The Evaluation of Aluminum Content for Different Water Samples from Some Iraqi Cities

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Abstract

In this study, different samples of water are collected from different provinces including, (Babylon , Maysan , Al kut) which were (river water ,drainage water and drinking water). Water sampling was during the month of February 2014. The chemical properties of these samples have been determined including (pH - Ec-Ca-Mg-K - Na - HCO_3 and CO_3) as well as measured aluminum for each sample and the results were as follows ,it was founded that Ec ranged from(1 .101 - 5.39) ms / cm ,higher value found in Babylon for drainage water and lower value found in Al kut for drinking water . The values of pH are ranged from(7.65 -8.26)) and the values for Na^+ are ranged from (5.26-29.91) meq / L and the values of K^+ are ranged from (0.19-1.53) meq / L and values for Cl ranged from (15 - 31) meq / L and the values for CO_3 ranged from (0 - 0.1) meq / L and the values for HCO_3 ranging from (1.6-7) meq / L and the values for Ca ranging from (3.4-11.8) meq / L and the values for Mg ranging from (4.4-19.4) meq / L and the values for (Al) is very high and ranging from (0.640 to 0.647) ppm**,** and compared the results with standard specification of Iraq.

Key word : Chemical tests of water, Aluminum ratio

الخلاصة

في هذه الدراسة تم استخدام عينات مختلفة من المياه من محافظات مختلفة (بابل , ميسان , الكوت) وكانت عينات المياه هي (ماء النهر , ماء البزل, ماء الإسالة) وقد تم جمع العينات خلال شهر شباط لعام 2014 وتم قياس الخصائص الكيميائية لهذه العينات والتي شملت (pH – Ec– Ca– Mg –K – Na – HCO_3 – CO_3)وكذلك تم قياس عنصر الألمنيوم لكل عينة وكانت النتائج كالتالي وجد إن قيم ل Ec تتراوح مابين ms /cm(5.39 –101. 1) وسجلت أعلى قيمة لعينة مياه البزل في محافظة بابل وأدنى قيمة في عينة مياه الشرب في الكوت , وقيم ل pH تتراوح مابين (8.26– 7.65)) وقيم ل Na تتراوح مابين ml/L (29.91–5.26) وقيم ل k تتراوح مابين ml/L (1.53 –0.19) وقيم ل Cl تتراوح مابين ml/L (31 –15) وقيم ل CO_3 تتراوح مابين ml/L (0.1–0) وقيم ل HCO_3 تتراوح مابين ml/L (7 –1.6) وقيم ل Ca تتراوح مابين ml/L (11.8 –3.4) وقيم ل Mg تتراوح مابين ml/L (19.4 –4.4) وقيم ل Al كانت جدا عالية و تتراوح مابين ppm (0.647–0.640)وتمت مقارنة النتائج مع المواصفة القياسية العراقية للمياه .

الكلمات المفتاحية: الفحوصات الكيميائية للمياه , نسبة الالمنيوم

Introduction

Aluminum residual in drinking water enter the human body through the gastrointestinal tract. Dissolved aluminum in drinking water is classified as highly reactive (due to inorganic complex) to non-reactive (bound to inorganic complexes). Aluminum is more dissolved in the stomach when the pH is extremely low. The absorption in the stomach may be a risk. Chronic exposure to aluminum (toxic form: Al^{3+}, $Al(OH)^{2+}$)is associated with various health problems. Aluminum and its compounds cover about 8% of the Earth's surface. It is the third most abundant element after oxygen and silicon, this compound occurs naturally in cryolite, silicates, and bauxite rock [Krewski *et al.,* 2007]. Aluminum is a non-essential trace element with no known biological function to which humans are frequently exposed [Health Canada 2008]. Aluminum is widespread throughout nature, air, water, plants and consequently in food [Narin *et al.,* 2004]. The physical and chemical characteristics of aluminum make it ideal for a variety of uses in food, drugs,

consumer products, and water treatment processes [Health Canada, 2008]. The toxicity of aluminum depends on the form (total aluminum, total dissolved aluminum, monomer organic aluminum, monomer inorganic aluminum, polymeric aluminum) in which it occurs, while the mechanisms of its action depend on the range of tolerance of an organism to aluminum concentration [Gauthier *et al.,* 2000;Rondeau *et al.,* 2000] studied relation between aluminum concentrations in drinking water and Alzheimer's disease: an 8-year follow-up study and show high concentration of aluminum in drinking water may be a risk factor for Alzheimer's disease. [Al-Obaidi *et al.,* 2009] studied aluminum concentration levels in Tigers' river drinking water treatment plants and supply network in Nineveh Governorate and show result revealed that the Al concentration on the river (through Mosul city) ranged from 7-37 $\mu g/L$.The plants have increased the concentration in raining times to about 25-50 $\mu g/L$(ppb) ,because of adding alum in its work .Water distribution network does not affect the residual Al^3 in these studied and show that Al^3 concentration in drinking water is in the safe side according to several international health organizations if the plants do not add alum . [Martyn *et al.,* 1997] studied Aluminum concentrations in drinking water and the risk of Alzheimer's disease and show the relation of aluminum and silicon in drinking water to risk of Alzheimer's disease. They were studied in eight regions of England and Wales. Exposure to aluminum and silicon in drinking water was estimated from residential histories of 106 men with Alzheimer's disease, 99 men with other dementing illnesses, 226 men with brain cancer, and 441 men with other diseases of the nervous system. All subjects in the study were between 42 and 75 years of age. There was little association between Alzheimer's disease and higher aluminum or lower silicon concentrations in drinking water when cases were compared with any of the control groups. [Mohd *et al.,* 2011] studied Risk assessment of aluminum in drinking water between two residential areas. The result showed that the mean concentration of aluminum in drinking water from Sungai Lembing (SL) was 0.11 ± 0.0634 mg/L and 0.12 ± 0.0462 mg/L for Bukit Ubi (BU), Kuantan, Malaysia. The mean value of Chronic Daily Intake (CDI) in SL (0.0035 ± 0.0028 mg/kg/day) was lower compared to BU (0.0037 ± 0.0021 mg/kg/day). [Joseph Marie Siellechi *et al.,* 2010] studied the effect of water treatment residuals (Aluminum and Iron ions) on human health and drinking water distribution systems and show the aluminum and iron contents in drinking water that can mainly be derived from the water treatment process because these metal ions are commonly used as reactant for coagulation flocculation When the optimum physico-chemical condition of the treatment of raw water is not well established, the probability is the presence of residual coagulants in treated water increases. In most water treatment plants, variation in raw water quality and the quantity make a good monitoring of the optimum conditions necessary the treatment. In spite of these, consumers are exposed to dangerous consumption of residual coagulant in drinking water.

This study aims to evaluate the content of aluminum content in some samples collected from different Iraqi cities.

Material and Methods

Water Samples used in this study were collect from three Iraqi provinces (Babylon, Maysan, Al kut) as shown in Figure (1), seven samples of water were collected in this paper (drainage water ,river water and drinking water) collected three samples of water from Babylon, two samples of water from Maysan and two samples of water from Al kut shown in tables (1, 2 and 3). Water sampling done through

month of February 2014 . The samples were obtained directly from each source and collect in 1 liter Polyethylene bottles and acidified to1% with nitric acid .These samples were subsequently stored at $4C^0$ for as short time as possible before analysis to minimize physicochemical changes . The determination of the major chemical properties of the water samples were performed within one week after the collection of the sample . Conducted the tests chemicals in the laboratory of the College of Agriculture / University of Wasit. Calcium , Magnesium , Chlorine, Carbonat and Bicarbonates were estimated by a manner correction , Sodium and Potassium were measured by device Flame Photometer, estimated electrical conductivity (Ec) and the degree of interaction for sample of water using Ec-meter and pH-meter ,and Aluminum measured by using colorimetric method (device spectrophotometer).

Fig. (1) Map of Iraq show samples locations

Results and Discussion

Through this study , the values of pH ranged between (7.65-8.26) higher value in Babylon for drainage water which are valued at about 8.26 and lower value found in the waters of the Maysan, which are valued at about 7.65,The pH in this study within the allowable limits of water and ranging from (6.5 to 8.5) .Figure (2) shows the pH values of different water samples.

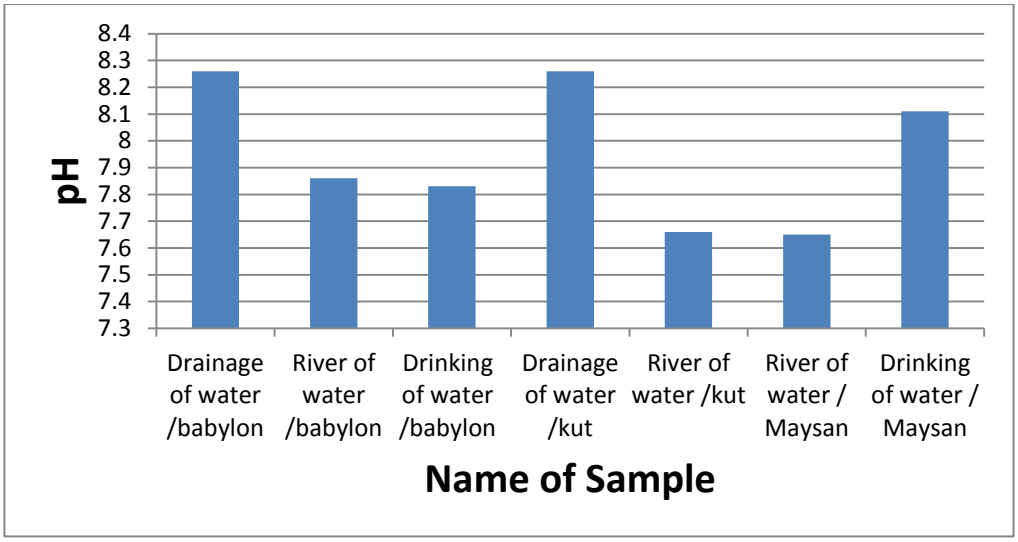

Fig. (2) pH reaction degree for studied water samples

The values of Electrical Conductivity ranged between (1.101 -5.39) ms/cm higher value found in Babylon for drainage water and lower value found in Al kut for drinking water , that mean Euphrates water is more salinity from Tigris water, and allowable limit for Ec (high salinity) ranging between(0.75-2) ms/cm . Figure (3) shows the values of Ec for water samples.

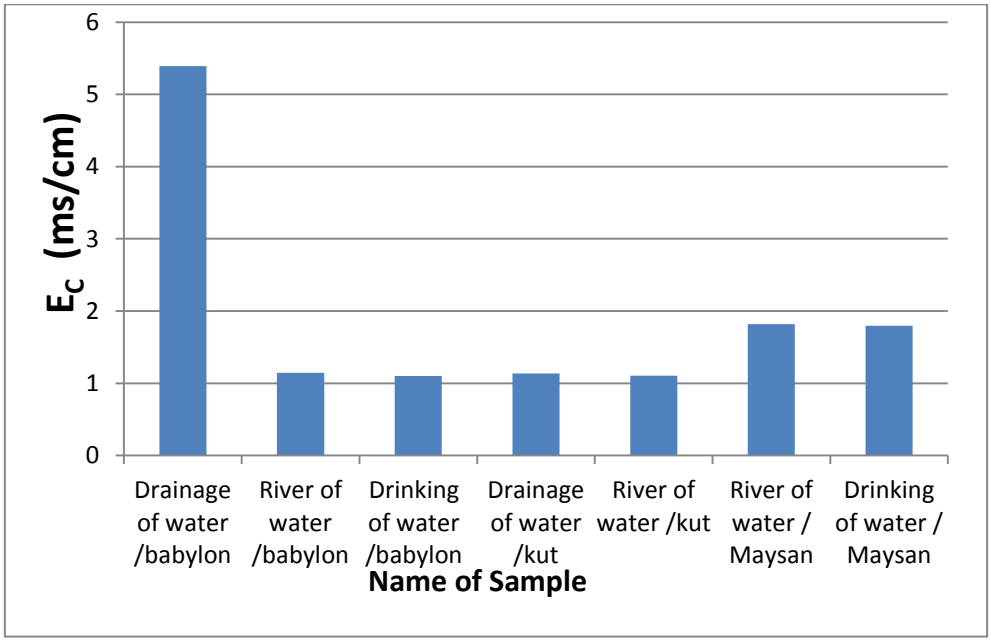

Fig. (3) Electrical conductivity ms/cm for studied water samples

The value of sum Calcium and Magnesium ranged between (8 – 31.2) meq / L is within allowable limit, the maximum allowable limit for calcium is 200mg/L and magnesium is 50mg/L , the highest value of the sum of calcium and magnesium is in the drainage waters of Babylon, which is equal to 31.2 meq / L and the lowest value in the drinking water of Babylon. Figure (4) shows the values of Calcium and Magnesium for water of samples.

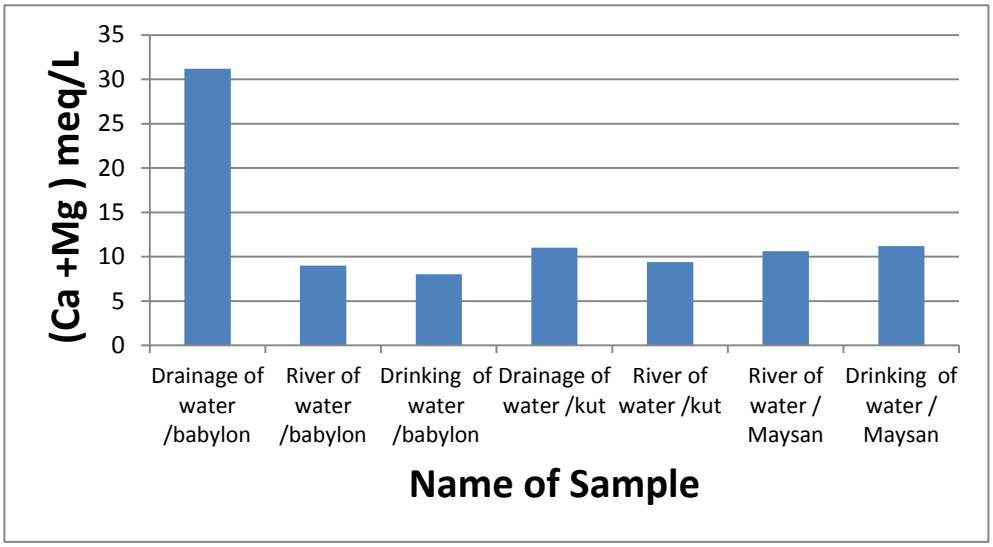

Fig .(4) Calcium and Magnesium levels for studied water samples

The Sodium from the elements is very important to indicate, where is the height of normal values in the water that are dangerous to health as it leads to high blood pressure. In this study values of Sodium for water samples range between (5.26-29.91) meq /L this values within allowable limit that did not exceed 250 mg/L . Figure 5 shows the values of sodium for water samples.

The Potassium is a very important element. In this study , values of Potassium for water samples range between (0.19-1.53) meq /L this values within allowable limit that did not exceed 12 mg/L . Figure (6) shows the values of Potassium for water samples.

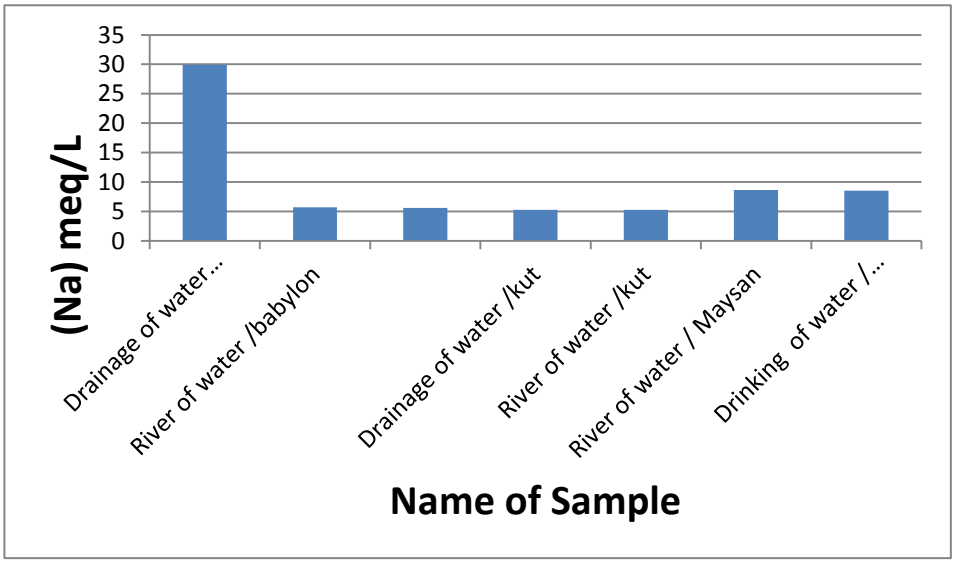

Fig. (5) Sodium levels for studied water samples

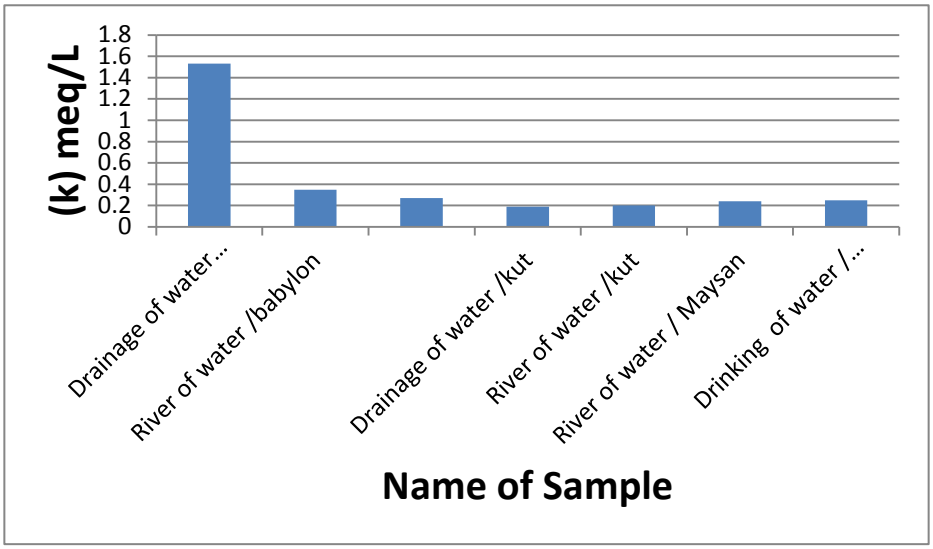

Fig .(6) Potassium levels for studied water samples

Chlorine is very important elements . In this study values of Chlorine for water samples range between (15-31) meq /L this values within allowable limit that did not exceed 200 mg/L . Figure (7) shows the values of chlorine for water samples.

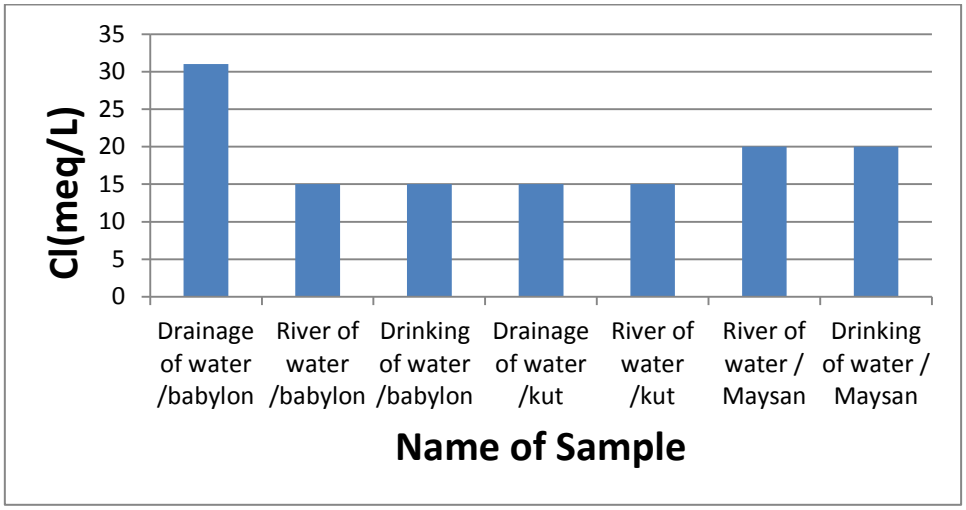

Fig. (7) Chloride levels for studied water samples

Carbonat of water samples are ranging between (0 - 0.1) meq / L that did not exceed allowable limit and values of Bicarbonates of water samples are ranging between (1.6-2.4) meq / L within allowable limit that did not exceed 200 mg/L Figure (8) shows the values of Carbonat for water samples and figure 9 shows Bicarbonates values for water samples.

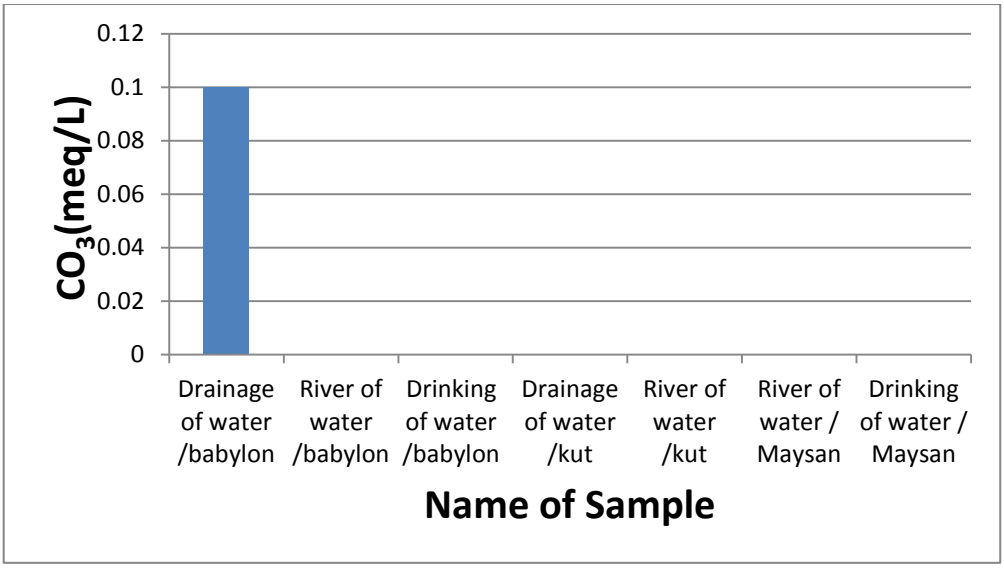

Fig. (8) Carbonate levels for studied water samples

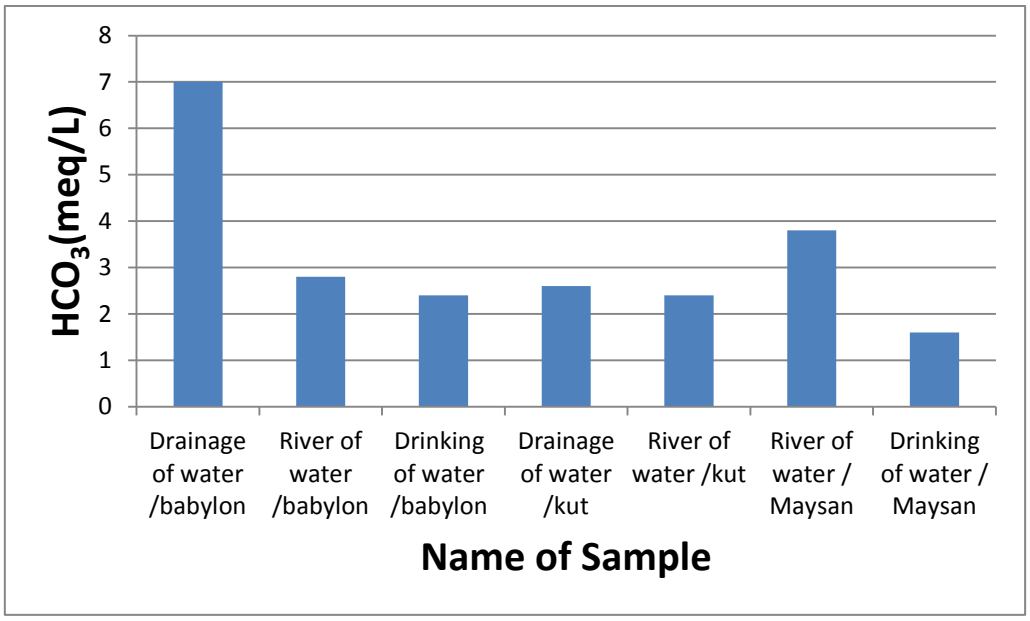

Fig. (9) Bicarbonates levels for studied water samples

The Aluminum(Al) from the elements is very important to indicate where is the height of normal values in the water which are dangerous to health as it leads to Alzheimer's disease [Martyn *et al.*, 1997]. The aluminum element is measured by using Colorimetric method (device Spectrophotometer) (APHA(American Public Health Association) (2005)) . In this study values of Aluminum for water samples range between (0.640-0.647) ppm is very high. Aluminum values in this study exceeds allowable limits which range (0.1- 0.2) ppm . That's means the water contain high ratio of pollution. Figure 10 shows the values of Aluminum for water samples. Tables (1 ,2 and 3) shows the chemical properties of water samples.

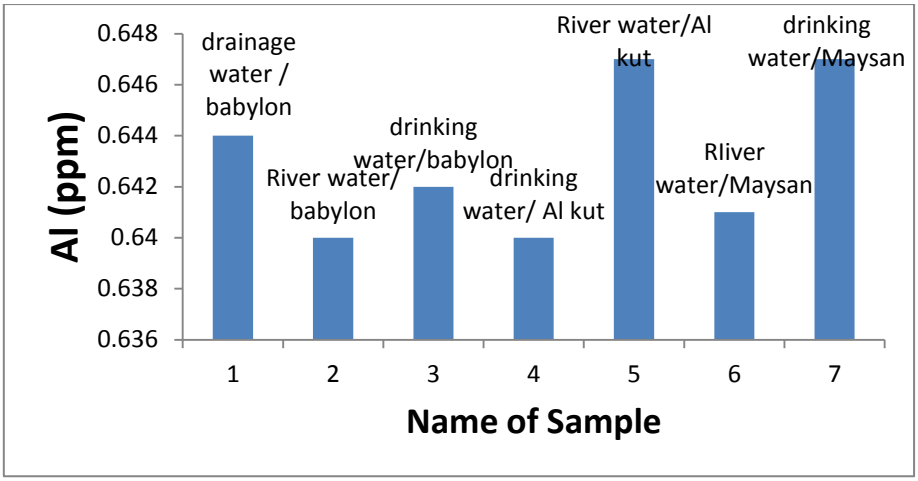

Fig. (10) Aluminum levels for studied water samples

Table (1) Chemical Properties of Studied Water Samples in Babylon

Sample / property	Drainage water	River water	drinking water
E_C(ms/cm)	5.39	1.144	1.101
pH	8.26	7.86	7.83
Na(meq/L)	29.91	5.73	5.59
K(meq/L)	1.53	0.35	0.27
C l(meq/L)	31	15	15
Ca+Mg(meq/L)	31.2	9	8
HCO_3 (meq/L)	7	2.8	2.4
CO_3 (meq/L)	0.1	0	0
Al (PPM)	0.644	0.640	0.642

Table (2) Chemical Properties of Studied Water Samples in AL kut

Sample / property	Drainage water	River water
E_C(ms/cm)	1.137	1.105
pH	8.26	7.66
Na(meq/L)	5.26	5.27
K(meq/L)	0.19	0.20
C l(meq/L)	15	15
Ca+Mg(meq/L)	11	9.4
HCO_3 (meq/L)	2.6	2.4
CO_3 (meq/L)	0	0
Al (PPM)	0.640	0.647

Table (3) Chemical Properties of Studied Water Samples in Maysan

Sample / property	River water	drinking water
E_C(ds/cm)	1.820	1.796
pH	7.65	8.11
Na(meq/L)	8.66	8.53
K(meq/L)	0.24	0.25
C l(meq/L)	20	20
Ca+Mg(meq/L)	10.6	11.2
HCO_3 (meq/L)	3.8	1.6
CO_3 (meq/L)	0	0
Al (PPM)	0.641	0.647

Conclusions

It is concluded that :

1 - The increased electrical conductivity leads to an increase in salt concentration in water.

2- The interaction pH values are ranging between (7.65-8.26)

3 - the Euphrates water are more salinity than the Tigris, consisting from Na and Cl

4- The concentrations of (Na ,Ca ,Mg ,Cl ,K ,CO_3 ,HCO_3) within allowable limits of water and concentrations of (Na ,Ca ,Mg ,Cl ,K ,CO_3 ,HCO_3) in drainage of water Babylon is more than other water .

5-Aluminum ratio in water is very high, between (0.640-0.647)ppm. That's means the water contain ratio of pollution.

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