history, most of the human civilization grown near water recourses. Existing freshwater resources are rapidly decreasing due to factors such as an increase in population, climate change, and industrialization. Consequently, people are at risk of water scarcity. As a result, it is very crucial that water resources need to be managed carefully. In line with, pollution that caused by people shall produce an increasing demand for good water quality. Water quality varies according to the water usage. There are different requirements for drinking water and irrigation water, or for water used for other different purposes. Therefore, it is essential to determine the potentials of water resources in term of water quality and define what are the current problems and take the necessary precautions.

As stated before, the same situation can be found in Iraq, increasing population, agricultural activities and industrial development led to an increase in freshwater demand. Basrah province has particular circumstances due to its location, where water sources are in their worst situation. Therefore, strategic plans need to be put in place to optimize water resources. These plans must be based on practical research from different aspects.

Research about the river's water quality that includes the physicochemical parameter, bacterial infections, and heavy metal contamination is a factor that is fundamental in establishing projects for water resource management [1,2].

Across the world, various scientific documents concerning the situation of the surface water quality have now been published [3,4]. Various researchers on the Shatt Al-Basrah canal in Basrah authorities have conducted a number of studies. Haneff et al. [5] examined the water quality parameters of the canal using the collected data from three stations along the canal. The first station is located near Grmat Ali, called Abu Sukhair, the second station under Mohammed Al-Kasim Bridge and the third station is located in Khur Al-Zubair. The collection of water samples was done over a period of two months (April and May).

Regular quality monitoring for water is one of the significant strategies of conservationists, hence, local administrations have actually constructed numerous sampling stations across the streams, specifically rivers that cross along the cities, industrial and agriculture facilities [6-9].

Accordingly, this study aims to investigate the applicability of using the Shatt Al-Basrah canal as a source of fresh water. In this paper, physicochemical parameters of water quality for the Shatt Al-Basrah canal (Basrah authorities, Iraq) such as pH, Ca, Mg, PO4, Cl, SO4, DO, NO3, TDS, and EC were taken from the study area and were analyzed and evaluated, then to achieve this objective, a field research had been set in 2013. The surface water quality for Shatt Al-Basrah canal was evaluated in terms of drinking water quality requirements based on Iraqi and World Health Organization standards.

2. EASE OF USE

The Canal of Shatt Al-Basrah is one of the water body at Basrah Authorities (Iraq) where this study is located. This Canal passes through different cities in Basarh; Fig. 1 shows the study location and boundaries. Historically, Canal of Shatt Al-Basrah, is an artificial canal, was first opened in 1983 that forms the lowest side part of the general estuary. The length of the Canal is about 38 km within the lands of the sedimentary plain, and it is located at the longitude of N 30º 20' to 30º 60' and latitude of E 47º 00' to 47º 60'. It starts from the Hammar marsh and extended south to Khor al-Zubair. Usually, controlled by the regulator of Shatt al-Basrah that was located at 22 km from the entrance of Shatt Al-Basrah and 15 km from the Khor al-Zubair. The purpose of the regulator of Shatt al-Basrah is to regulate the level of water in the general estuary and prevent the entry of saline water during the tide to the general estuary.

To determine and assess the water quality of the Shatt Al-Basrah Canal, two sampling stations were selected as shown in Fig 1. The triangular symbols (ST1 and ST2) as presented in Fig. 1, are regarded as water sampling stations. The physicochemical parameters of water such as pH, electrical

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conductivity (EC), total dissolved solids (TDS), sulfates (SO4), chlorides (Cl), magnesium (mg), calcium (Ca), dissolved oxygen (DO), nitrates (NO3) and phosphate (PO4) were measured along the Canal in the study location.

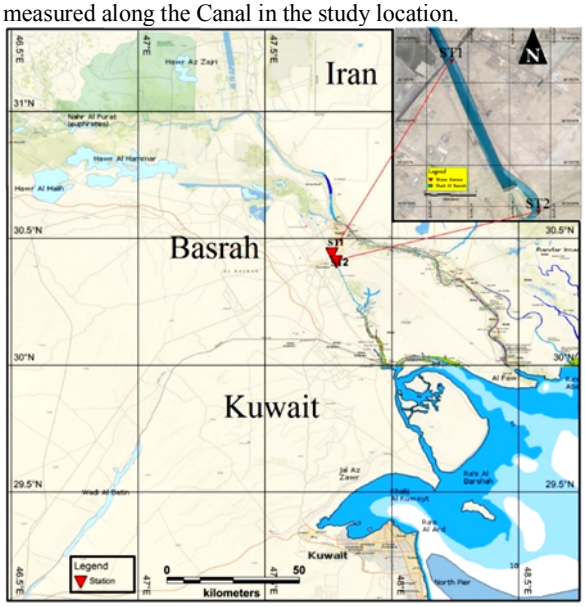

Fig. 1. Location of the area under investigation and sampling stations.

3. GENERAL PROPERTIES OF WATER

Water quality parameters such as temperature, total dissolved solids, and electrical conductivity constitute the physical parameters of water pollution.

When there is an increase in water temperature, the chemical reactions process is increased. In addition, it will decrease the water solubility of gases such as CO2, O2, CH4, and N2 [10]. The high temperature can help to enhance the biological life. Given that the evolution of biological life increases oxygen consumption and the content of dissolved oxygen in water decreases at high temperatures. For this reason, the increase in temperature causes deterioration of water quality especially in terms of drinking water.

The electrical conductivity as essential water quality parameters is a measure of the ability of water to transmit the electrical current. It describes the change in dissolved solids, such as mineral acids in the water [10]. In poor water quality resources, when the rain comes with excess water, the number of mineral salts will change. Total dissolved solids is a measure of the mixed content of both inorganic and organic substances included in the water.

The pH value of water is the measure of acidity and alkalinity. It also provides information on the effect of water on contact with materials. The pH value for pure water is 7. If the pH is below 7, water is acid, and when the pH is above 7, it is alkaline. Chloride is found in a certain amount in all natural waters. Chloride content increases with increasing mineral content. The water solubilizer solves and removes the chlorides in the upper layers of the soil and in the lower soil formations [13].

The chloride ions' concentration in water reveals water health. The chloride ions' concentration in most drinking water cannot surpass 30 ppm. The amount of chloride can reach up to 50-100 ppm in human contaminated water. However, the excess amount of chlorine in a water does not indicate that it is dirty. Because of the chloride concentration in the water near the sea and rock, salt deposits increases.

Nitrate is the final oxidation product of the nitrogen, which is important to show that the organic matter decomposes in water. However, during the movements of groundwater, the water may be mixed with nitrate due to other reasons altogether. The widespread use of fertilizers also increases nitrate concentration in surface waters. Water containing 10 ppm denatured nitrate leads to cyanosis in children. For this reason, it is not desirable to pass these limits.

The presence of nitrite in water is an indication that water is contaminated with feces which its concentration in drinking water should be zero. The availability of phosphorus in water depends on the density of the population, the frequency of agricultural fertilization, plant cover, animal husbandry, and the treatment systems. It can be said that the surface flows after heavy rainfall in the agricultural areas and the phosphorous transport are proportionally less than the other pollutant sources.

4. WATER SAMPLING METHODS

The in-situ average monthly measurement was chosen at the sampling points of the areas covering the study area. At the selected stations, the chemical and some physical parameters of water are measured and assessed simultaneously in the field and in the laboratory.

The water samples from the Canal are collected in accordance with the standard methods [11]. According to this, the sampling method from selected stations in the study area ensures that the water sample can be transported easily in the laboratory as stated in the regulation, enough volume for analysis and can be used for the desired purpose in the laboratory. The water samples which taken in the study area were analyzed within a few hours after they were conveyed to the laboratory. In order to monitor the changes in the water quality of the sampling stations carefully, the water samples were attained in two periods each month with the total of six months of measurements. Physical and chemical properties of water samples from different periods analyzes were carried out in the laboratory, whereas the electrical conductivity, total dissolved solids, and pH, were measured and analyzed in the site using portable devices. Semi-monthly sampling and measurements procedure carried out in the monitoring station to be able to examine the physical and chemical properties of water. The average monthly measurements were selected for this research.

5. RESULTS AND DISCUSSION

In order to determine the quality of the water resources of the Shatt Al-Basrah Canal, it is important to evaluate the changes according to measurement periods. The values of the summary statistics of physicochemical parameters that measured can be seen in Table 1. The measuring unit of these values are in (mg/L) except pH is unitless and EC in (µS/cm).

Parameter	Min	Max	Avg	Range	STDV	CV
pH	7.4	8.75	8.31	1.35	0.356	4.103
DO	2.805	10.75	5.90	7.95	2.262	36.698
PO_4	0.225	0.995	0.37	0.77	0.210	54.831
NO_3	7.485	15.605	9.68	8.12	2.191	21.680
Ca	216.5	857.5	424.17	641.00	197.472	44.573
Mg	391	895.5	587.25	504.50	201.810	32.902
SO_4	1300	3750	2318.75	2450.00	940.329	38.827
Cl	2650	6667.5	4039.88	4017.50	1499.397	35.535
TDS	8369	19005	12232.17	10636.00	4255.007	33.304
EC	10820	24300	16013.33	13480.00	5353.410	32.008

Table 1. summary statistics of physicochemical water parameters in the study location.

The pH of natural waters is usually alkaline or slightly acidic Due to biological activity and some geological factors. Fig. 2 and Table 1, show the values of pH, which varies from 7.40 to 8.75 with an average value of 8.31, hence, almost all water samples, are alkaline. The international standard for drinking water quality [12] proposed that pH must be ranged from 6.5 to 8.5 as a standard limitation for drinking usage. Fig. 2 revealed that three samples have pH values greater than the standard limitation. The high values of these three samples may be due to sewage insertion to the Canal.

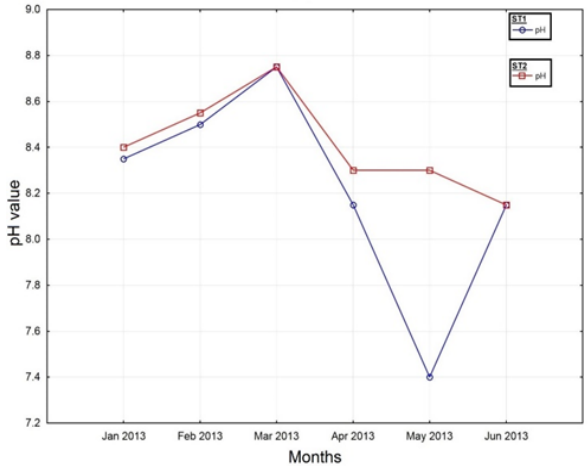

Fig. 2. The pH values of water samples in the sampling stations.

The dissolved oxygen concentrations as shown in Fig. 3 and Table 1 show the changes in concentration are between 2.81 and 10.75 mg/L with a mean value 5.90 mg/L for both sampling stations. The international standard for drinking water quality [12] proposed a 5 mg/L for the upper limit for the concentration of dissolved oxygen in the water. As revealed in Fig. 3, six samples of water exceed the standard limitation. As shown in Table 1 and Fig. 3, the concentration of nitrates changes between 7.49 and 15.61 (mean value 9.68 mg/L for both sampling stations), hence, all the water samples are within the standard limitation of for drinking water quality [12], that proposed the nitrates must not exceed a concentration of 50 mg/L.

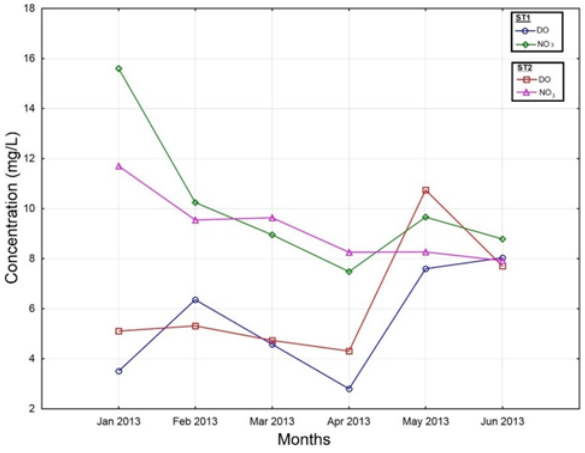

Fig. 3. The DO and NO3 values of water samples in the sampling stations.

The EC parameter is a measure of the presence of ions. It has a relationship that is direct to TDS. As a result of increasing some water ions such as chloride, calcium, sulfate, potassium, magnesium, and sodium, the electrical conductivity will increase; thus, the quality of water is decreased. The values of EC that were measured were between 10820 and 24300 µS/cm and the mean value of EC at the sampling stations was 16013 µS/cm. The international standard for drinking water quality [12] has recommended the 1500 µS/cm for EC as a maximum limit for the standard limitation to use the water for drinking, it is noticed that all the EC values in the Canal are above the standard limitation as shown in Fig. 4. The TDS concentration as confirmed in Fig. 4 and Table 1, varies between 8369 and 19005 mg/L (mean value of 12232.2 mg/L). The WHO standard [12] has suggested the concentration of 500 mg/L for EC as the upper standard limit, thus, all the TDS values in the Canal are above the standards as shown in Fig. 4.

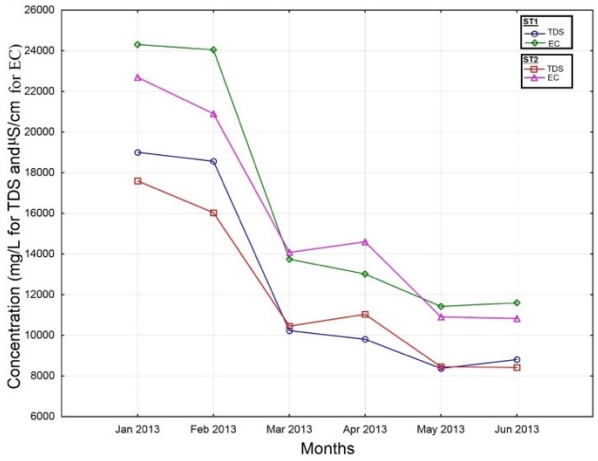

Fig. 4. The TDS and EC values of water samples in the sampling stations.

Fig. 5 and Table 1, show the values of cation concentrations (Ca and Mg) at the sampling stations. The measured concentration of calcium in the water samples was ranged between 216.5 to 857.5 mg/L with a mean value of 424.2 mg/L. Observing of allowable calcium concentration from the standard limitation (75 mg/L) and compare it with the measured values, it is noticed that all values of calcium concentration in all water samples are above the standard. High values of calcium concentration in the study location may be due to the fine clay minerals in Canal's sediment and other factors such as dissolving of minerals particularly halite, along with ion exchange. Fig. 5 and Table 1, show the changes in magnesium concentration that ranged between 391 and 895.5 mg/L with a mean value of 587.3 mg/L. The international standard for drinking water quality [12] has proposed a concentration of 50 mg/L for upper limitation of magnesium concentration; hence, all the values of magnesium concentration in the Canal are above the standards as shown in Fig. 5. Usually, magnesium hydroxide and magnesium carbonate, soluble in water, is a result of the deposit of high magnesium concentration, and only in extremely alkaline conditions.

The concentration of phosphate as presented in Fig. 6 and Table 1, vary between 0.23 and 0.99 mg/L (mean 0.37 mg/L). There is no standard limit for phosphate parameter in drinking water.

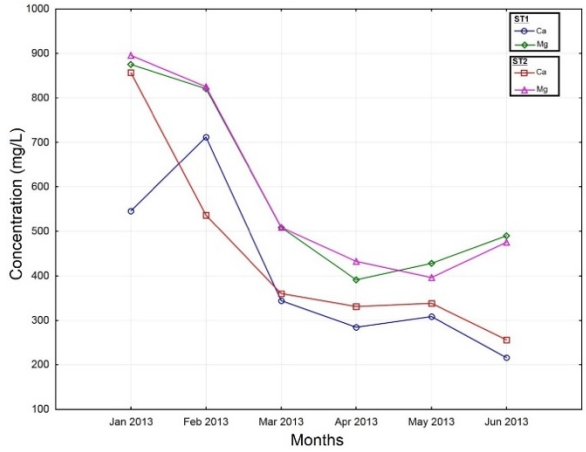

Fig. 5. The Ca and Mg values of water samples in the sampling stations.

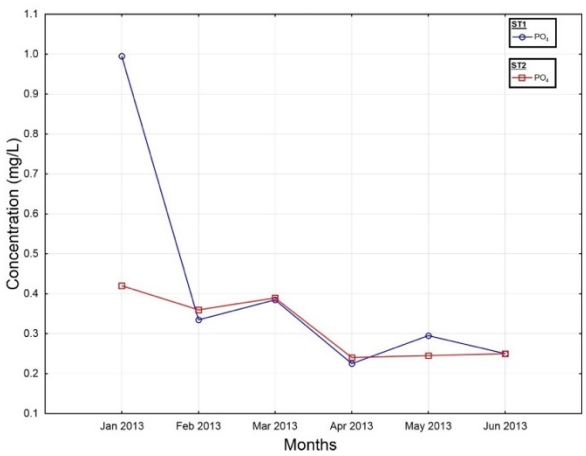

Fig. 6. The PO4 values of water samples in the sampling stations.

The concentrations of anions, in the study area, are shown in Fig. 7. The primary resource of the sulfate is inserting of the industrial sewage into the rivers. The concentration of sulfate as shown in Fig. 7 and Table 1, vary between 1300 and 3750 mg/L. The mean value of 2318.75 mg/L is recorded for SO4 concentration in the study location. WHO standard [12] suggested that the 250 mg/L is the upper limit for the SO4 concentration to use the water for drinking. With deference of the WHO standard, all water from stations unfit for drinking. The concentration of chlorine in the study area, as shown in Fig. 7 and Table 1, vary between 2650 and 6667.5 mg/L with the mean of 4017.5 mg/L. The high values of the chlorine concentration are affected by sewage. Furthermore, the standard [12] suggested the 250 mg/L is the maximum allowable limit for chlorine concentration in drinking water; which means, all chlorine's concentration at the study location was above the WHO limits.

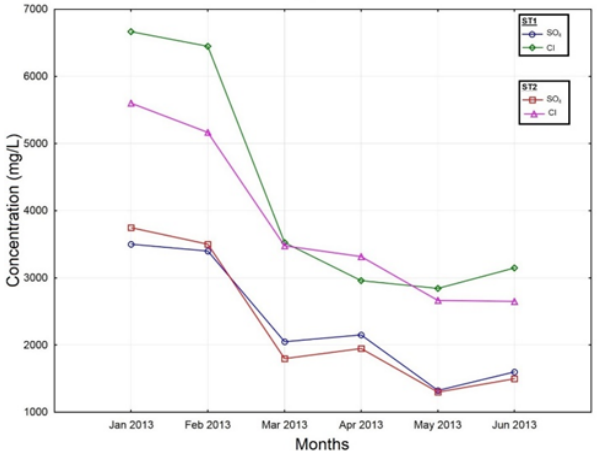

Fig. 7. The SO4 and Cl values of water samples in the sampling stations.

6. CONCLUSION

Some of the main sources for supplying water for drinking, industrial and agricultural consumption are Rivers and Lakes. Consequently, these sources need to be controlled regarding its water quality due to its direct importance for the environment and especially for the human. Unfortunately, sometimes these water sources, seems that it has been considered a place for sewage injection leading to their contamination. The assessment study of water quality is the most important subject for developing the agricultural and industrial projects. In this paper, the quality of water for the Canal of Shatt Al-Basrah was evaluated. The measuring of the physicochemical parameters in the study location including pH, Ca, Mg, PO4, Cl, SO4, DO, NO3, TDS, and EC. The results from this work are finding that the water in the Canal is unsuitable for human drinking, but

may be suitable for developing the agricultural projects. Because of these results from all water quality parameters (except for PO4 and NO3), it is revealed that most of the studied parameters, such as anions and cations, have a concentration greater than the allowable concentration limit of WHO standard. All samples in the study location were almost unsuitable for drinking based on WHO standard and the water in that area need to have further studies for irrigation purposes.

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