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Assessment of the quality of Surface and Groundwater in Shegagha area

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تقييم جودة المياه السطحية والجوفية بمنطقة الشقيقة

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Abstract:
Water samples were collected from eleven surface and deep wells in the Shegagha area to study the concentration of salt ions and element ions, as well as the pH, EC, and TDS levels. The results indicate that the average carbonate ion concentration is 647.81 ppm, which exceeds the acceptable range for drinking water according to Libyan and WHO specifications in most samples. Additionally, the average chloride ion concentration is 966.73 ppm, exceeding the acceptable drinking water limits in most samples. The concentration of sulfate ions in all samples exceeds the recommended limits, with an average of 1054 ppm. On the other hand, the sodium ion concentration is within permissible limits, with an average of 73 ppm. The average potassium ion concentration is 3.345 ppm, meeting the standards for drinking water. The pH level averages at 7.045, within the permissible limits. However, the TDS and EC levels are high, with average concentrations of 1477.45 ppm and 1676 dsm- respectively, exceeding the acceptable limits for drinking water according to Libyan and WHO specifications.

Keywords: Back Titration, Gravimetric Method, Titration, Electric Conductivity.

الملخص
تم جمع عينات من إحدى عشر بئراً سطحياً وجوفياً بمنطقة الشقيقة , وتحديد تركيز هذه الأملاح والعناصر و ,PH TDS, EC وأظهرت النتيجة أن متوسط تركيز أيون الكربونات كان 761.27 ppm وهذا أعلى من الحد المسموح به حسب المواصفات القياسية الليبية والعالمية والتي لا يزيد فيها تركيز الكربونات عن 500 ppm ماعدا 27% من هذه العينات ذات تركيز أعلى من الحد المسموح به أما بالنسبة لمتوسط تركيز أيون الكلوريد كان 966.73 ppm وهو أعلى من الحد المسموح به لمياه الشرب والذي يتراوح تركيز الكلوريد فيه من 250-500 ppm حسب المواصفات القياسية وكان تركيز أيون الكبريتات حوالي1054 ppm وهو أعلى بكثير من الحدود المسموح بها حسب المواصفات القياسية الليبية ومنظمة الصحة العالمية والتي لا يزيد تركيز الكبريتات فيها عن 400 ppm ، أما متوسط تركيز أيوني الصوديوم والبوتاسيوم كان على التوالي 73 ppm و3.345 ppm ووجد مطابق وضمن الحد المسموح به في كل العينات، بينما متوسط الحامضية pH كان 7 وهو ضمن الحد المسموح به حسب المواصفات القياسية، وكان متوسط التوصيل الكهربي EC وأملاح الكلية الذائبة TDS على التوالي 1676 -dsm و1477.45 ppm وهو أعلى من الحد المسموح به حسب المواصفات القياسية الليبية والعالمية.

الكلمات المفتاحية: المعايرة العكسية، الطريقة الوزنية، معايرة، توصيل كهربائي.

Introduction:

Salts and elements can be found in surface water and groundwater due to natural processes or human activities. High concentrations of these substances can lead to degraded water quality and health issues for humans, animals, and plants [1]. The increase in concentration of salts and elements can lead to water pollution, causing various diseases in humans [2]. Water pollution can stem from different sources, including agricultural and industrial activities, which release salt [3], heavy elements, fertilizers, pesticides, and sewage waste into the water system [4]. The rock structure can also contribute to water pollution, increasing the concentration of total dissolved salts and hardness salts [2,5]. Such water may not be suitable for human use, and to assess groundwater suitability, several elements and salts need to be measured. This study aims to determine the levels of Na^+, K^+, Cl^-, $CO3^{-2}$, and $SO4^{-2}$ ions in groundwater samples according to the World Health Organization (WHO) and Libyan specifications [6].

It's important to note that pure water, like distilled water, is completely free of salts and is not suitable for drinking as it has a high ability to dissolve substances, leading to the quick corrosion of iron and copper water pipes. As a solution, calcium carbonate is added to protect the pipes [11]. In some cases where drinking water is provided through thermal desalination of seawater, producing semi-distilled water, it is necessary to compensate for the lack of dissolved salts by adding 100 ppm sodium hydroxide [8].

Material and methods

In this study, we utilized reagents purchased from Sigma Aldrich without further purification. We collected eleven water samples from various water bodies in and around the Ashegagha area. The concentration of carbonate ions (CO3-2) in the collected water samples was determined using the volumetric method. To estimate the concentration of carbonate, we titrated 50 ml of water samples with a 0.1 M EDTA solution in the presence of Eroichrom black T as an indicator and drops of buffer solution [12,13]. The concentration of carbonate salts in each sample was calculated using the appropriate law.

($CO3^{2-}$) mg/l = M (EDTA)* V (EDTA) * F.W (CO_3) / V (H_2O).

The measured concentration of chloride ions in samples of drinking water was determined by back titration of 0.1M silver nitrate with 50 ml from each water sample. This was used to calculate the concentration of chloride to estimate the increase. A solution containing potassium thiocyanate in the presence of ammonia and ferric sulfate was used as an indicator [14]. The concentration of chloride was then calculated."(CL) ppm = mg (CL) / V (H_2O) L

Number of mmole of CL^- =number of mmole of $AgNO^{3-}$ number of mmole of KSCN.

And number of mg of CL^- = number of mmole of CL^- * W (CL).

The concentration of sulfate (SO_4^{-2}) ions in the drinking water samples was determined using the weight method. This involved adding an increase in saturated barium chloride solution to 200 ml water samples, separating the formed sediment through filtration, and then drying it. The weight of the sediment in the form of barium sulfate was then measured to calculate the sulfate concentration [15]. The concentration of sulfate ions in each sample was determined using the applicable law. "W(SO_4^{-2}) mg/l =W (BaSO4) * F. W (SO_4) / F. W ($BaCL_2$).

The concentration of both sodium and potassium is calculated automatically using a device for

The (Na, K Analyzer BMB, UK) is utilized for analyzing the concentration of sodium and potassium ions via standard electrodes for these elements. The pH meter, model 80 type Grifine, and the electrical conductivity (E.C) values were measured using a HANNA instrument.

Results and discussion

The results of the Figures show the relationship between the concentration of elements and salts PH, EC, TDS, and water well samples, which will be explained later according to each form and the extent of its conformity with Libyan and international standards.

Table 1: The location of samples and concentration of salts, elements, DS and EC in units (ppm), dsm-

TDS...	EC	PH.	Potassium K^+	Sodium Na^+	Sulphate SO_4^{-2}	Chloride CL^-	Carbonate CO_3^{-2}	location	Source of water	Number of samples
108	180	6	0.1	4.5	375	350	120	was	surface	1
1177	1955	7.2	7.9	142.6	1299	994	840	was	deep	2
1640	2460	7.6	5.5	117.3	1714	1327	480	ashabia	Deep (B)	3
173	288	7	0.4	13.3	470	450	360	Shelagh	ssurface	4
3500	2009	7.5	5.5	108.5	461.5	1278	720	ashabia	deep (A)	5
1240	1250	6.6	0.1	4.7	Noppt	830.7	820	as habit	surface	6
1640	2738	7	0.4	11.5	4615	1320.6	948	shegagah	deep	7
1770	1880	7.4	5.1	108	Noppt	1334.8	1128	ashabia	Deep (C)	8
1870	1650	7.2	5.8	113.1	1705	1164.4	1248	faculty	deep	9
1494	2480	7.2	5.7	169	Noppt	690	930	malta	deep	10
1640	1550	6.8	0.3	10.5	955	894.6	780	almassged	deep	11
1000	1200	8.5	40	200	400	250	400	The permitted limits in Libyan		
1000	1250	9	12	200	400	500	500	The permitted limits in the WHO		

Table 2: The statistical analysis of wells samples.

		Carbonate CO^{3-}	Chloride CL^{-}	Sulphate SO_4^{-2}	Sodium Na^{+}	Potassium K^{+}	pH	EC	TDS
N	Valid	11	11	11	11	11	11	11	11
	Missing	0	0	0	0	0	0	0	0
Mean		761.272	966.73	1054	73.00	3.345	7.045	1676.36	1477.45
Mode		0.00	0.00	0.00	0.00	0.1	7.2	0.00	0.00
Std. Deviation		315.910	349.526	671.393	63.816	3.039	0.4546	835.574	901.86
Minimum		120.00	350.00	0.00	4.50	0.10	6.00	180.00	108.00
Maximum		1248.00	1334.8	4615.00	142.60	7.9	7.6	2738.00	3500
Sum		8374.00	10634.1	11594.50	803.00	803.00	77.50	18440.00	16252.00
		a. Multiple modes exist. The smallest value is shown							

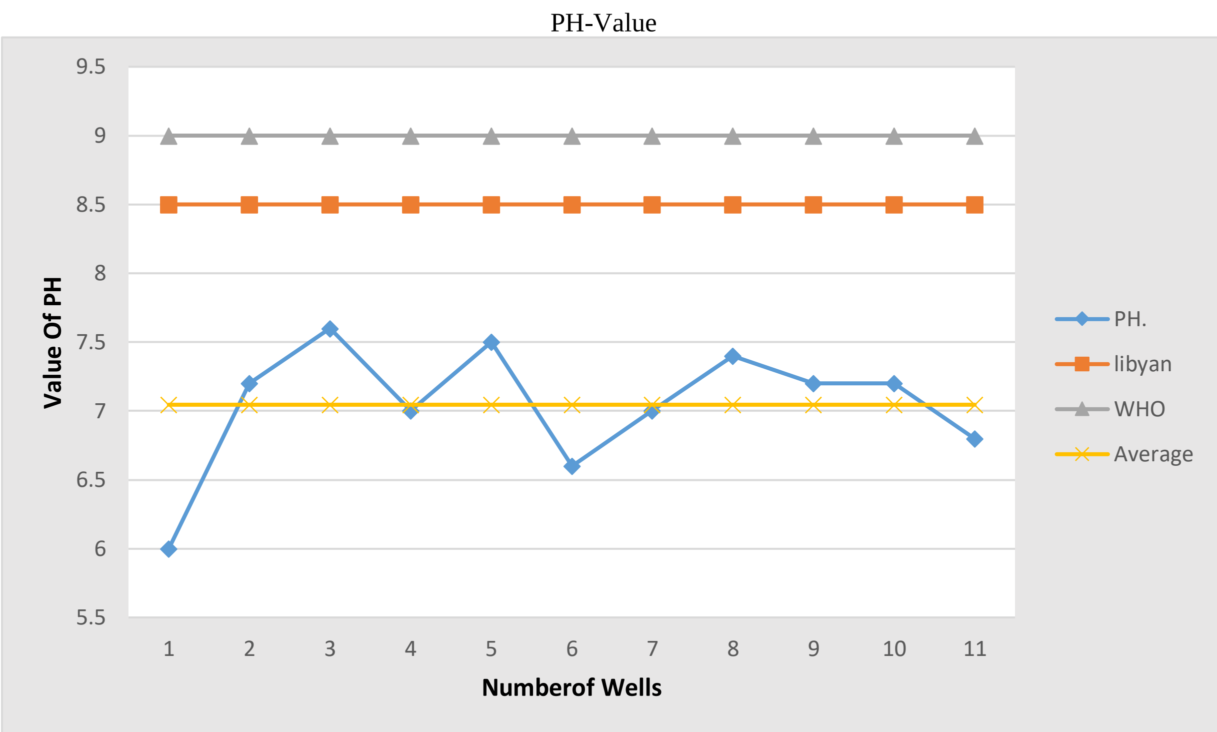

Figure 1: pH for all water samples.

The pH value depicted in Figure 1 ranges from 6 to 7.6, which aligns with both Libyan and WHO standard specifications. Additionally, the results indicate that the pH value did not exceed the specified range.

Electrical Conductivity:

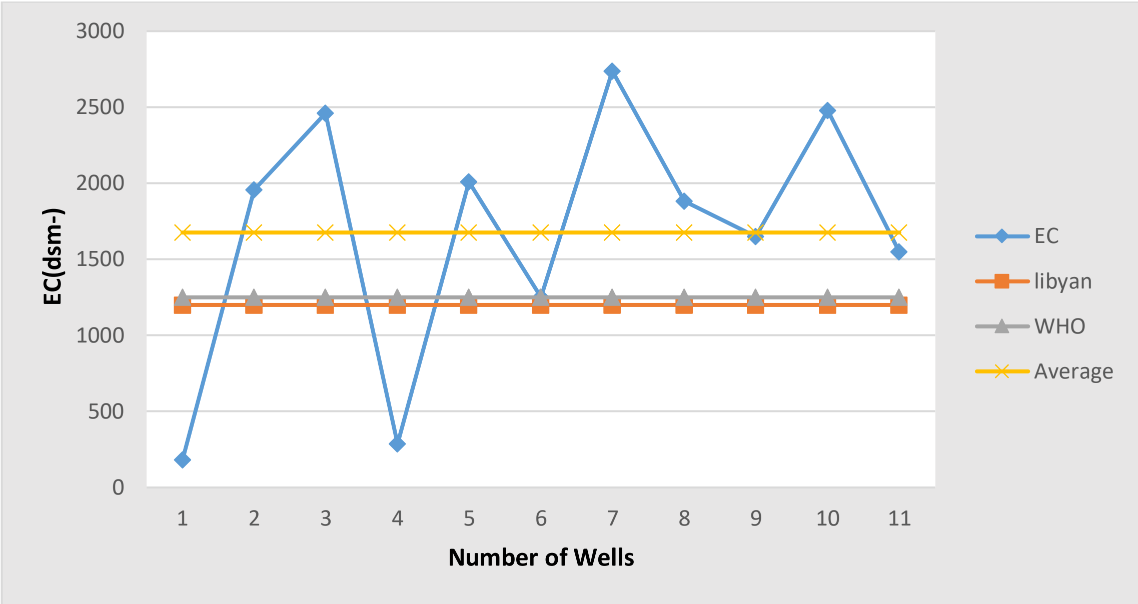

Figure 2: EC value for all water samples**.**

In Figure 2, it is evident that the average EC concentration is 1676 dsm- which falls outside the acceptable range for drinking water as per Libyan and international specifications. The majority of the samples have EC values that exceed the acceptable limits for drinking water.

Total dissolved solids

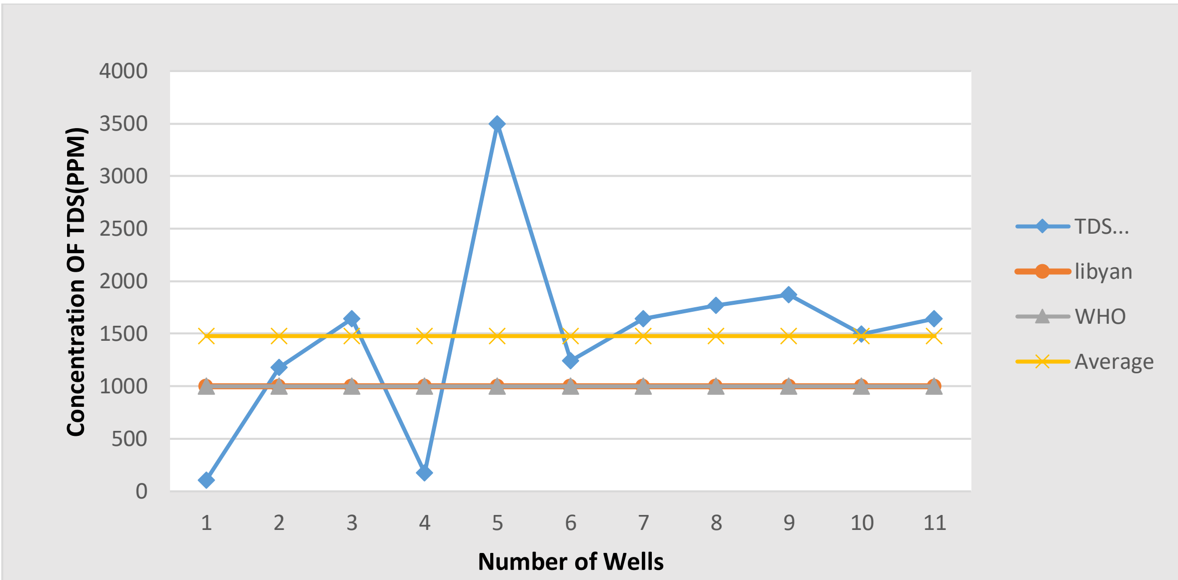

Figure 3: T.D.S concentration for all water samples.

In Figure 3, it is evident that the average TDS concentration is 1477.45 ppm, which exceeds the acceptable range for drinking water according to Libyan and WHO specifications. This concentration level is not suitable for drinking water, indicating a need for further treatment or alternative water sources.

Carbonate Ion:

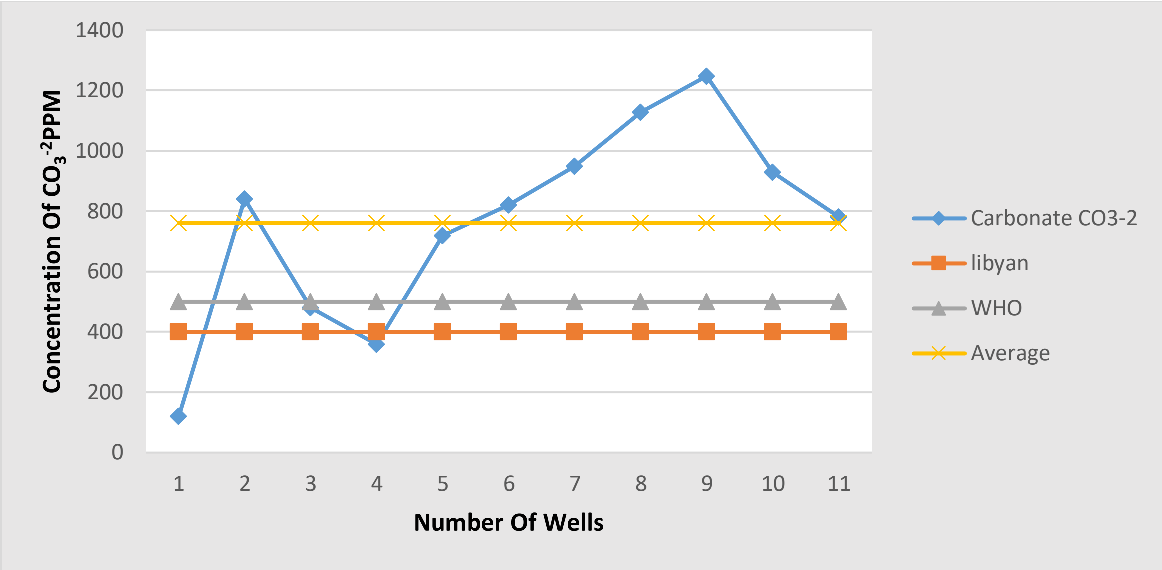

Figure 4: Carbonate concentration for all water samples.

In Figure 4, it is evident that the average carbonate concentration is 761.27 ppm, meeting both Libyan and international standards for drinking water. Additionally, the figure illustrates that 27% of the well water samples have carbonate ion levels within the acceptable range for drinking water specifications.

Chloride Ion:

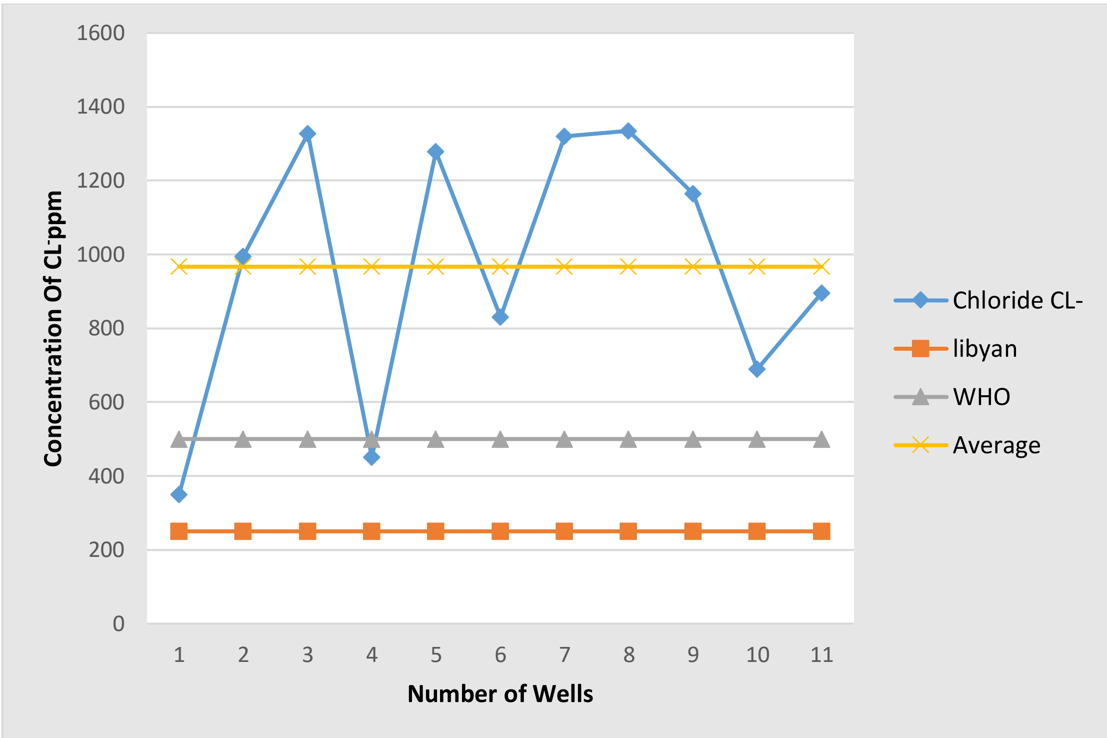

Figure 5: Chloride ion concentration for all water samples.

In Figure 5, it is evident that the average chloride ion concentration is 966.73 ppm, which surpasses the acceptable limit for drinking water as per Libyan and WHO specifications. Additionally, the majority of well water samples exhibit chloride ion concentrations that exceed the permissible range for drinking water standards.

Sulphate Ion:

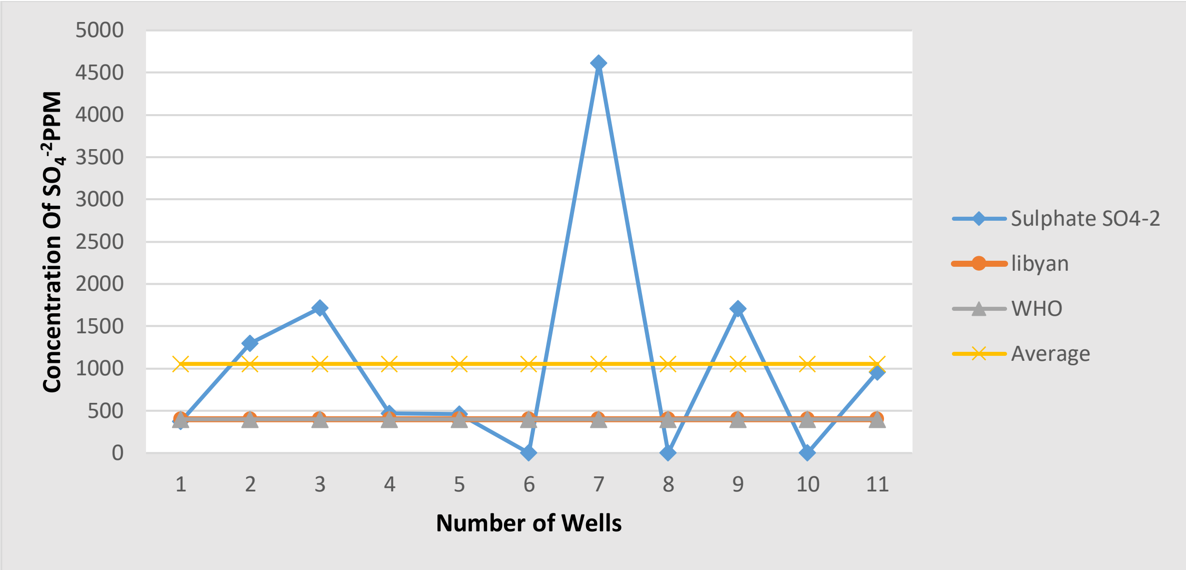

Figure 6: Sulphate ion concentration for all water samples.

The average sulfate concentration in the water from the wells, as illustrated in Figure 6, is 1054 ppm, surpassing the recommended limits set by Libyan and World Health Organization standards. This could potentially be attributed to the leaching of sulfates from rocks as rainwater percolates through the soil and into the groundwater.

Sodium Ion:

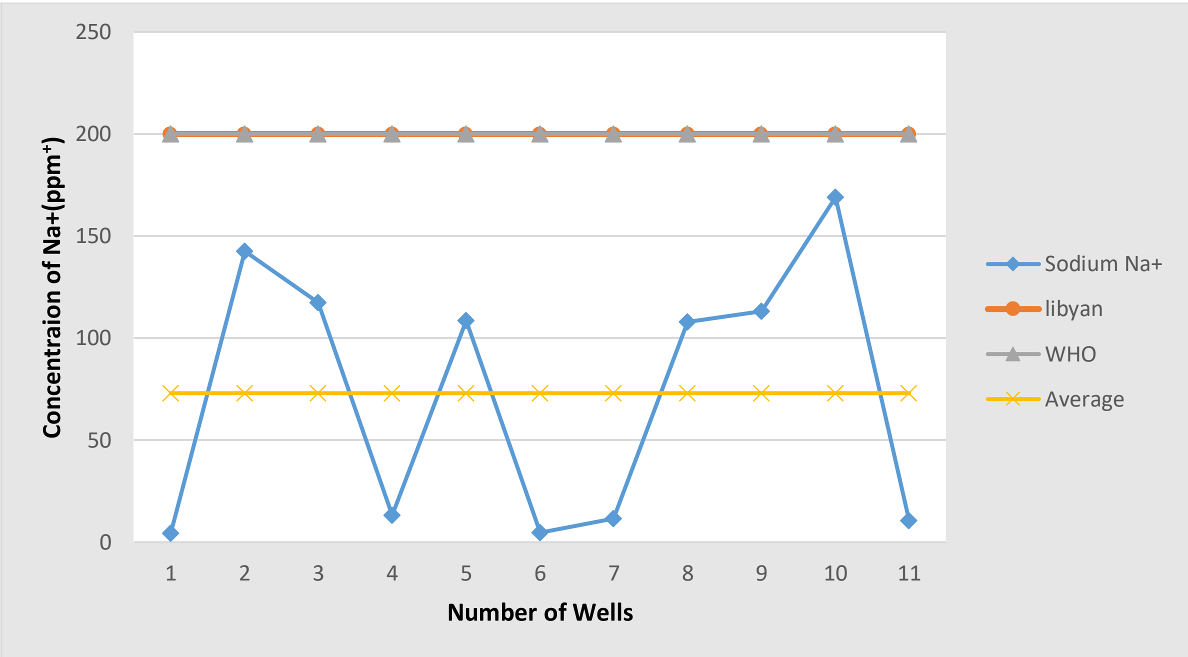

Figure 7: Sodium ion value for all water samples.

The data presented in Figure 7 illustrates the sodium ion concentration in water samples, averaging at 73 ppm. It is worth noting that some of the samples do not surpass the permissible limit set by the specified Libyan and WHO standards.

Potassium Ion:

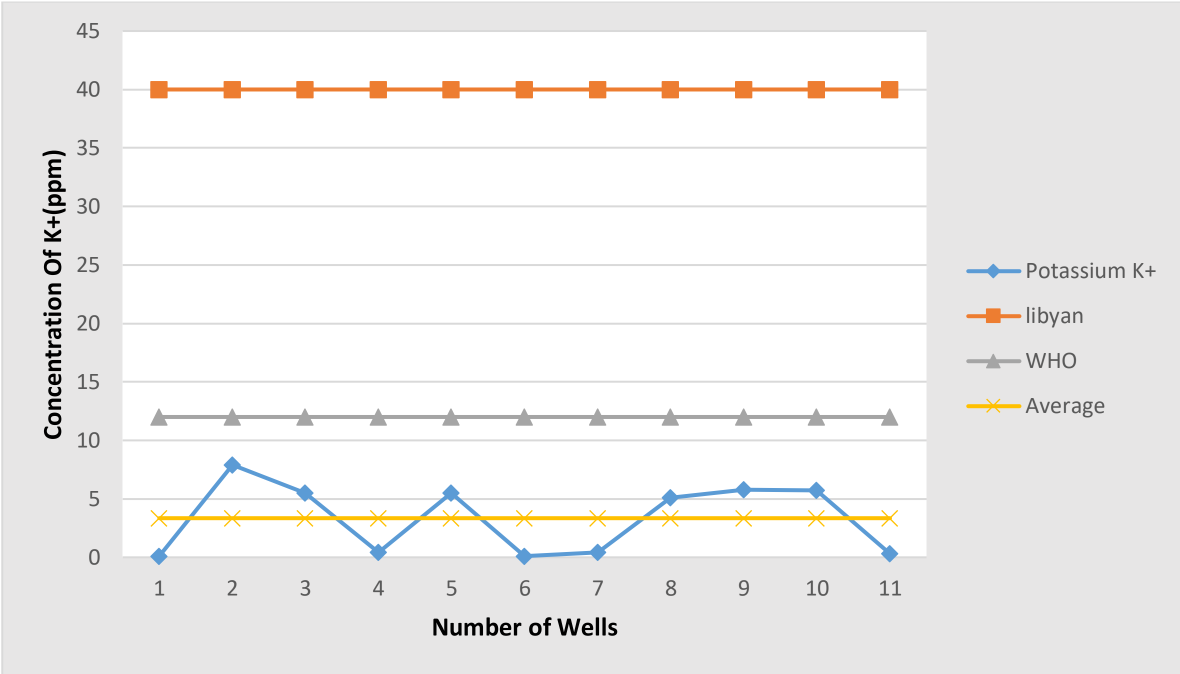

Figure 8: Concentration of potassium ion for all water samples.

The potassium ion concentration for the water samples is illustrated in Figure 8, indicating an average amount of 3.345 ppm. The results demonstrate that none of the samples exceeded the permissible limit as recommended by the specified Libyan and WHO standards.

Conclusion

Based on the sample results, we observed that the average pH levels fell within the acceptable range for drinking water as per Libyan and WHO specifications. However, the average levels of TDS and EC exceeded the permitted range for drinking water. The carbonate ion concentration in most samples surpassed the limits set by Libyan and WHO standards. Additionally, the levels of chloride and sulfate ions exceeded the acceptable range in the majority of samples. On the other hand, the concentrations of sodium and potassium ions in all water samples remained within the permissible limits outlined by both Libyan and WHO standards.

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