

EXTENDED ABSTRACT

**Assessment of Major elements and Heavy Metals of Surface Water
using Statistical Analysis and the Saturation Index Diagrams
(Case study: Lorestan Province, Azna River)**

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Introduction

Surface water quality is largely influenced by physical processes, chemical and biological processes such as weathering of minerals, rocks, climate and precipitation amount. Human activities (domestic and industrial wastewater, atmospheric sediment, irrigation return flow, etc.) also can reduce the quality of surface water and disrupt using it for drinking, industrial and agricultural consumption. The investigation of saturation index changes is useful to determine the different stages of the evolution of hydro chemical and chemical reactions to control the water chemistry. The control processes of water chemistry including physical, chemical and biological processes, structural, geological and mineralogical composition of the host rocks, and human activities such as household and industrial wastes, excessive use of chemicals and pollution emissions of wastewater tanks can effectively affect the surface water chemistry. Hierarchical clustering methods are appropriate methods for data analysis of water samples which are applied to assess the water quality data and the possibility of sample hydrochemical grouping having the highest importance of the statistical viewpoint in hydrology, hydrogeology and geology. In this study, Azna river water quality has been investigated based on the major elements and heavy metals. Results showed that the reactions due to area formations are the factor that affects the major elements and heavy metal in the surface waters of area.

Methodology

The study area is conducted in some parts of Azna and Aligoudarz located in Lorestan province, between '20 °49 to '5 °49 eastern and longitude and '10°33 to '50°33 northern latitudes. Azna River with an area of 2189/1 Km² is one of the Karun's catchment area in the east of Lorestan Province whose average discharge measured to be 38/88MCM (million cubic meters) during a period of 21 years. Besides, lithological units of second to fourth eras outcrop in the study area which are prioritized from the oldest to youngest as phyllite, quartzite, paragnys, marble, shale, sandstone, tuff and volcanic rocks, crystalline limestone, not separated miocene sediments, marl, limestone, conglomerates originated from the Bakhtiari conglomerate and alluviums. Alluvium of fourth period including sand, clay, silt and gravel covers the plain. Studied chemical quality of groundwater in this study include salt remain, electrical conductivity, acidity, bicarbonate, chlorine, sulfate, all anions, calcium, magnesium, sodium, potassium, all

cations, total hardness and heavy metals. PHREEQC Interactive software and saturation index were applied to study the reaction between water and rock in the region and also its interaction with ground and geology.

Results and Discussion

According to the significant level of Kolmogorov - Smirnov test, all elements of the study area have normal distribution. In the scree plot, the special quantities are plotted against the components representing that there are factors in the river samples that indicating the water quality of the area. Saturation index is a useful one to determine the balance of water state. Applying the saturation index values of various minerals and the investigation of the relationship between saturation indices are helpful to identify the factors affecting the hydrochemistry of surface waters. The geochemical processes of study area are introduced by the investigation of saturation indices. All samples of the studied river in terms of calcite, dolomite and aragonite concentration were super saturated, while they were under saturated in terms of gypsum, anhydrite and halite concentration. The high saturation indices of dolomite respected to calcite show the further dissolution dolomite minerals respected to calcite along the water passage of Azna river. As a result, the mentioned processes can be considered as the factors affecting the composition of the water in the studied area. Chemical evolution sequence of river water is determined in the connection with the complete dissolution of limestone. In water river sources, water-rock reactions are the controlling factors of water quality. Samples of the studied river regarding the calcite, dolomite and aragonite were super saturated, while with respect to gypsum, anhydrite and halite were under saturated.

Conclusions

According to statistical studies, the application of principal components analysis based on major elements and heavy metals in the area, showed the highest correlation between the total soluble solids and chlorine; and linear regression analysis of cations, anions and electrical conductivity, as the dependent variable versus of total dissolved solids as the independent variable showed high correlation between total dissolved solid with electric conductivity and Cl. In terms of heavy metal in the study area the amount of cadmium exceeds the standard amount and other elements are in the standard range. There is the highest correlation between Zinc, Cadmium and Manganese, Chromium in the study area.



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