Ground Water Quality Assessment of Najaf City, Iraq.

Kasim Kadhim Alasedi

Abstract— Groundwater (GW) quality in Najaf city were evaluated by determining Radon (^{222}Rn), Heavy metals (HMs), and physiochemical parameters of twenty-seven different public GW on November 2013. The products showed that wells ^{222}Rn concentrations ranged (317-5010) Bq/m^3 were lesser than 11000 Bq/m^3, a maximum contaminant level (MCL) proposed by United States Environmental Protection Agency (USEPA). hydrogen ion concentration (pH), Electrical conductivity (EC), Total dissolved solids (TDS), Salinity (Sal.),Turbidity (Tur.), Cations (Na^+, K^+) and heavy metals (HMs); Cr, Co, Cu, Zn, Cd, and Pb for the groundwater under study has been examined. The results showed great variations among the analyzed samples with respect to their physical and chemical parameters. However, most values were higher the maximum permissible levels recommended by world health organization (WHO) drinking water standards. The harvests of metallic contents except Cu and Zn were higher the maximum permissible levels recommended by WHO drinking water standards. The quality assessment shows that in general, the GW in the study area is not entirely for direct drinking according to physiochemical properties and HMs concentrations, the water in the studied wells can be used for irrigational purposes.

Index Terms— Radon-222, Heavy metals (HMs), Physiochemical parameters, EPA, WHO, Groundwater, Najaf city.

1 Introduction

WATER quality is affected by natural processes and human activities. It is often thought that the chemical composition is the only factor involved. However, other conditions such as biological, physical, and radiological factors should be considered when mentioning water quality [1, 2].

Radon (^{222}Rn) is a naturally occurring radioactive, odorless, and noble gas that is soluble in water produced by the decay of radium-226 (^{226}Ra) within the natural decay chain of uranium-238 (^{238} U). Radon which shows a half life of 3.8 days, emanates from the surface of mineral grains by recoil and enters the water filled pore space of sediments and aquifers In recent years a lot of data about radon concentration in water has been collected for uranium prospecting, earthquake prediction, and groundwater exploration [3, 4]. Heavy metals (HMs) are elements having atomic weights (63.54-200.59) and a specific gravity greater than 4.0 i.e. at least 5 times that the water. They exist in water of colloidal, particulate, and dissolved phases [5]. Among the wide variety of contaminants affecting water supplies, heavy metals deserve specific attention regarding their high toxicity even at law concentrations [6]. Water quality is a major emerging concern throughout the world. Drinking water sources are threatened from contamination with far-reaching consequences for the health of children, economic, and development of communities.

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Groundwater is emerging as an essential and vital component of the life in Najaf city, support system today, the groundwater resources are being utilized for drinking, irrigation, and industrial purposes.

2 METHODOLOGY

2.1 Study area

The Najaf area is located on the edge of western plateau of lower Mesopotamian at 50 km south of the ancient city of Babylon and 160 km southwest of Baghdad the capital of Iraq. Najaf lands is flat and leveled linked to Euphrates river water, it is higher in the southern portions of the desert areas, extending to the Kingdom of Saudi Arabia. Twenty-seven well water samples were collected in November 2013. As it is indicated in Figure (1).

2.2 Sample Analyses

RAD-7 (Durridge company, USA) H_2O with a 250mL glass sample bottle specially designed for ^{222}Rn measurement then slowly immersed into the bucket Figure2. Three water samples (A, B and C) were collected from each well (S_1-S_{27}) for the ^{222}Rn analysis. For determining heavy metal concentrations, 50mL water were acidified with approximately 0.5ml of concentrated HNO_3 (BDH) and passed through acid washed folded filters, the filtrate was stored in acid washed polypropylene tubes until it was measured. Cr, Co, Cu, Zn, Cd and Pb in samples were detected by AA 6300 Flame Atomic Absorption Spectrophotometer, Shimadzu, Japan. Sampling and analytical techniques followed the suggestions by [7-9].

The Hydrogen Ion Concentration (pH), Electrical Conductivity (EC), Total Dissolved Solids (TDS), Salinity (Sal), and Turbidity(Tur) of water samples were measured.

pH, EC, and TDS of water samples for chemical analysis were filtered then refrigerated at 4 ^{0}C before chemical analysis by

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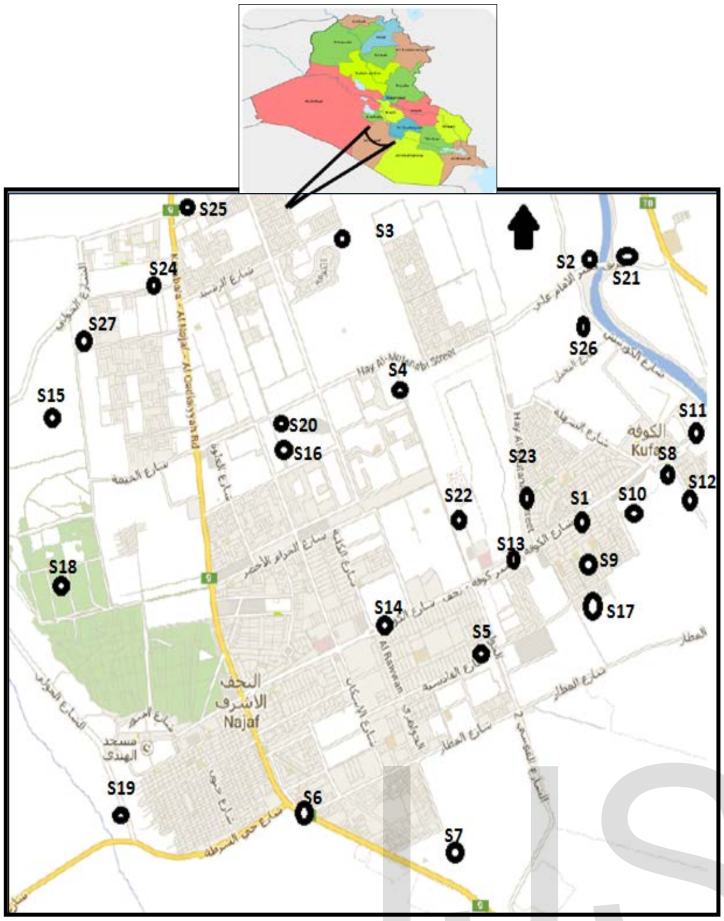

Fig. (1): Location of wells in Najaf city

multimeter type Crison MM40, Spain. Sampling and analytical techniques followed the recommendations by [10, 11]. Salinity (Sal) was determined according to the procedure [10] measured by WTW, Germany. Turbidity (Tur) measured by turbicheck, Loribond, Germany. Sodium ion (Na^+) and Potassium ion (K^+) were determined [12] by flam photometer type 378 Elico, England.

Fig. (2): Rad-7 H2O assembly with a 250 ml water sample

3 RESULT AND DISCUSSION

3.1 Radon- 222

Radon concentration was measured in 27 samples of wells collected all over the central core of Najaf city, radon concentrations in the groundwater varied from 569Bq/m^3 to 5010Bq/m^3 within average mean value 1838Bq/m^3 while lowest was found in groundwater number 18 as shown in figure(3). Higher concentrations were found in some parts south of the city which might be due to change of geological regime or exposure of younger granitic rocks associated with high abstraction of wells. The overall concentrations of radon in well waters are found to be far below the permissible limits.

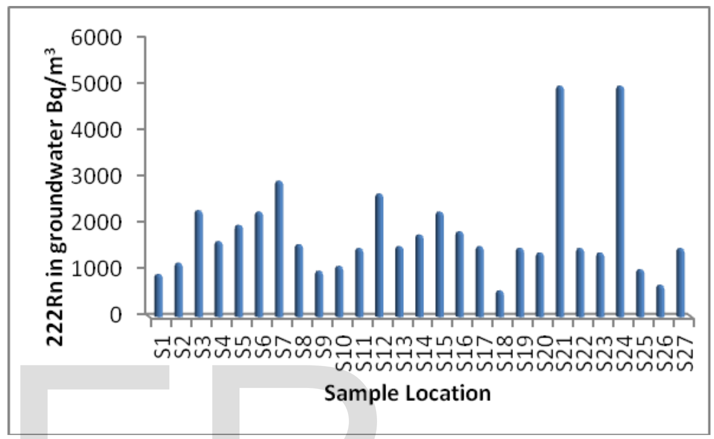

Figure (3): 222Rn concentrations in water samples

3.2 Physicochemical parameters

pH is one of the most important operational water quality parameters. Substantial variations were recorded in the pH level; always the average values of pH in all sites were between 6.91 to 7.60 within permissible limit. Electrical conductivity (EC) and total dissolved solids (TDS) are a measurement of water's capacity for carrying electrical current and it is related to the concentrations of ionized substance in the water. not citations The levels affected by EC of water are a direct function of TDS, from the results it was evident that the highest value of 9330 µs/cm is obtained at S17 where as the lowest value of 3230 µs/cm is obtained at S3. Samples analyzed for TDS are showing values range 3200 to 6370ppm, as compared with the standard value which is 800ppm. The sampling location number is having higher TDS values in collected ground water samples. The fluctuations in EC correlated positively with the TDS which are indicators of polluted water. Suspended matter of turbidity often includes mud, clay and slit. Turbidity values ranged from 0.27NTU to 10.8NTU. The maximum permissible levels for turbidity from 0-10NTU [13]. The excessive turbidity in water causes problems with water purification process such as flocculation and filtration, elevated turbid water is often associated with the possible of microbiological contamination as high turbidity makes it difficult to disinfect water properly [14] Salinity is a major water quality limitation on the environmental values (including potential beneficial uses) of groundwater. It is influenced by human action such as irrigation, disposal of waste waters, seawater

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intrusion in response to excessive extraction from coastal aquifers, and the like. Excessive salinity in all groundwater may limit their use and therefore the productivity of lands reliant on bore water irrigation. Lower salinity levels were registered from 0.7ppt to 9.3ppt. These values were low compared with WHO guidelines values of 3-10ppt. Mean concentrations of sodium and potassium from the GW samples were 867 and 11.1ppm, respectively. Sodium is more mobile in soil than potassium and so it is used often as an indicator of human impacts to shallow GW. Sodium is also a common chemical in minerals. Like potassium, sodium is gradually released from rocks.

Table (1): Status of physiochemical parameters and heavy metals in ground water samples.

*Ref. [13]

Parameters	Mean	Max.	Min.	WHO*
PH	7.22	7.60	6.91	6.5-8..5
EC (µs/cm)	5090	9330	3230	800
TDS (ppm)	3200	6370	2090	500
Salinity (ppt)	2.9	9.3	0.7	3-10
Turbidity (NTU)	2.15	10.8	0.27	5
Na^+ (ppm)	867	1630	114	20
K^+ (ppm)	11.1	21.8	1.7	10
Cr (ppm)	0.1381	0.3980	ND	0.05
Co (ppm)	0.0202	0.1873	ND	<0.001-0.002
Cu (ppm)	0.0240	0.1042	ND	2
Zn (ppm)	0.0759	0.3834	ND	3
Cd (ppm)	0.0214	0.0535	ND	0.003-0.005
Pb (ppm)	0.0890	0.0430	0.0033	0.01

3.3 Heavy metals

The results of various heavy metals (HMs) analysis in groundwater samples (GWS) are listed in figure (4). During present investigation, chromium (Cr) ranged from ND to 0.398ppm in GWS. Most of GWS collected from the study area contained Cr above permissible limit 0.05ppm recommended by WHO for drinking water. Cobalt (Co) usually occurs in association with other metals such as copper, nickel, manganese and arsenic. Small amounts are found in most rocks, soil, and surface and under GW, plants and animals. Cd concentrations ranged between ND to 0.1873ppm above permissible limits <0.001-0.002ppm recommended by WHO for drinking water. The concentration of Cu varied from the range of ND to o.1042ppm. GWS contained copper within permissible limits, 2ppm prescribed by WHO. The concentration of zinc (Zn) ranged between ND to 0.3834ppm, and found within permissible limit 3ppm recommended by WHO for drinking water. Cadmium (Cd) metal was found in the range of ND to 0.0535ppm. The high concentration of Cd in some water samples of the study area may be attributed to the runoff from the agricultural fields where pesticides as well as cadmium containing phosphates fertilizer have been used. GWS collected from the study area contained lead (Pb) ranged from 0.0033 to 0.0430ppm above permissible limit 0.01ppm recommended by WHO for drinking water. The possible source of Pb are combustion of gasoline, uses of lead arsenate as pesticide as well as its uses in lead pipe, paints, pigments and lead storage batteries [15].

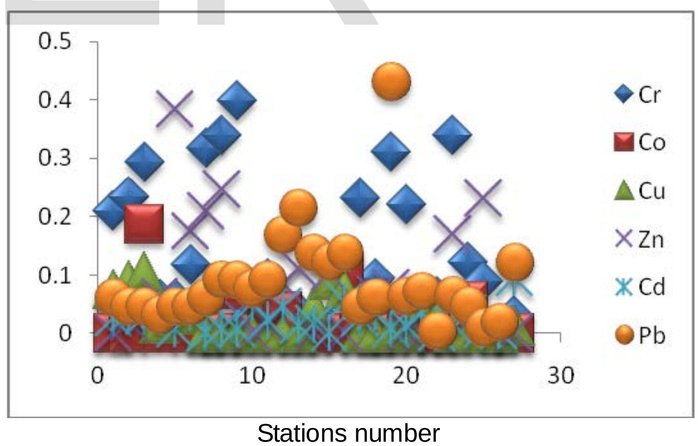

Figure (4): Concentrations of heavy metals in ground watesamples.

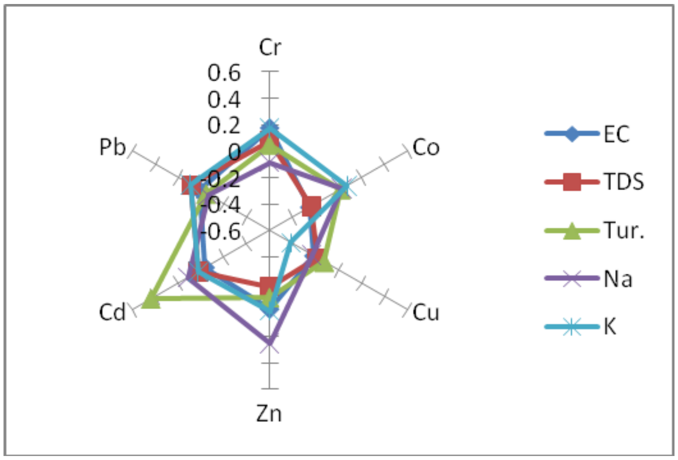

Figure (5): Correlation of heavy metals and some physiochemical parameters.

4 CONCLUSIONS

The water quality of GWS had three objectives: (1) all results of radon concentrations were less than the allowed maximum values. (2) Physiochemical properties more than WHO guideline values, these refer to inefficiency for drinking water. (3) Concentration of some toxic HMs such as Cr, Co, Cd and Pb were higher the maximum permissible levels recommended by world health organization (WHO) drinking water standards.

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REFERENCES

[1] V.J. Warren, J.H. Mark, M.P. Elizabeth, and A.C. Paul, "Water Supply and Pollution Control" 8th ed. by Pearson Education In. 2009.

[2] S.C. Bhatia, "Environmental Chemistry" by Statih Kumar Jain, 1st. ed., pp.1-28, 2002.

[3] S. Axel, S. Michael and M. Martin, l. *Applied Radiation and Isotopes*, vol. 66, pp.1939-1944, 2008.

[4] L.C. Gunderson, R.R. Schumann, J.K.Otton, R.F. Dubiel, D.E. Owen and K.A.Dickinson, "Geology of Radon in the United States". In: Gates A.E., Gunderson L.C., Eds. Geologic Controls on Radon Special Paper, *Geological Society of America*, Boulder, Colorado, USA, vol. 271, pp.1-16, 1992.

[5] A.A. Adepoju-Bello, O.O. Ojomolade, G.A. Ayoola and H.A. Coker, Nig.J.Pharm.vol.42, no.1, pp.57-60, 2009.

[6] J.E.Marcovecchio, S.E. Botte, and R.H.Freije, "Handbook of water analysis" 2nd ed. by CRC press, London, pp.275-311, 2007.

[7] G.E.Batley, and D.Gardner, "Sampling and Storage of Natural Water for Trace Metal Analysis", *Water Research*, vol.11, pp.745, 1977.

[8] K.S. Subramanian, C.L. Chakrabarti, L.E. Suetias, and I.S. Maines, "Preservation of Some Traces Metals in Samples of Natural Water", *Anal. Chem.*, vol.50, pp.444, 1978.

[9] S. Berman and P.Yeats, "Sampling of Seawater for Trace Metals", *Crit. Rev. Anal. Chem.*, Vol.16, pp.1, 1985.

[10] American Public Health Association (APHA), American Water Works Association and Water Environment Federation. "Standard Methods for the Examination Water and Wastewater", 20th ed. American Public Health Association, Washington, USA, 1998.

[11] L. Chi-Man and J.J. Jiu, *Water Research*, vol.40, pp.753-767, 2006.

[12] A. Genecollins, *Geochemistry of Oil Field Water*. Elsevier Scientific Publishing Company, pp.57, 1975.

[13] World health organization (WHO), "Guidelines for drinking water quality", Geneva, 3 rd ed., vol.1, 2008.

[14] V. Jayalakshmi, N. Lakshmi and M.A.Singara Charya, *International Journal of Research in Pharmaceutical and Biomedical Sciences*, vol.3, no.2, pp.1041-1046, 2011.

[15] A.Bhavana, V.Shrivastava, C.R.Tiwari and P.Jaip, *Res.J.ofChem and Env.*, vol.13, no.4, pp.23-27. 2009.