Chemical Analyses for Lead and Cadmium in potable Groundwater Sources in Al-Marj City, Libya.

[*]Boshra Al-Barghathi, [**]AbdelkareemElgazali [*]Youssef F Lawgali
[*]Sami .H.Almabrok

Abstract: The main aim of this study is to investigate the suitability of the groundwater in Al-Marj city for human consumption, by estimating the concentration of Lead (Pb^{2+}), Cadmium (Cd^{2+}), and some other heavy metals. The average concentrations of both metal ions in the samples were0.037 and 0.004 mg/l respectively, which considered higher than the Libyan standard.These findings indicatedthat the groundwater used in the present study is not suitable for drinking, domestic, and irrigation purpose. Because of its potential effect on human health and cause a serious diseases such as cholera, diarrhea and cancer.

Key words: Heavy metals, Libya ,Drinking water.

Introduction

For all living creatures including the human being, water is considered as one of their basic needs.,Therefore, water is one of the most important and valuable substances on the earth [1,2]. Recently, there has been a great increase in the demand for safe drinking water. Although water plays an important role of the life due to its essential for human survival, many are denied access to sufficient potable drinking water supply and sufficient water to maintain basic hygiene [3]. However, around 71% of the earth's surface is covered by water [4].The freshest water is available as groundwater in aquifers. Several water resources suchoceans, ice caps, glaciers, groundwater, and lakes and rivers contained 98.93%, 1.05%, 0.009% and 0.0001%, respectively [5]. This underground fresh water has been considered as one of purest forms of available in nature to meet the overall demand of household, industrial, recreational, agricultural and environmental activities [6-8].

Around the world, 1.5 million people mostly are children, die annually from diarrheal diseases in regard to water-related disease [10,13,14]. However, approximately 1.1 billion people in world are rely on unsafe drinking water sources from lakes, rivers and openwells [9,11].About 22 African countries, which including Malawi, are failed to provide safe and clean drinking water to 50% of their population [12].This is caused by the drinking and using of water contaminated by faucalmatter. In addition, by inadequate sanitation [3,10].

[*] University of Benghazi

[**] University of Benghazi, Faculty of Arts and Sciences ,Department of Chemistry Tokara&
The Environmental and Biological Chemical Research Center - Tokara – University of Benghazi

[*] University of Benghazi & The Environmental and Biological Chemical Research Center - Tokara – University of Benghazi Author :yogaly6@yahoo.com

[*] University of Benghazi

Methodology

Study Area

The study area was in Al-Marj region, which located at Al-JabalAl-Akhder in the eastern north part of Libya, at 32.50 ^{0}N –20.82 ^{0}E; and according to Libyan general population census of 2006 the city population is about 184,531 person [15].

In the study area, groundwater is the main source of water supply for all water uses, therefore, this excessive demand became too much load on the groundwater of this area, and the pure water that come from Botrabah desalination plant is not enough for Al-Marj city, and its surrounding area.. Therefore, the quantity and quality of this source of groundwater might be changed without a propel control or protection.

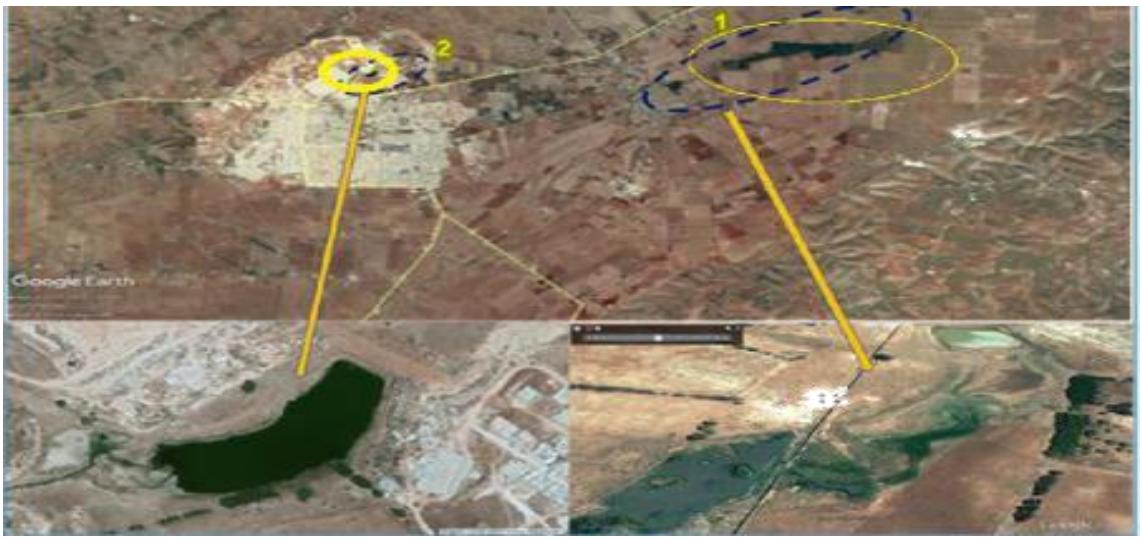

Figure (1): The huge areas of municipal sewage in the study area. (1) Is the main contamination source, and No (2) is the secondary contamination source.

It can be seen from Fig (1)and (2)that the huge area of municipal sewage discharge in two side-lakes as random damping sites in Al-Marj city. These lakes are the main contamination sources in the Eastern sector of this city, and the secondary contamination source in the western sector of this city.

Groundwater sampling

- Samples of groundwater from the study area wereselected to represent the condition of groundwater quality, and ground surface contaminants, especially, to municipal sewage effluent. All sampling wells are boreholes with electrical pumps, and the samples were collected twice(Fig.2) fromnine sites. Thefirst collection was collected at dry season (fall 2017), and second collection (nine samples) were collected from the same wells to assessing the wet season at summer 2018. All samples were collected in clean and autoclaved glass bottles and transferred to the lab in less than 24 hours of sampling.

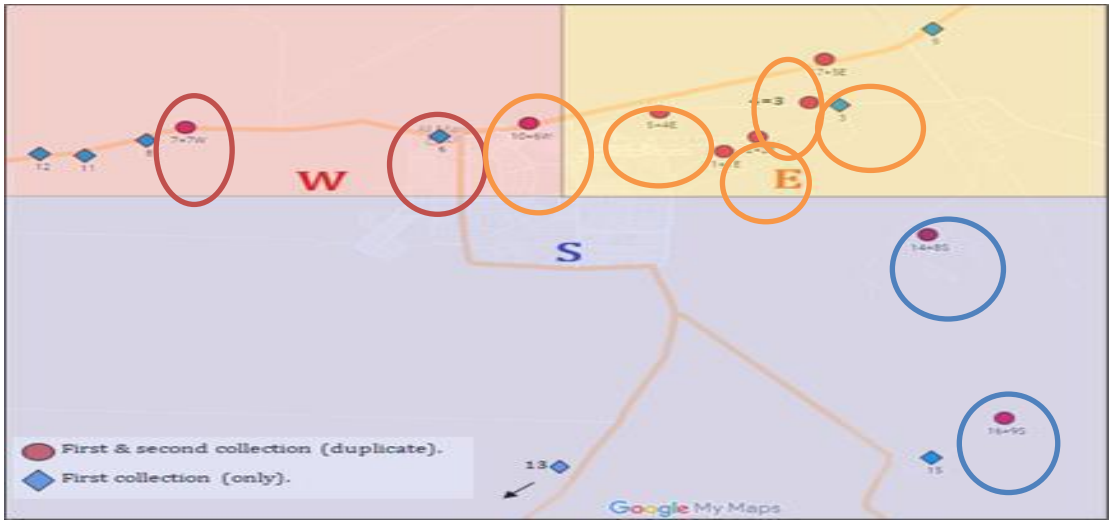

Figure (2) :Groundwater sampling locations of the study area.The studied area was divided into three sectors: Eastern(E), Western(W)and Southern(S).

Table(1) :Numbers of sampling sites of collections at the dry and wet seasons.

First collection(dry) Sample .no	1	2	4	5	17	10	7	14	16
Location of the samples collections	1E*	2E	3E	4E	5E	6W*	7W	8S	9S*
Second collection(wet) Sample .no	1	2	4	5	17	10	7	14	16

*Eastern(*E), Western(*W)and Southern(*S).

Analytical Methods

For chemicals analyses, all groundwater samples were collected in a cleaned and autoclaved glass bottles, stored in cold box, and then transported to the laboratory of Environmental and Biological Chemistry Research Center (EBCRC). However, the quality of groundwater wells is determined through some chemical analyses of lead and cadmium metal ions using atomic absorption spectrophotometry (AAS).

Results and Discussions

Results of collection for the selected groundwater samples from the study area are shown in Table(2).Result showed that Cd^{2+} is still within the recommended values by Libyan standards and WHO guidelines. Cadmium (Cd^{2+}) concentration in groundwater samples number: 2, 4 & 17 in the East (E) direction of the study area, were recorded equal to 0.006, 0.015 and 0.029 mg/l respectively.

Table(2):Cadmium and Lead concentrations(Milligrams per liter)in the groundwater samples. Results were compared with Libyan standards.

Samples Numbers	**1**	**2**	**4**	**5**	**7**	**10**	**14**	**16**	**17**	**Standers**	
Samples. Directions	**(1E)**	**(2E)**	**(3E)**	**(4E)**	**(7W)**	**(6W)**	**(8S)**	**(3E)**	**(5E)**	**Libyan Stander**	**WHO Stander**
Cadmium (mg/L)	0.001	0.006	0.015	0.001	0.016	0.001	0.001	0.001	0.03	**0.003**	**0.003**
Lead (mg/L)	**0.006**	**0.081**	**0.069**	**0.09**	**0.056**	**0.073**	**0.037**	**0.137**	**0.19**	**0.01**	**0.01**

In addition, lead (Pb^{2+}) concentration in groundwater were ranged between 0.006 to 0.187 mg/l, which were exceeded the recommended value by Libyan standard, except sample (no. 1) in East direction of the study area, was under the Libyan standard limits.

However, in the study area, the sewage and municipal water are discharged to the environment without any treatment.This maycontains some harmful chemicals as result of sewage leaching from municipal sewage discharging without treatment or protection to the groundwater, causinga microbiological contamination of the groundwater. Therefore, presenting a significant health risk when this groundwater exploited.The outcome from this study indicates that the groundwater in this area is contaminated with municipal wastewater discharging on the ground surface.

التحليل الكيميائية للرصاص والكادميوم في مصادر المياه الجوفية الصالحة للشرب في مدينة المرج ، ليبيا

المستخلص: تتمثل الأهداف الرئيسية لهذه الدراسة في تقييم الصفات الكيميائية للرصاص والكادميوم للمياه الجوفية في مدينة المرج لأغراض الشرب والاستخدامات المنزلية والري، وكذلك تحديد مستويات بعض المعادن الثقيلة الملوثة مثل عنصر الكادميوم و الرصاص. قّسمت منطقة الدارسة إلى ثلاثة أقسام (مناطق) كالآتي: القسم الشرقي والقسم الغربي و القسم الجنوبي وذلك لتقدير مدى تأثُّر جودة المياه الجوفَّية في هذه الأقسام(المناطق) بتصريف مياه الصرف الصحي للمدينة على سطح الأرض بدون معالجة أو وقاية للموارد المائية في المدينة، وكذلك مدى تأثُّر جودة المياه الجوفَّية بالنشاطات الزراعية في المنطقة مثل الأسمدة و المبيدات، حيث يشمل القسم الشرقي من المدينة (المرج القديم) المصدر الرئيسي للتلُّوث وهو المسبب الرئيسي في وصول مياه الصرف الصحي في المدينة إلى المصادر الجوفيَّة لمياه الشرب، حيث يتم صرف مياه المجاري للمدينة على سطح الأرض بدون معالجة.

إجراء أي معالجة أو حماية للبيئة" في هذه الدراسة تم جمَعت العينات مرتين خلال العام (الشتاء و الصيف)، وُحّللت لقياس جودة المياه الجوفَّية باستخدام طرق التحاليل المعمليَّة المعتمدة والتي تشمل التحاليل الكيميائية."

تم تحديد مستويات العناصر الثقيلة مثل عنصر(الرصاص والكادميوم) في المياه الجوفية في المدينة والمنطقة المحيطة بها في فصلي الرطب والجاف تم قورنت النتائج بالمواصفات الليبية القياسية ومنظمة الصحة العالمية لمياه الشرب، تم حساب متوسط النتائج المعمليَّة للعناصر الكيمائية الملوثة (الرصاص والكادميوم) حيث وجد أن متوسط نتائج تركيز عنصر الكادميوم (0.037 مجم / لتر) اعلي من معيار الليبي كما كان أيضاً متوسط عنصر الرصاص اعلي من معيار الليبي (0.004 مجم / لتر)و من خلال النتائج نستنتج من هذه الدارسة لقياس جودة المياه الجوفيَّة الكيميائية أَّن المياه الجوفَّية لمنطقة الدارسة غيُر صالحة لاستخدامها للشرب والأغراض المنزلية والرّي، التي تهدد صحة الإنسان بأمراض خطيرة مثل الكوليرا والإسهال والسرطان لذلك فإن شرب الماء قد يشكل خطرا على الصحة حتى لو كان يحتوي على القليل من الملوثات الكيماوية مثل الرصاص والكادميوم.

References:

[1] WHO/UNICEF, "Progress on sanitation and drinking-water - 2014 update," World Health Organization and UNICEF, Geneva, Switzerland, 2014.p. 23.

[2] WHO, Guidelines for Drinking-water Quality, (NLM classification: WA 675) ed., vol. FOURTH EDITION, Geneva: World Health Organization WHO, 2011, p. 541.

[3] WHO, World health statistics 2011, ISBN 978 92 4 156419 9 (NLM classification: WA 900.1) ed.,Geneva: World Health Organization WHO, 2011, p. 170.

[4] B.Nirmala, B.V.Suresh Kumar , P.A.Suchetan and M.ShetPrakash, "Seasonal Variations of PhysicoChemical Characteristics of Ground Water Samples of Mysore City, Karnataka, India," International Research Journal of Environment Sciences, no. Int. Res. J. Environment Sci- Vol. 1(4), 43-49,November, pp. 43-49, 13 July 2012.

[5] R. M. Harrison, in Principles of Environmental Chemistry, Ed. R. M. Harrison, RSC Publ., Cambridge, UK, 2007, pp. 314–346. 5. J. S. Thayer, Environmental Chemistry of the Heavy Elements, VCH, New York, 1995, (a) pp. 75–94

.[6] S.C.Izah and E.R.Ineyougha, "A review of the microbial quality of portable water sources in Nigeria,"Journal of Advances in Biological and Basic Research, no. 01[01]2015, pp. 12-19, 1 2015.

[7] R. S.Devi, "Physicochemical Analysis of Groundwater samples near Industrial Area, CuddaloreDistrict,Tamilnadu, India," International Journal of ChemTech Research, Vols. Vol.4, No.1 , Jan-Mar 2012, no.ISSN : 0974-4290 , CODEN (USA): IJCRGG, pp. 29-34, 2012.

[8] R.D.Pratima and M. Augur, "Correlation of Physico-Chemical Analysis of ground water ofManendragarh area (Hasdeo basin), Chhattisgarh, India," International Journal on Recent andInnovationTends in Computing and Communication, vol. 2, pp. 3074-3076, October 2014.

[9] A R Lawrence, A G Howard, K M Ahmed and M Nalubega, "ARGOSS Guidelines for Assessing the Riskto Groundwater from On-Site Sanitation," BRITISH GEOLOGICAL SURVEY BGS - NaturalEnvironment Research Council NERC, London, 2001.

[10] UNICEF, UNICEF Handbook on Water Quality, New York, NY: United Nations Children's Fund(UNICEF), 3 United Nations Plaza, 2008.

[11] N. M.Mgbemena and F. U.Okwunodulu, "Physicochemical and microbiological assessment of boreholewaters in Umudike, Ikwuano L.G.A., Abia State, Nigeria," Pelagia Research Library, Advances in Applied Science Research, no. ISSN: 0976-8610, pp. 210-214, 2015.

[12] T.Kanyerere, J.Levy, Y.Xu and J.Saka, "Assessment of microbial contamination of groundwater in upperLimphasa River catchment, located in a rural area of northern Malawi," African journal online, vol. 38,no. 4, pp. 581-595, July 2012.

[13]The Impact of Water, Sanitation and Hygiene on Key Health and Social Outcomes: Review of Evidence, Consortium London School of Hygiene & Tropical Medicine, New York, NY, USA, JUNE 2016,P 35.

[14] WHO, "Preventing disease through healthy environments. Towards an estimate of the environmental burden of disease," © World Health Organization 2006, Geneva, Switzerland, 2006

[15] اللجنة الشعبية العامة، :الهيئة العامة للمعلومات ،ليبيا ،مسيحي 2006النتائج النهائية للتعداد العام للسكان لعام ،الهيئة العامة للمعلومات ص290