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Determining frequency of ionic, type, faciesand water contaminants of Karoon river

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Key words: Water type, Ionic frequency, Karoon River.

Abstract

The changes in river ecosystem and fading away the species of organisms lead to risk of dearth of high quality water resources and to harmful impacts resulting from using contaminant waters on human beings. In order that the changes in solutes and qualitative parameters of these valuable resources to be studied properly, there should be a careful reflection on the managing approach and qualitative and quantitative monitoring. Identification of both water type and facies and alertness of presence of the dominated ions help how to exploit these recourses. The Karoon River is the longest and largest water-flow in Iran, which in its flowing course crosses the Khuzestan province. For purposes of this study, 3 hydrometery stations of which were selected and then its main dominated cation and anion concentrations were determined. The statistical evaluation and drawing the radial plots for determining the ionic frequency showed that at the three stations the dominated cation and anion concentrations are Na+K> Ca >Mg and CI> SO_4>HCO_4 respectively. The dominated type and facies of water's chloro-sodic and the way of dominated facies development is basic one.

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Introduction

Karoon's watershed basin with area 42574 km² is situated between longitude, 48°4´ to 51°55´ east and altitude 30°17´ to 32°04´ north (Zare`ei and Akhondali 2006).

Traveling one thousand km path, Karoon is the most important running water resource in the country and it plays a critical role in securing farming and urban needs both at national and regional level.

While the needs of many industries, urban and agriculture are met by this river as well as hydroelectricity plants, due to releasing the redundant farming water and wastewaters of metal, chemical, oil, food, cellulosic industries, power stations and urban sewages into it, there are too much contaminations and it has raised the treatment and improvement cost of the river and progressively increased the adverse impacts caused by pollutions on the health of region's people (Afkhami, 1998).

Due to over-exploitation, the surface water resources especially the rivers, is more exposed to risk than the other ones. Influx of wastewaters from industries leads to increased temperature, organic matters, minerals and hazardous combinations of heavy metals into water and in addition to contaminate the aquatic animal inhabitants, they cause to imbalance of syntheses existing in the water. Amongst the various natural resources such as soil, woods, pastures and water, the latter, for many reasons, is of special importance in Iran. Because of natural constraints and particular climate condition in Iran on one hand and increasingly global concern about future water resources on the other hand, in the environmental inventory studies, we must focus particularly on the surface water resources especially the rivers. The studies on water resources may include determination of hydrological, climatic, discharge conditions and watershed extent and the possibilities of direct and indirect exploitation of such resources and finally their pollution situation and characteristics of the sources causing the contamination (Afkhami, 1999).

The amount of solutes in the rivers is constantly increasing and averagely at most of the rivers this increase of the solutes amounts to two through seven fold of initial amount. Today, the contamination of rivers around the globe has turned them in to unusable resources. It is now threatening the life of human and other organisms on the earth (Mohammadi, 1996).

In Iran the naturally scarcity of the water resources is one of the most challenging issue and among four globally defined levels for water stresses, Iran falls at the most extreme level of stress (Mohammadi, 2010).

Pour Mohammdi and Rahiminezhad (1997) in a investigation titled "*Quality Variation of Water in the Zayandeh rood River*" concluded that salinity of the river at the bottom has extremely increased, so that its water is no longer suitable for agriculture purposes.

By studying the effect of pollutants' sources on Zayandeh rood water quality, Abolghasemi Rahimabadi (1998) found that its quality near Zarinshahr is at good condition, but the interval between Zarinshahr and Esfahan the quality diminishes, where the wastes of urban, industries, and agriculture are deposited. From east of Esfahan to Govkhuni marsh too the quality of water is low because of discharging the wastewater of water treatment plant installed in the south of Esfahan and salinity of region's lands and even following the Farfaran bridge, use of Zayndeh rood's water for agriculture purposes is actually impossible.

Jonson *et al.* (1997), Osborn and wily (1998) reported that the results of period related to the season of land use have a different effect on water quality.

The aim of this research is to determine the frequencies of ionic, type, facies and the contami-

nants of Karoon`s water running into Khuzestan plain, which uses these sources to determine how to manage and control quantitatively and qualitatively.

Material and method

Study area

To determine the quality of Karoon River, the data of three stations installed along it, related to 2011 collected by Khuzestan Electricity and Water Authority, was used. The stations from origin to end respectively are: Gotvand, Ahwaz and Bahmanshir.

Laboratory method

In order to specify the concentration variations of the whole solutes in water, the electrical conductivity (EC), sodium adsorption ratio (SAR), exchangeable sodium percentage (ESP) were measured. In the setting of Chemistry software designed by Department of Energy, the EC and PH were statistically evaluated by entering the main anions and cations concentration (calcium, magnesium, sodium, potassium, carbonate, carbonate, bicarbonate, chlorine and sulfate, in $mmol^{-1}$) and the radial plot was drawn. Then the determination of ionic and faces and type frequencies were performed to find out how they develop.

Results and discussion

Statistical Evaluation of ions' Concentration

Traveling one thousand km path, Karoon is the most important running water resource in the country and it plays a critical role in securing farming and urban needs both at national and regional level.

While the needs of many industries, urban and agriculture are met by this river as well as hydroelectricity plants, due to releasing the redundant farming water and wastewaters of metal, chemical, oil, food, cellulosic industries, power stations and urban sewages into it, there are too much contaminations and it has raised the treatment and improvement cost of the river and progressively increased the adverse impacts caused by pollutions on the health of region's people (Afkhami, 1998).

According to fig 1, in the Govt and station in 2011, the mean ion concentration for Na+k ions was highest and for HCO_3 was lowest and the variation coefficients for SO_2 ion were highest and for HCO_3 were lowest.

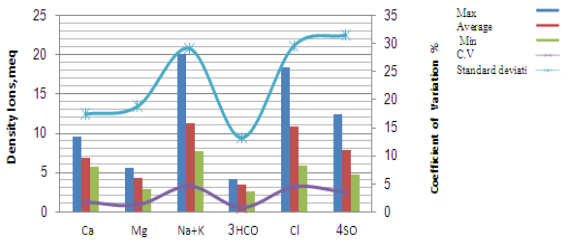

Fig. 1. Statistical parameters of various chemical components in Gotvand station, 2011.

According to fig 2 in the Ahwaz station in 2011, the mean ion concentration for Na+k and CI ions was highest and for Mg ion was lowest and the variation coefficients for SO_4 ion were highest and for HCO_3 and Mg ions were lowest.

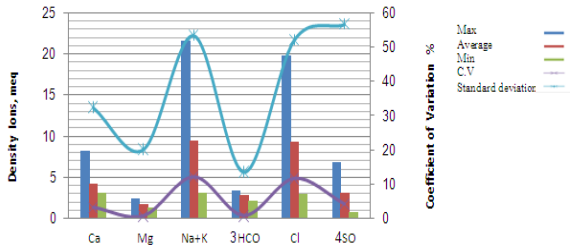

Fig. 2. Statistical parameters of various chemical components in Ahwaz station, 2011.

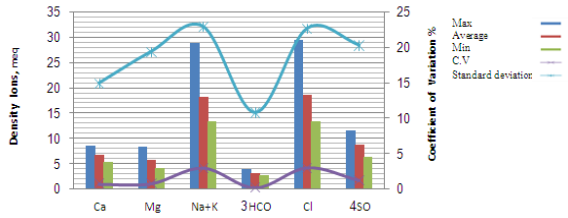

Fig. 3. Statistical parameters of various chemical components in Bahmanshir station, 2011.

According to fig 3. in the Bahmanshir station in 2011, the mean ion concentration for Na+k and CI ions was highest and the variation coefficient for HCO_2 ion was lowest.

Results' Tables of Ionic, Type and Facies Water Frequencies Using Chemistry Software

In these tables, the cation and anion concentration is represented based on their values ranging from high to low and also on type, facies and the way of their development into water (tables 1 to 3). The table 1 shows that in Gotvand station at the one year period of time in 2011, the water type and facies was choloro-sodic and the only case of variation was occurred in September, where both the type and facies were bicarbonate calcic. The dominated development was transfer one.

Table 1. The frequencies of ionic, type and facies and the way of its development- Gotvand 2011.

Month	Anion concentration	Cation concentration	Water Type	Water Facies	Facies and Type	Development way of type and facies
M1	Cl> SO_4 > HCO_3	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M2	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M3	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M4	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M5	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M6	HCO_3 >Cl> SO_4	Ca>Na+K> Mg	Bicarbonate	Celcic	Bicarbonate Celcic	Transfer development
M7	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Transfer development
M8	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M9	Cl> SO_4 > HCO_3	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M10	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M11	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M12	Cl> HCO_3 > SO_4	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Transfer development

Table 2. The frequencies of ionic, type and facies and the way of its development-Ahwaz 2011.

Month	Anion concentration	Cation concentration	Water Type	Water Facies	Facies and Type	Development way of type and facies
M1	Cl >SO_4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Basic development
M2	Cl >SO_4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Basic development
M3	Cl >SO_4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Basic development
M4	Cl >SO_4 > HCO_3	Na+K>Ca> Mg	Chloro	sodic	Chlorosodic	Basic development
M5	Cl >SO4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Basic development
M6	SO_4> Cl > HCO_3	Na+K>Ca >Mg	sulfate	sodic	sulfate sodic	Transfer development
M7	SO_4> Cl > HCO_3	Na+K>Ca >Mg	sulfate	sodic	sulfate sodic	Transfer development
M8	Cl >SO_4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Basic development
M9	SO_4> Cl > HCO_3	Ca>Na+K >Mg	sulfate	Celcic	sulfatecalcic	Basic development
M10	Cl >SO_4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Basic development
M11	Cl> SO_4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Basic development
M12	Cl >SO_4 > HCO_3	Na+K>Ca >Mg	Chloro	sodic	Chlorosodic	Transfer development

The table 2 represents the type and facies of water at Ahwaz station in 2011 where at the most of the year's months the water was chlorosodic and at the three months (September, October, November) the type and facies was sulfate calcic and sulfate sodic. The dominated development of Ahwaz station is transfer.

Table 3 also indicates the water type and facies of Bahmanshir station over 2011 where it is entirely chloro-sodic representing high concentrations of the elements and the increased solutes and salinity in this area, the development of Bahmanshir station is the basic throughout the year.

Table 3. The frequencies of ionic, type and facies and the way of its development- Bahmanshir.

Month	Anion concentration	Cation concentration	Water Type	Water Facies	Facies and Type	Development way of type and facies
M1	Cl >SO_4> HCO_3	Na+K > Ca > Mg	Chloro	sodic	Chlorosodic	Basic development
M2	Cl>SO_4 > HCO_3	Na+K > Mg > Ca	Chloro	sodic	Chlorosodic	Basic development
M3	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	Chlorosodic	Basic development
M4	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	Chlorosodic	Basic development
M5	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	Chlorosodic	Basic development

Month	Anion concentration	Cation concentration	Water Type	Water Facies	Facies and Type	Development way of type and facies
M6	Cl >SO_4 >HCO_3	Na+K > Mg > Ca	Chloro	sodic	sulfate sodic	Transfer development
M7	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	sulfate sodic	Transfer development
M8	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	Chlorosodic	Basic development
M9	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	sulfatecalcic	Basic development
M10	Cl > SO_4 >HCO_3	Na+K > Mg > Ca	Chloro	sodic	Chlorosodic	Basic development
M11	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	Chlorosodic	Basic development
M12	Cl >SO_4 >HCO_3	Na+K > Ca > Mg	Chloro	sodic	Chlorosodic	Transfer development

Water Classification Using Radial Plot

With respect to radial plots related to the three stations in 2011, the dominated anion in the Gotvand station is the chlorine that followed by bicarbonate and its dominated cation is the sodium that followed by calcium. Consequently, the dominated type, except for one case, is chloroand the faciesis sodic in the gotvand station (fig 4). The dominated anion in the Ahwaz station is sodium that followed by sulfate, except three months in a year in which the dominated anion is sulfate and the dominated cation is sodium that followed by calcium. In turn, the dominated type of Ahwaz station is chloro and during the three months (September, October, November) the water type was sulfate and the facies was sodic (fig 5). The dominated anion in the Bahmashir station was chlorine that followed by sulfate and the cation was sodium and then calcium. In turn, the dominated type of Bahmandhir station throughout the year is chloro and the facies is sodic (fig 6).

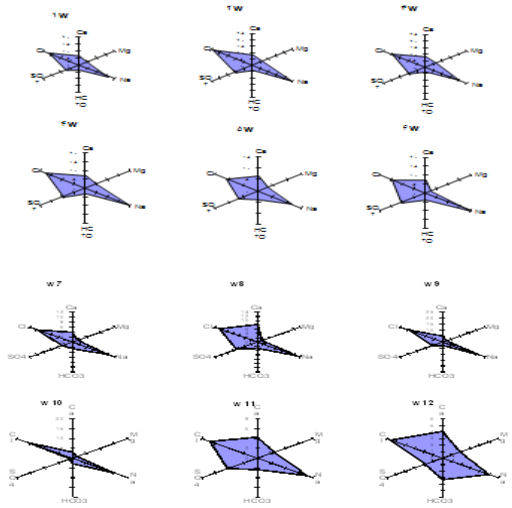

Fig. 4. Radial plot of Gotvand station-2011.

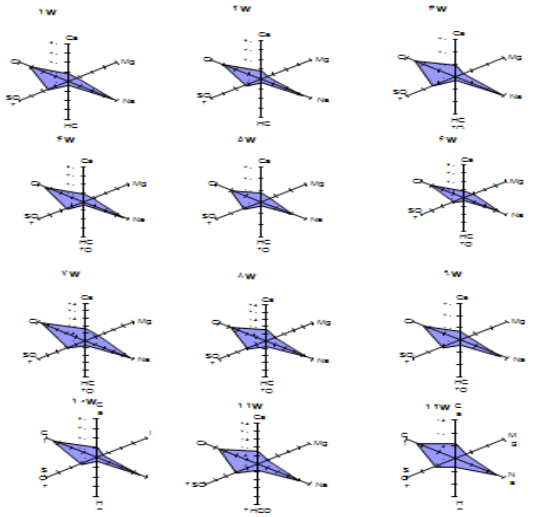

Fig. 5. Radial plot of Ahwaz station-2011.

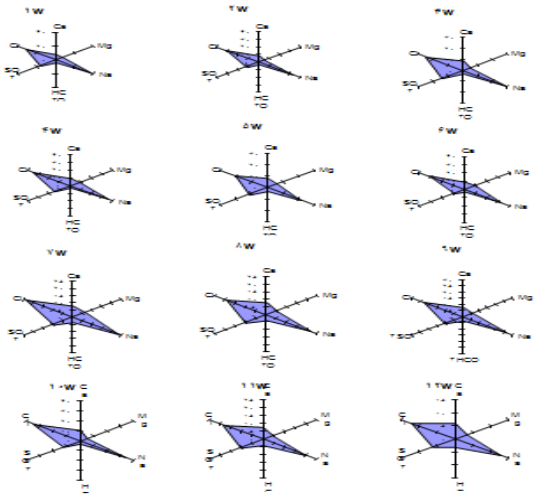

Fig. 6. Radial plot of Bahmanshir station- 2011.

Conclusion

The radial plot, classification and determination of water type show that the quality of Karoon River is decreasing as the solutes and the elevated concentrations of the elements increases. Given that the cation concentration of Na+K is > Ca > Mg, being

dominance of sodium in the Ahwaz station especially in the Bahmanshir limits the water for agriculture purposes. Also, with respect to radial plots of all the three stations in 2011, we consider the pollution of the river by sulfate ion and extremely increased the solutes as the results of discharging the urban and industries wastewaters into downstream of the river at Khuzestan plain. In the case of over-exploitation of water and releasing various pollutants into the river and given the recent droughts, it is accepted that within coming years with increase of ions, in particular sulfate, sodium and chorine, their side effects will be featured on environment and human beings.

Thus, it is recommended that there should be an extensive and accurate study on adverse effects caused by industries and wastewater discharged in to running water recourses. Also, the river should be exploited with regard to kind of usage and management and the kind and dominated ion concentration must be considered.

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