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Physico-Chemical Analysis of Ground Water in Different Sites of Al-khums City, Libya

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Abstract: ***Deep ground water is an important source of water supply throughout the world. The dependency of people on ground water has increased in the past few decades due to tremendous increase in crop production, population and industrialization. Thus regular monitoring of deep ground water becomes very essential. The present study was carried out to assess deep tubewell ground water quality of Al-khums city, situated on Mediterranean Sea coast of Libya. To study various water quality parameters, ground water samples from four major sites,(0.3-8 kms away from sea shore) of the city were collected in summer season (months of April-May) .All the samples were analysed for major physico-chemical parameters : temperature, pH, electric conductivity(EC), total dissolved solids (TDS), total alkalinity(TA), total hardness(TH), Na^+, K^+, Cl^- by using standard analytical methods. Results showed that the water quality status was found to vary place to place. The results were analysed and compared with "Libyan Standard No. 82 for Drinking Water" and "WHO Water Quality Guidelines". The results revealed that the ground water was not suitable for drinking as well as domestic purposes due to significant variation of most of the physico-chemicals data from the standard permissible limit which was maximum in water samples collected from nearby coastal areas. It is concluded from this study that the ground water of the area needs a substantial degree of purification treatment before using for drinking and domestic purposes.***

Keywords: Al-khums city (Libya), Ground water, Water quality, Hydrochemistry, Physico-chemical parameters.

1. Introduction

Groundwater is an important water resource in both the urban and rural areas of Libya for domestic as well as for agriculture purposes. Protection of groundwater is a major environmental issue for the sake of maintaining the human health and health of the ecosystems Water is the dominant environment of these ecosystems and has attracted a great deal of interest for maintaining the water quality . There is an extensive literature which stresses deterioration of water [1-4]. The intrusion of salty seawater into wells is a ground water pollution problem in many coastal cities and towns. Apart from intrusion of sea water into ground water ,the addition of various kinds of pollutants and nutrients through the agency sewage, industrial effluents, agricultural run off etc. in to the water bodies brings about a series of changes in the physicochemical and characteristics of water, which have been the subject of several investigations [5-9]. A vast population in the coastal area [10] utilizes a shallow and deep ground water for drinking, agriculture and other purposes. Regular monitoring of the quality of ground water should be undertaken, temporarily and spatially to identify the sources of toxic contaminants and other inhibitory compounds that affect the quality of water [11]. Therefore, the present investigation was undertaken in view to monitor the quality of ground water by assessing of physico-chemical properties of groundwater near coastal areas of Al-khoms city in different sites.

2. Methodology

2.1 Study Area

Al-khums city and rural-areas nearby Al-khums city situated on the Mediterranean coast of Libya (see Fig.1 & Table1).



Figure 1 : Map of Libya showing Al-khums city

2.2 Sampling

Groundwater samples were collected from four active wells sites 0.3 to 8 km away from Mediterranean Sea coast in summer season in the months of April- May, 2013(Table-1). Samples were drawn with the aid of locally made plastic drawer into pre-cleaned bottles. Samples were analyzed immediately for parameters, which need to be determined instantly and rest of samples were refrigerated at 40° C for the remaining analysis.

2.3 Hydrochemistry

The collected samples were analysed for major physical and chemical water quality parameters like pH , Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Alkalinity (TA), Total Hardness (TH), Chloride (Cl^-), Sodium (Na^+) and Potassium (K^+) were carried out referring the 'standard methods. The pH was determined by using pH meter with combined electrode (Model – Hanna, sensitivity □□0.01), EC was measured by using conductivity meter

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(Model – Jenway-4520)., TDS were estimated by evaporation method , TA was determined by titrimetrically [12], TH was determined by complexomertry [12], Cl^- content was measured by Mohr's method [12], and Na^+ and K^+ were measured by employing Flame Atomic Absorption Spectrophotometry [12].The electrical conductivity (EC), pH and temperature of the groundwater samples were determined in-situ. All the studies were carried out in Analytical Chemistry Laboratory, Department of Chemistry, Faculty of Sciences, Al-Khums, Al-mergheb University, Libya

Table 1: Showing sample collection sites

Name of site	Depth of water level	Distance from sea coast
Al-mergeb (S1)	100 m	8 km
Suk-al-khamis(S2)	72 m	1.5 km
Libda(S3)	42 m	0.3 – 0.5 km
Karrot (S4)	12 m	0.3 – 0.5 km

3. Results and Discussion

The aim of the present study is to determine the extent of ground water contamination and seawater intrusion around Al-khums coastal area. For this study, physico-chemical analysis was done with the ground water samples collected from four different places 0.3km to 8km away from the seashore around Al-khums City coastal area. The results of the physicochemical parameters for different water samples are presented in Table 2. These results were compared with values of prescribed standard quality parameters presented in Tables 2.

Table 2: Average results of the physicochemical parameters

S. No.	*Parameter*	*Sampling Points*				*WHO [13]*	*Libya Standard No. 82 [14]*
		S1	**S2**	**S3**	**S4**		
1.	pH	6.92	6.98	7.14	6.88	6.5 – 8.5	6.5 – 8.5
2.	EC (ms/cm)	3.475	5.995	6.164	19.920	1.4 ms/cm	*
3.	TDS(mg/L)	1851	3284	3108	10852	1000	1000
4.	TH (mg/L)	545	1085	975	3050	500	500
5.	TA (mg/L)	600	700	750	750	120	200
6.	Cl^- (mg/L)	681	958	940	2417	250	250
7.	Na^+ (mg/L)	122	137	146.	225	200	200
8.	K^+ (mg/L)	7.5	12.8	15	21	*	40

* = Not mentioned

The quality of water resources depends on the location and management of the water sources. It includes anthropogenic discharge as well as the natural physicochemical properties of the area. The results of physico-chemical analysis of water samples are discussed as below.

3.1 pH

pH provides an important piece of information in many type of geochemical equilibrium or solubility calculation and is considered as an important ecological factor [15]. The pH was recorded as 6.92, 6.98, 7.14 and 6-88 at sampling location S1, S2, S3 and S4, respectively and are found to be in the permissible limit as prescribed under standard values of WHO and Libyan standard.

3.2 EC

Electrical Conductivity is a useful tool to evaluate the purity of water [16]. EC values were in the range of 3.475 ms/cm (S1) to 19.92 ms/cm (S4). EC values for all the investigated samples were found to be greater than the limit prescribed by WHO and Libyan standard which indicate the presence of high amount of dissolved inorganic substances in ionized form. Theses high values of electrical conductivity may be due to the high concentration of ionic constituents present in the water bodies and sea water intrusion. So these water samples cannot be used8 for drinking purposes and are unsuitable even for irrigation purposes as the values are beyond the permissible limit.

3.3 TDS

Total Dissolved Solids usually related to conductivity. Water containing more than 500 mg/l of TDS is not considered desirable for drinking water supplies, though more highly mineralized water may be used where better quality water is not available [17]. The maximum value of TDS during the study period was found as 10852 mg/l at sampling location S4 and minimum was 1851 mg/l at S1. The TDS values of all the water samples of the selected places are greater than the limit prescribed by WHO and Libyan standard so these water samples are not suitable for domestic and drinking purposes.

3.4 Total Alkalinity

Alkalinity value in water provides a valuable idea of natural salts present in water. The cause of alkalinity is the presence of minerals which dissolve in water from soil. The various ions that contribute to alkalinity include bicarbonate, borates hydroxide, phosphate and organic compounds. These factors are characteristics of the source of water and natural changes taking place at any given time [18]. The maximum value of alkalinity was found as 750 mg/l at sampling location S3 and S4 and minimum 600 mg/l at S1 and found greater than the limit prescribed by WHO and Libyan standard. In samples

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S2, S3, & S4 as the alkalinity values are much less than the values of total hardness, neutral salts of calcium or magnesium such as sulphates and chlorides may be present because of the intrusion of sea water.

3.5 Total Hardness

Hardness is the property of water which increases the boiling points of water and prevents the lather formation with soap . Total Hardness was found in the sample water ranges from 545 mg/l (S1) to 3050 mg/l (S4), which shows the values higher than the permissible limit prescribed by WHO and Libyan standards .It indicates very high values of hardness of water at all sampling locations according to the prescribed classification of water on the basis of hardness [19].

3.6 Chloride

Source of chloride in ground water is usually found as NaCl, $CaCl_2$ and $MgCl_2$ in widely varying concentrations The variation of concentration of chloride is mainly depend on the salts present in the soil and polluting materials like sewage and trade/ industrial wastes.(Shaikh and Mandre, 2009). The maximum value of chloride was recorded as 2417 mg/l at sampling location S4 and minimum was 681 mg/l (S1) and found greater than the WHO and Libyan standards.

3.7 Sodium

Maximum concentration of sodium was found 225 mg/l at sample location S4 and minimum concentration was estimated 122 mg/ml at sample location S1 . All the samples were found to have sodium ion concentration under permissible limit of WHO and Libyan standards, except sample location S4.which showed slightly higher concentration than permissible limit.

3.8 Potassium

The major quantity of potassium in ground water enters with weathering of rocks but the quantities increase in water due to disposal of waste water [20]. Maximum concentration of potassium was estimated 21 mg/l at sample location S4 and minimum concentration was found 7.5 mg/ml at sample location S1. All the samples were found to have lower concentration of K^+ than the permissible limit of WHO and Libyan standards.

4. Conclusion

Analysis of ground water samples collected from various locations of Al-khums City revealed that all water samples do not comply with WHO and Libyan Standards. The water samples that are collected 0.3 to 1.5 km away from the sea water are gradually more contaminated near sea coast than those are collected 8 km away from the sea shore. The non portability of the ground water may be due to high values of TDS, Total Hardness and Chloride content. Because the ground water was contaminated more by the intrusion of sea water and salts present in higher concentration in soil/rocks or due to other contaminations. So the water samples that are collected near the coastal area cannot be used not even for domestic purposes and requires a substantial degree of purification treatment before use for drinking and domestic purposes.

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