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The investigation of chemical quality of surface water in the North of Dezful in Khuzestan Province

Jamal Kazemi Asl

Payame Noor University, Bandar Imam Khomeini, Iran

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Abstract

To evaluate parameters of the chemical quality of surface water flow, statistics and hydrometric stations data and results of the conducted tests on the water samples are used in area of the study. Results show that water quality in terms of parameters Ec change in taken samples from 630 micromos-cm to 6330 micromos-cm. The average value of Ec in this section is 1860.42 micromos-cm. Thus, it becomes clear that water quality of Sardasht River flowing from downstream of the Sardasht city was extremely low and has reduced the quality of water in so far as it cannot be used for drinking and agriculture. In terms of total dried residue samples (TDS), water quality of taken samples in terms of salinity is located at the level of fresh waters. One of the indicators of drinking water quality refers to its hardness which is measured based on calcium carbonate. According to the statistics of chemical constituents of water, taken samples from upstream of Sardasht are good for human drinking. Based on the Wilcox classification, taken samples from the upstream of Sardasht are located in C2S1 class and from the view of water quality for agriculture are in class of good water.

Introduction

Water is considered as polluted when it is regarded as a threat for the environment or is not appropriate for using ,based on human activities. For example, according to EPA (1999), the water that becomes mineral by dissolving of bedrock salts (chloride, sulfate and phosphate) is not contaminated. If it was contaminated water, all of mineral waters or warm mineral waters were considered as contaminated water. Therefore, waters contain amount of solution or suspension that their origin is geological and geochemist called this material "residual" (Darrell,1989; Ballukraya and Ravi, 1999). So, the degree of contamination can be estimated by measuring the deviation between the physical and chemical characteristics of suspicious water compared to the residual material (Mohan, Singh, Tripathi and Chowdhary, 2000). Definition of residual materials is difficult especially, for areas that have history of farming activities for centuries and have experience in industrial activities for decades. A contaminating can be defined as follows: a contaminating is a chemical or physical or biological agent that has originated from human activity and in abnormal intensity or density cause to gradual change of nature of water quality. The main human activities in the studied area are agriculture and animal husbandry. The origin of agricultural pollution primarily is related to excessive use of fertilizers and pesticides in the second degree is related to animal husbandry and human activities (Darvish Zadeh, 1996). It is possible that this type of contamination encompassing a wide areas (Ramesam, 1982). Excessive spreading of fertilizers chemicals which is carried out in relation to the modern farming methods caused contamination by nitrates, nitrites, sulfates and even chloride. Pesticides pollution is

Corresponding author: Jamal Kazemi Asl, Payame Noor University, Bandar Imam Khomeini, Iran, Email: kazemi@bikpun.com

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also added to these contaminants. The cleaning elements are considered as contaminants with the domestic sources.

Materials and methods

Geographical position of area

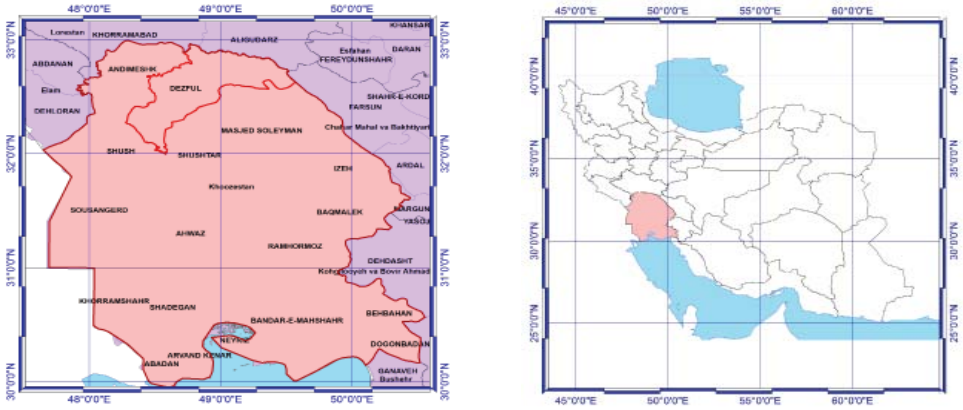
The studied area, with width equal to 380.01 km is located in the southwest region with geographical coordinates of 48 degrees 36 minutes and 20 seconds to 48 degrees 55 minutes 40 seconds east longitude and 32 degrees 24 minutes to 32 degrees 40 minutes north latitude and is considered in range of political divisions of the Khozestan province, in the city of Dezful. Its distance from Dezful city is 21 km. The highest point of studied area is1807 m and the lowest point is 193 meters. Waterways of the studied area are part of the drainage system of the Dez River.

Data Analysis

To evaluate parameters of the chemical quality of surface water flow, statistics and hydrometric stations data of Zorabad which is located on the Gang river are used and in area of the study. The raw statistics of the studied stations and taken samples are given in the following tables.

Results

After collection of data and static and related controls and removal of some of the samples because of inadequate statistical parameters, the following factors were taken into account. Sodium absorption ratio (SAR), percent sodium (Na%), dry residue (TDS), electrical conductivity (EC), acidity (PH), total hardness (TH), anions and Cations, and determining of the mean values, minimum and maximum for each parameter is listed in Table 1.



Map 1 - Location of area of the study

Table 1. Final statistics of chemical quality water of Gang river in Zorabad station

	SAR	Cation	K+	Na+	Mg++	Ca ++	Anion	So4-2	Cl-	Hco3-	Co3-	pH	EC	TDS	Q(m3/s)
						Meq/lit							(mmos/sec)	(mg/lit)	
Max	11.697	74.7	0.95	45	12.8	20.8	74.8	24.7	46.5	4.75	0	8.7	6330	4553	33.9
Average	3.02	18.90	0.09	8.93	4.69	5.19	18.99	8.09	7.53	3.32	0	8.11	1866.42	1218.45	15.75
Min	1.011	6.2	0.01	2.25	0.05	2.3	6.1	0.23	2.38	0.2	9	7.5	630	356	5.48

Evaluation of physicochemical water

There are various combinations of elements in water that are effective on its chemical and physical quality. Here, considering of the anions and Cations can show more properties of the water and by their help, other characteristics of the water can be determined. The relationships between Cations and anions and other water quality factors are considered in the following.

Cations and Anions

According to Ellis (1970), the most important anions in water including bicarbonates, sulfates, chlorides, nitrates and silicates, which according to the different conditions of each region, their amounts are different in water. Cations in the water are including calcium, magnesium, sodium and potassium. The measurement units for density of anions and Cations are milligrams per liter, parts per

million (PPm) and mill equivalent per liter. Table 2 shows the position of the anions and Cations in mill equivalent per liter averagely in taken samples.

Table 2. Position of the Anions and Cations in Zorabad station

Element	Maximum	Average	Minimum
Anions (meq/L)	74.8	18.99	6.1
Cations (meq/L)	74.7	18.90	6.2

Density of total dissolved salts or TDS

Density of total dissolved salts in water or dry residue is an important factor in water quality and has significant effect on shifting and chemical converting and ionization of materials (Sarin, *et al*, 1989). Also, density of total dissolved salts has important role in determining communities of aquatic and plants. Many of plants and aquatic are used to leave in freshwater or saltwater. Density of total dissolved salts plays an important role in determining the water balance in the human and animal drinking, agriculture and industry. Based on the density of total dissolved salts, waters are classified in terms of salinity as Table 3.

Table 3. Different levels of water salinity in terms of density of total dissolved salts

Type of water	Density of total dissolved salts in milligrams per liter
Low salinity	3000 - 1000
Average salinity	10000 - 3000
High salinity	35000 - 10000
Very high salinity	More than 35000

The maximum of density of total dissolved salts (TDS) observed in the samples of Zorabad station is 4553 mg L, the minimum of TDS is 356 mg L and its average is 1218.45 mg L. According to the above categorization, it averagely is placed in relatively salty water class, but there is fluctuates between classes of fresh water to relatively salty water.

Total Hardness of water or T.H.

One of the indicators of drinking water quality refers to its hardness, which is measured based on calcium carbonate.

As Keller (1979), most of the water hardness is related to ions of calcium and magnesium and total hardness is obtained according to mg per liter from the following equation:

$$TH = (Ca + Mg) * 50$$

Where, Mg, Ca was according to milli equivalent and total hardness in mg/Lit. In Gypsiferous area, the hardness of groundwater exceeds 1,000. In most of the rivers and Zagros mountain streams its amount is between 200 and 300. According to the World Health Organization (as cited in Agresti, 2002) recommends, the hardness of drinking water should not exceed 500 and in good condition, less than 80. Softness or hardness of waters is classified as table 4.

Table 4. Levels of water hardness

Kind of water	Hardness amount (mg/lit)
Soft	0-50
Average	51-120
Hard	121-180
Very hard	More than 180

The minimum amount of TH in the samples of studied region is120 and its maximum 1,700 (mg/ Lit) and the mean is 494 mg/ Lit which indicating change of the level of TH from hard to very hard.

One of the simple ways to determine the concentration of dissolved ions in the water is the water electrical conductivity measurement. Distilled water was almost electric insulation. While, dissolved salts in the water making it conducts. If electricity is relatively insulated water solve salts in the water. As Winchester and Floyed (1977), when the amount of dissolved salt in water increases the electrical conductivity increases too. In other words, its electrical resistance decreases.

In most cases, waters that are used for human drinking have the electrical conductivity of 354 to 2100 microcosm to cm and in drinking water of Tehran, it is 400 microcosm to cm. Electrical conductivity (EC) ranges in quality samples from 360 to 960 microcosm to cm with the mean of 638 microcosm to cm.

The relationships between the various factors of water quality

There are some relationships between the various factors of water quality among them examining the experimental results and also obtaining some of them based on the other factors, can be used.

The most important relationships are listed below:

The relationship between anions and Cations

If anions and Cations are obtained based on the milli-equivalent, their sum must be equal with or have has negligible difference. In general, the greater dissolved ions in the water, there is more difference in the mentioned sum as well (Pearce and Gal, 1977). In any case, the difference must not be more than 3 percent. This percent difference can be calculated from the following equation:

$$\%E = \left|\frac{A-C}{A+C}\right| * 100 < \%3$$

Where E refers to the percentage of difference and A & c refers to the sum of anions and Cations in milli-equivalent . Valant. For Zorabad station, we have:

$$\%E = \left|\frac{18.90-18.99}{18.90+18.99}\right| * 100 = 0.24\%$$

The percentage of difference is less than 3% and the accuracy of experimental results is confirmed.

The relationship between electrical conductivity and total dry residue

Surface water and groundwater analysis indicated that there was a clear and fix proportion between dissolved salts or dry residue and electrical conductivity of water as follows:

$$\frac{TDS}{EC} = 0.64$$

In which:

TDS: dry residue is mg/Lit

EC: electrical conductivity of water is micro mouse/ cm

In most cases, approximate ratio is 64/0 when the electrical conductivity of water is less than 3 milli mouse and totally their change is from 55/0 to 7/0. In waters with high alkalinity or acidity, mentioned ratio was less than 55/0 and in very salty water is more than 7/0.

In Zorabad station, this ratio is obtained equal to which is approximately equal to the approximate ratio of 64/0.

Evaluation of water quality in terms of human drinking

Drinking water should contain suitable quality from different aspects that they can be examined in all physical, chemical, toxic, bacteriological and radiological features. In this context, there are different standards in different countries of world that often have slight different from each other. One of the ways for classification water for human drinking is using of Schoeller Diagram. According to the statistics of chemical constituents of water in region, Schuler diagram for Zorabad station is shown in Figure 1.

As can be seen, water quality in Zorabad station for human drinking is averagely inappropriate and in times of water scarcity and drought when the density of dissolved salt of water increase, water quality status for human drinking is placed in class of temporary is drinkable.

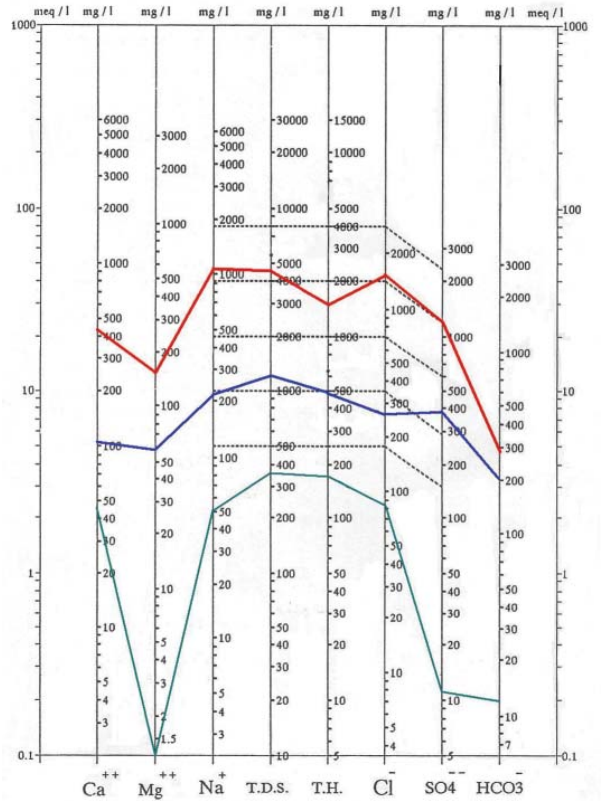


Figure1. Schoeller Diagram for classification of drinking water in Zorabad station

Evaluation of water quality from agricultural perspective

In affairs of agricultural, in addition to water quantity, water quality also has an important role and inappropriate quality can be one of the limiting factors in this section that in addition to agricultural problem, creates problems for soil (Rajmohan, Elango, Ramachandran and Natarajan, 2000). In addition to water quality, factors such as soil texture, water consumption amount,

drainage conditions, chemical elements of soil and finally type of plants for planting also affects in the final conclusion. Therefore, only by knowing waters quality, we cannot decide about their utilization planning. For example, inappropriate water quality in the river margins with coarse texture, salt tolerant plants can be used that can be grown.

There are various ways of classifying water. So far, different classification is provided for measurement of the degree of water quality in terms of salinity and agricultural utilization by reputable research centers of world (Bartarya, 1993). One of the most popular methods for classification of water for agriculture refers to classification of Wilcox which is performed based on two important factors, namely the sodium absorption ratio (SAR) and electrical conductivity (EC).

Sodium Adsorption Ratio (SAR) is calculated by following equation:

$$SAR = \frac{Na^{+}}{\sqrt{0/5(Ca^{++} + Mg^{++})}}$$

Where sodium, calcium and magnesium are expressed as milli equivalent gram/Lit. In diagram of Wilcox each of the two elements of electrical conductivity and sodium adsorption ratio is divided into four parts that generally cause to creation of sixteen groups in water quality.

The various mentioned groups are classified in the diagram as following:

• Very good water, in that EC of waters is less than 250 micro mouse/cm and are placed in C1S1 class.

• Good water that is related to one of the classes of C2S1, C2S2 and C1S2. Waters with average quality that is related to one of the classes of C3S3, C1S3, C2S3, C3S1 and C3S2.

• Iinappropriate waters that are in classes of C1S4, C2S4, C3S4, C4S4, C4S1, C4S2 and C4S3. Whatever their index is larger, they would be inappropriate much more. Only in certain circumstances, it is possible that some of the waters are usable (coarse-textured soils with high drainage and salt tolerant plants).

Conclusions

According to WilCox diagrams, it can be seen that the water quality in the Zorabad station is in classes of C3S1 and C3S2 and C4S2 and from the water quality for agricultural use is in the classes of moderate to inappropriate. Average waters are mainly suitable for irrigation of coarse textured soils with good drainage. Adding organic matter to the earth will have a significant impact in preventing soil degradation.

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