Physical and Chemical Properties of Ground-Water in Sayad with Respect to Drinking and Agriculture Purposes

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Abstract

The present study covers the average analysis of physical and chemical parameters pH, T.D.S, EC, and T.H. The pH is suitable for drinking and irrigation, where the EC is not suitable according to Libyan standard, but irrigation is accepted.T.D. S value is higher than drinking Libyan standards and agriculture. This means T.D.S is not acceptable for drinking and agriculture purposes. Chloride, compared to Libyan standard, it is not suitable for drinking and irrigation. The T.H when compared with drinking Libyan standards and irrigation, it is not suitable for drinking and irrigation. Which is accepted by drinking Libyan standards and irrigation? Sulphate average is without the accepted value for drinking and it is not suitable for irrigation. Nitrate is below the drinking Libyan standards. Therefore, these wells are suitable for drinking and agriculture. Calcium levels is below the drinking Libyan Standards, while the value of irrigation is accepted. Also, (Mg, Na, K, Cd, Cr, Cu, Mn, Pb, Zn, and Hg are within the permitted value for drinking and irrigation.

Keywords: *Ground-water, pH, electric conductivity, total hardens solids, total hardness.*

1. Introduction

Water is one of the most valuable natural resources on earth about 97.5% is saline water and only 2.5% is available as fresh water of that 70% is locked in icecaps and glaciers or lies in deep underground reservoirs [1]. Ground-water, a gift of nature, acts as a reservoir by virtue of large pore space in the earth material, conduit which can transport water over long distances, and mechanical filter which improves water quality by removing suspended solids and bacterial contamination [2]. Quality of ground-water is equally important to its quantity owing to the suitability of water for various purposes; therefore, water quality analysis is an important issue in ground-water studies, the variation of ground-water quality in an area is a function of physical and chemical parameters that are influenced by geological formations and other factors such as soil-water interaction, dissolution of mineral species, duration of soil-water interaction and anthropogenic sources [3-5]. Today, the human activities are constantly adding industrial, domestic and agricultural wastes to ground-water reservoirs at an alarming rate. The ground-water contamination is generally irreversible i.e., once it is contaminated, it is difficult to restore the original water quality of the aquifer. Excessive mineralization of ground- water degrades water quality thus producing an objectionable taste, odour and excessive hardness [2]. Ground-water is defined as the water below the land surface; water above the land surface (in liquid form) is called surface water. In urban areas as, the ground surface is typically much less pervious than in rural areas, and surface runoff is mostly controlled by constructed drainage systems. Surface-water and ground-water in urban areas also tend to be significantly influenced by the water-supply and waste water removal systems that are an integral part of urban development's [1]. Unpolluted safe drinking water is one of primary requisites for healthy human life. The health hazards from polluted water are evident from the fact that about 80% of infectious diseases throughout the world are water related [6]. Due to inadequate availability of surface water, to meet the requirement of human activities, ground-water remains the only option to supplement the ever-increasing demand of water. Ground-water is the primary source of water for domestic, agricultural and industrial uses in many countries, and its contamination has been recognized as one of the most serious problems [3-8]. The quality of water is of upper most importance compared to quality in any water supply planning and specially for drinking purposes purity is equally important. The chemical and physical, characteristics of ground-water determine is usefulness, for municipal, commercial, irrigation, and drinking water supplies [9]. Ground-water quality can be defined as the physical and chemical of ground-water. Temperature, turbidity, color, odour, and taste make up the list of physical parameters. Naturally, ground-water contains ions. These ions slowly dissolve from minerals in the soils, rocks, and sediments as the water travels along its flow path. Some small portion of the total dissolved solids may have originated from the precipitation water or river water that recharges the aquifer. The ions most commonly found in ground-water quality analysis include: Na^+, Ca^{2+}, Mg^{2+}, HCO_3^-, Cl^-, and SO_4^{2-}. Minor ions include NO_3^-, CO_3^{2-}, K^+, Mn^{2+}, and Fe^{2+} [10]. The concentration of these ions gives ground-water their hydro-chemical characteristic, and often reflects the geological origin and ground-water flow regime. For the purpose of this study, the attention was on the physical and chemical parameters of ground-water. Ground-water has long been regarded as the best resource of water for any type of use. The ground-water is used for different purposes, the major ones being community water supply, agriculture, and industrial processes. Each type of use requires certain water quality criteria which determine whether the ground-water in question is suitable for the purpose. Although it is generally well protected from contaminating influences, the very uses for which it is deployed are causing its degradation. In some cases, excessive abstraction of ground-water has caused a gradual degeneration and a number of serious pollution problems in large ground-water bodies. The need to conserve vitally important aquifers as raw water sources calls for careful management of ground-water with respect to their quantity and quality. In general, ground- water contamination is irreversible, i.e., once it is polluted, it is difficult to restore the quality over a short span of time. Ground-water, although protected by the soil cover, is subject to quality changes as a result of activities of man on the overlying cover [11-13]. For instance, the increasing contamination of ground-water supplies by nitrates due to intensive use of chemical fertilizer, uncontrolled animal waste main discharges and incomplete industrial and municipal waste water treatment. The health problem resulting from high levels of nitrate in drinking-water is infant Methaemoglobinemia [3]. The quality of drinking water; the quality criteria which determine whether the ground-water under investigation is suitable for drinking are; water is said to have good chemical quality for domestic use if it is soft, low in T.D.S and free from poisonous chemical constituents [14]. Evidence relating chronic human health effects to specific drinking water contaminants is very limited and in the absence of exact scientific information, scientists predict the likely adverse effects of chemicals in drinking-water using laboratory animal studies and when available, human data from clinical reports and epidemiological studies. Many organizations such as World Health Organization (WHO), have established standards (guideline values) for many chemical constituents of drinking-water. A guideline value normally represents the concentration of a constituent that does not result in any significant risk to health over a lifetime of consumption [15-17]. A number of provisional guideline values has been established at concentrations that are reasonably achievable through practical treatment approaches or in analytical laboratories; in these cases, the guideline value is above the concentration that would normally represent the calculated health-based value. Guideline values are also designated as provisional when there is a high degree of uncertainty in the toxicology and health data. Physical and chemical parameters of water are the parameters that describe the physical and chemical states of water. These parameters can cause health problems beyond certain concentration levels [18-22]. Some of these parameters have been discussed below. The quality of irrigation water besides affecting crop yield and soil physical conditions, irrigation water quality can affect fertility needs, irrigation system performance and how the water can be applied. The aim of this study was measure the physical and chemical parameters such as: pH, EC, T.D.S and T.H of ground-water in Sayad area and measure the concentration of some cations and anions. The area of this study was carried out at Sayad district which is (5Km) from Janzoor (SaheL Jifara Shaibia). East of Sayad is Janzoor west is AL-Maya and Al-Hashan, north is the Medetterian Sea, and south is Al-Sahla.

2. Materials and Methods

Twenty ground-water samples were collected from the wells preserved in polyethylene bottle, 1.0 ml of chloroform is added to each sample to prevent excepted biological contamination, and when analyzed the heavy metals we added 1.0 ml of nitric acid to each sample to prevent adsorption of the heavy metals on the glass. All samples were stored in refrigerator at 5°C before being analyzed. The ground-water samples were analyzed for pH, EC and T.D.S sodium, potassium, calcium, magnesium, nitrate, sulphate, chloride and bicarbonate. Heavy metals such as iron, zinc, chromium, cadmium, copper, lead, manganese, and mercury. Since the 1970s, nitrate ($NO3^-$). Contamination of ground-water has become a significant environmental problem, with many parts of the world now reporting ground-water nitrate, pollution [23-26]. The pH measurement using pH-meter (HANNA 8424 model Hj) [27], EC and T.D.S were determined by conductive cell (JENWAY 4520) [28]. Calcium and magnesium were determined by complex metric titration [29], whereas potassium and sodium were estimated by flame photometer emission (corning model-400) [30]. Sulphate was determined gravimetrically [31]. Carbonate and bicarbonate were determined by titration method [32]. Chloride was estimated by argent metric titration [33]. Nitrate was determined by UV visible Spectrophotometer. Iron, zinc, copper, chromium, manganese, lead and cadmium were analyzed by Inductively Coupled Plasma model (JY 238), for mercury, analyzed by cold vapor.

3. Results and Discussion

The physical and chemical parameters of drinking-water samples items of pH, EC, T.D.S and the heavy metals such as: lead, iron, cadmium, chromium, zinc, manganese, copper, and mercury. The arithmetic average, the lowest, highest value of the elements in the wells samples, the Libyan standards for drinking water and the maximum standard for irrigate on water were listed in Table 1. All concentrations are measured in mg/l, and the electrical conductivity in µS/cm. Figure 1 show the pH value which extended between 6.6 and 7.2 with an average 7.02. These results are in agreement with international standard and Libyan specification. The results also shows that pH values did not exceed pH value 8.5 mean that carbonate ion are absent. The Figure 2 shows that the average T.D.S concentrations are 839 ppm, which is acceptable for drinking according to Libyan specification and also the international specifications. The Figure 3 show that the average EC concentrations are 1214 µS/cm, which is acceptable for drinking according to Libyan specification and also the international specifications. Samples have EC values exceeds the acceptable range for drinking-water specification. It is clear through the Table 1 that the average EC in the samples were analyzed 1214 is located within the category of medium-quality for irrigation.

4. Conclusion

It is observed that about 25% of ground-water exceeds the permissible limit of electrical conductivity, sulphate, chloride ion and total hardness prescribed by Libyan standard specification. EC was not managed according to Libyan standards, but irrigation is accepted. For chloride ion, it is not suitable for drinking and irrigation. These exceeded ranges may attribute to the excessive use of ground-water for irrigations and the intrusion of sea water. For sulphate, the accepted value for drinking is not suitable for irrigation. This may tribute to dissolution, sulphate rocks due to movement of rain water through the layer of soil in the ground-water. For T.D.S the range value is higher than drinking and agriculture, this means T.D.S is not acceptable for drinking and agriculture purposes. For T.H when compared with drinking Libyan standards, it is not suitable for drinking and irrigation. Almost all the parameters like pH-value, magnesium, calcium carbonate, bicarbonate, potassium, nitrate, sulphate, and the heavy metals chromium ion, manganese, iron ion, cadmium ion, copper ion lead ion and mercury ion were within the permissible limited prescribed. These results are in agreement with international standard and Libyan specification.

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Table 1: **Results of wells samples with Libyan Specifications**

TEST	Mean	Std. Deviation	Minimum	Maximum	Libyan standard Specifications For Drinking water [39]	Libyan Standards for Irrigation Water [39]
T.D.S	839.05000	297.635325	385.000	1519.000	500-1000	1500
pH	7.02100	0.165431	6.680	7.280	6.5-8.5	9
E.C	1214.4000	414.682935	564.000	2023.000	500- 1500	3000
Cl^-	209.87050	104.308206	72.450	453.070	200-250	355
HCO_3^-	234.47400	69.062715	138.330	390.000	250-400	520
SO_4^{2-}	108.08900	158.234024	9.870	756.330	200 - 400	500
NO_3^-	6.04500	3.812649	0.400	16.400	10- 45	25
T.H	427.35500	125.259959	209.800	688.400	200-500	-
Ca^{2+}	86.73500	28.958652	20.340	137.900	75-200	400
Mg^{2+}	48.92000	29.325176	9.400	126.000	30 -150	
Na^+	0.05425	0.019547	0.023	0.090	20-200	230
K^+	0.03760	0.010013	0.025	0.065	10 -40	-
Cd^{2+}	0.00190	0.000968	0.000	0.004	0.01 -0.05	-
Cr^{3+}	0.00179	0.001477	0.000	0.004	-	-
Cu^{2+}	0.01100	0.007239	0.000	0.022	0.1	-
Mn^{2+}	0.00831	0.007664	0.000	0.025	0.05 -0.1	-
Pd^{2+}	0.00831	0.007664	0.000	0.025	-	-
Zn^{2+}	0.05990	0.044534	0.005	0.150	-	-
Hg^{2+}	0.0004295	0.00018568	0.00011	0.00085	0.001-0.002	-

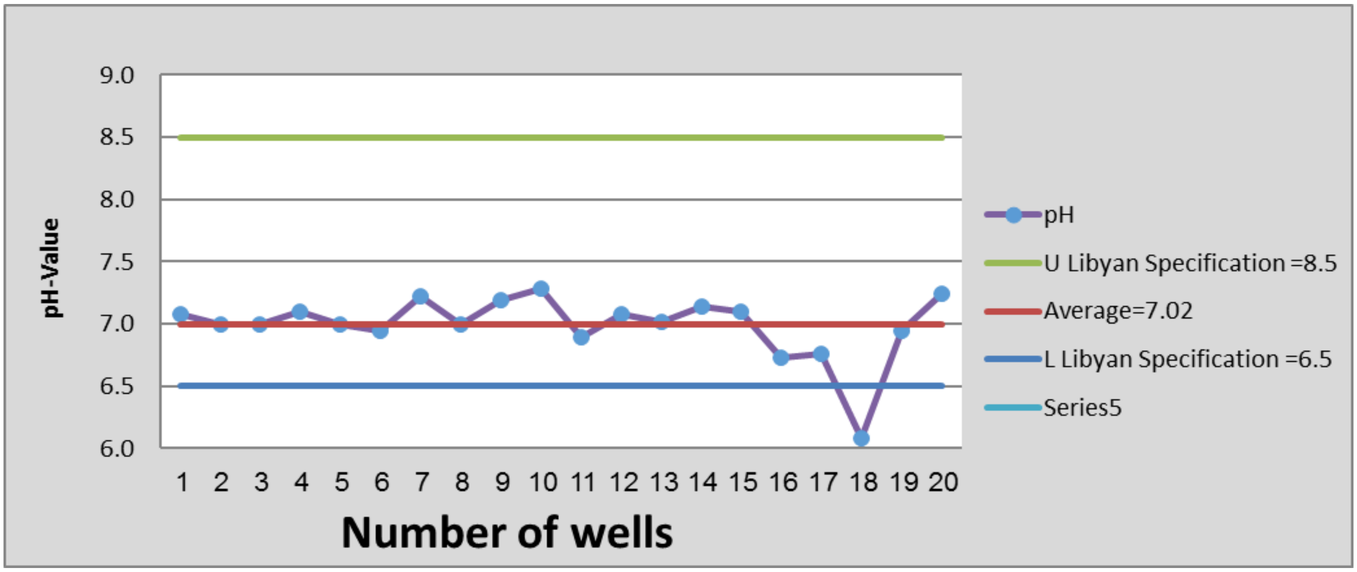

Figure 1: pH values for all water samples.

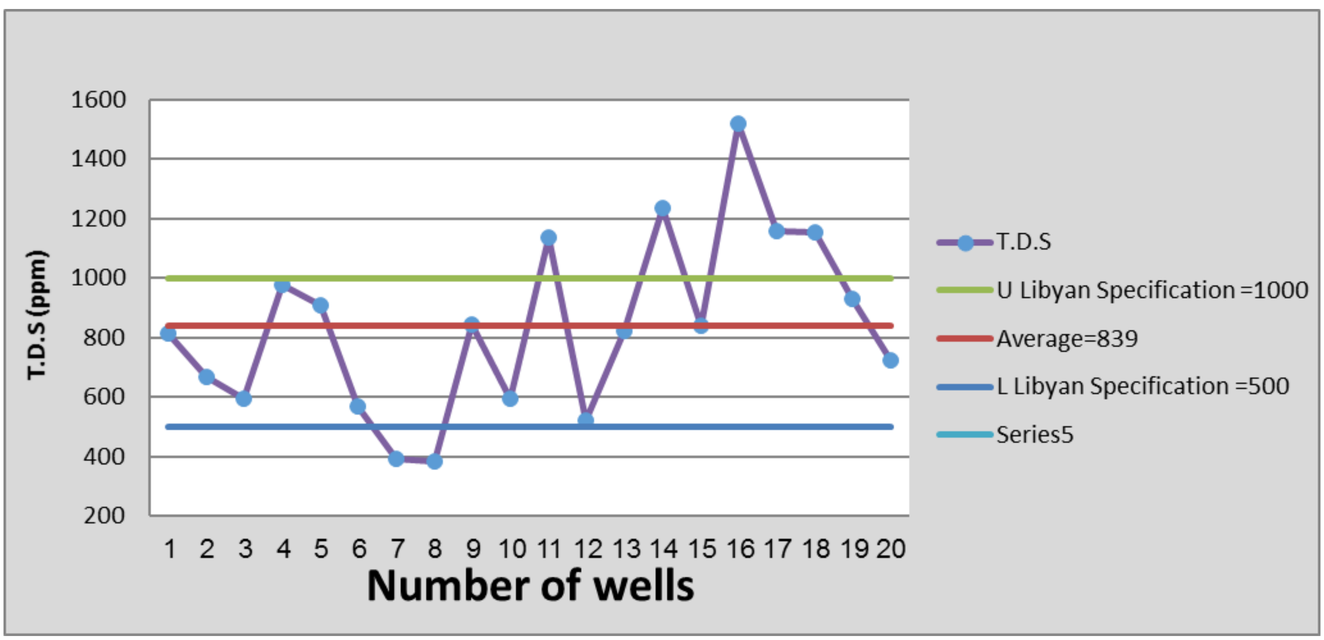

Figure 2: T.D.S values for all water samples.

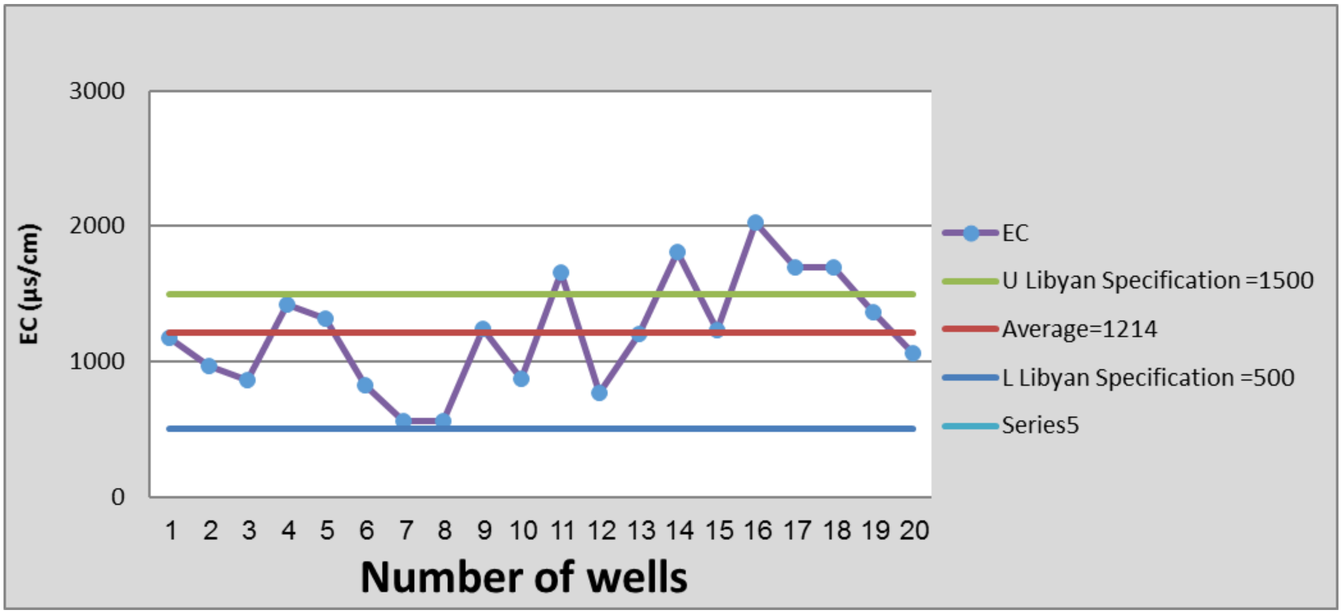

Figure 3: EC values for all water samples.