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Evaluation of Agricultural Suitability of Wastewater for Irrigation for Some Sewerage Stations in Ramadi – Iraq.

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Abstract

This study aims to examine the suitability of water for agricultural irrigation in some sewerage plants, and thus, reduce of pollution in Euphrates River waters. Three sewerage stations on Euphrates River are selected to compare their wastewater traits with international dependent values in order to state their suitability for irrigation. Some of chemical properties of wastewater are measured as; chemical oxygen demand COD, biological oxygen demand BOD, hydrogen potential pH and electrical conductivity EC, in addition to concentrations of; chloride Cl, ferrous Fe, cadmium Cd, and plumb Pb. All the studied properties of wastewater have significant differences for the three various sites and sources stations in comparison with river water. The values of pH are varied from 7.06 to 8.25 as neutral to alkaline. Nevertheless, the values of EC are much higher (C_3 class) and they are unsuitable for irrigation compared with river water, however, only the C_1 concentration lies within the permitted limits of river water. COD and BOD were much higher than normal limits in wastewater of the three stations compared with river water; such increase makes them unsuitable for agricultural irrigation. The concentrations of Fe, Cd, and Pb heavy micronutrients are much higher in all wastewater samples.

Keywords: Assessments, wastewater, irrigation, chemical elements, heavy metals.

Introduction;

Protecting public health is the primary purpose of establishing sewerage plant systems and networks for water, as good management and investments should be built on an adequate understanding of the sensitive risks posed by sewerage systems and how to control these risks [1].

Sewerage is defined as water released by the population through their daily uses and contains organic, mineral solids and pathogens. It is not limited to human secretions but includes bathing water, soap, industrial detergents, phenolic compounds and various pesticides. [2 , 3].

Countries, especially developed countries, suffer from the problem of sewerage disposal which are one of the main problems because of the negative effects that such water causes on the environment and human beings when directly or indirectly thrown to rivers or agricultural land. The development of civilization, the increasing population and the increasing demand for food require the provision of fresh water for various human, industrial and agricultural needs [4].

The city of Ramadi is located in western Iraq and is the centre of Anbar province and despite the importance of the city geographically and economically, it still suffers till nowadays from a significant deterioration in infrastructure and public services, as well as the problem of sewerage drainage domestic and public has become a major problem for the city. This city still relies on the old dilapidated networks to drain rainwater and torrents, and as a

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result of the lack of a sewerage system, residents worked to connect the sewerage collection tanks of the houses to this already dilapidated network, so the water resulting from this network is spent directly and without any processing to the Euphrates River and the Warrar Canal and this is one of the most dangerous and largest sources of river pollution [5].

The aim of this study is evaluating the water of some sewerage plants in Ramadi for the purpose of utilizing them in agricultural fields while there is no advanced central processing unit in the city.

Materials and methods;

Three sewerage samples are collected from each of the water collection stations of the Ramadi Sewers Directorate, which are located within the following metric coordinates: Central Ramadi Station E3 (M341939 3700896), West Ramadi H1 Station (W338672 3700501), South Ramadi Station D1 (S339908 3699495) as illustrated in Figure 1 at the beginning of November. The image (1a-b) illustrate those stations. Chloroform is added to the samples to stop microbial activity. The samples are stored in plastic containers and kept in the refrigerator at 4^o centigrade until the following required analyses are carried out, according to [6].

Some in situ tests are carried out, such as pH and EC. The spatial coordinates of the stations were installed and photographed using GPS.

Chloride is measured by titration with 0.01 N of (Argentum) silver nitrate (AgNO3) associated with potassium chromate (K_2CrO_4). Sulphate (SO_4) is measured by turbidity using spectrophotometer device of 420 nm wavelength with barium chloride ($BaCl_2$) according to [7].

The amount of BOD is estimated by the difference between the dissolved oxygen concentrations before and after incubation which determined according to the method (Azide Modification) described in (6) which depends on the oxidation of manganese hydroxide ($MnOH_2$) in the basic medium to a tetravalent manganese in one of the samples directly estimated and between the incubated sample at 20°C for five days. Whereas COD quantity is also estimated by the Dichromate reflux method (DCR) described in (6) which is based on the heating of the sample with the presence of the standard potassium dichromate mixture ($K_2Cr_2O_4$) of (0.25 N) and concentrated sulphuric acid with condensation and titration of the residual dichromate with a standard solution of iron-ammonia sulphate with the presence of the Freon indicator.

The micro and heavy elements (Pb, Cd, and Fe) are measured by atomic absorption spectrophotometer. Finally, all the estimated data are analysed statistically by GenStat genwin32 program.

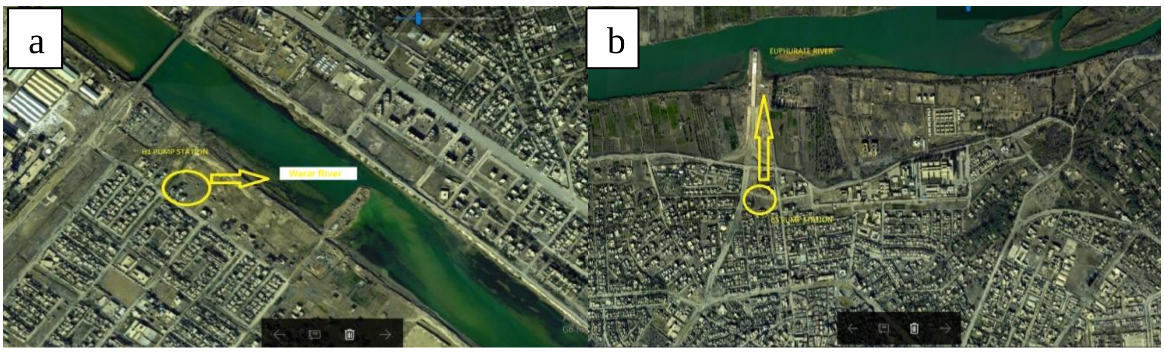

Image 1. (a) Location of H_1 station west of Ramadi, (b) Location of E2 station middle of Ramadi

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Results and discussion;

Table 1 shows the coordinates of the sites of the studied sewerage plants. The results of these samples are studied, which will be mentioned in turn and compare those results with the international standard specifications taken from some sources [8,9]. (Table 2).

Table 1; the sites coordinates of the studied sewage plants

Sample No.	Region	Coordinates
Station 1	Centre of Ramadi	E3(M341939 37008961)
Station 2	West of Ramadi	H1(W338672 3700501)
Station 3	South of Ramadi	D1(S339908 3699495)
River	------	-------

Table 2; international guide of irrigation water quality

FAO 1985 guide				
	Degree of Restriction on Use			**Potential Irrigation**
Severe	**Slight to Moderate**	**None**	**Units**	**problem**
	Normal Range 6.5 – 8.4		___	pH
> 3.0	0.7 – 3.0	< 0.7	$dS.m^{-1}$	ECw
EPA 1977 guide				
	Ranges		**Units**	**Properties**
	280 –160		$mg.l^{-1}$	Biological oxygen demand (BOD)
	700 – 550		$mg.l^{-1}$	chemical oxygen demand (COD)
	60 – 50		$mg.l^{-1}$	Chloride (Cl)
FAO 1976 guide				
	5.0		$mg.l^{-1}$	Fe
	0.01		$mg.l^{-1}$	Cd
	0.50		$mg.l^{-1}$	Pb

Chemical properties of studied sewerage water;

Figure (1- a) shows that the pH values of water of the three stations ranged from (7.06-8.25) compared to the river water, which means that the water is neutral to alkaline is within the permissible limits of 6.5-8.5 for human and therefore agricultural uses according to (8). The highest value is 8.25 for the Station E3 (central Ramadi) and the lowest value is (7.06) for Euphrates River water, due to the high amount of wastewater in homes, which contains some rapidly degrading organic acids such as carbonic, fulvic, humic and citric [10,11,12].

The values of EC for studied water in three stations (figure 1 - b) show significant increase ranged from 1.30 - 4.16 $dS.m^{-1}$ within C_3 class which is unsuitable for agricultural irrigation as it exceeds 3 $dS.m^{-1}$ (13) in comparison with 1.3 $dS.m^{-1}$ in river water. This result can be attributed to biological decomposition of some organic substances that exist in sewerage water. The reason for the high salinity of the E3 station (central of Ramadi) may be due to the consumption of water in that area, such as the use of detergents, which contain a high percentage of salts [13].

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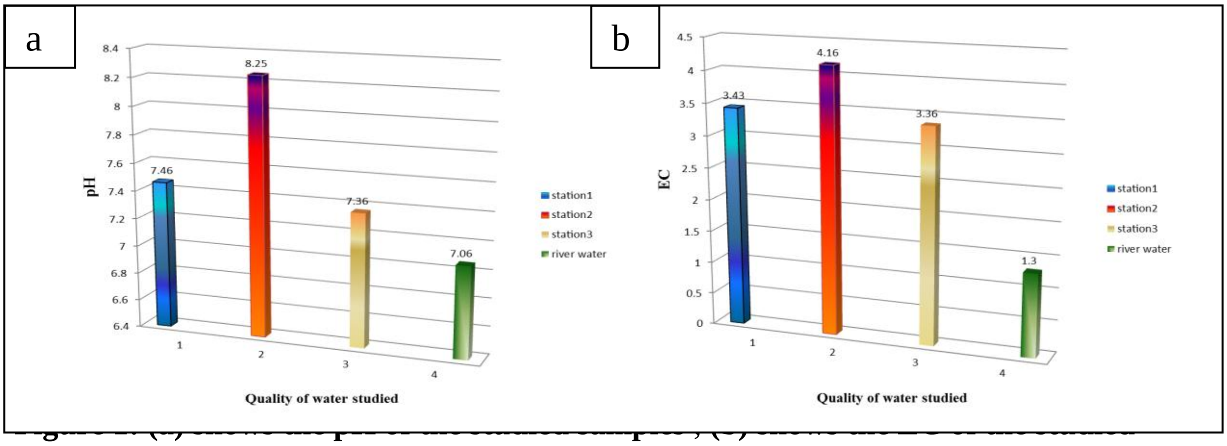

Figure 1: (a) shows the pH of the studied samples , (b) shows the EC of the studied samples

Soluble chloride ions content in water;

Figure (2 - a) shows that the chloride concentration values of the water in the three sewerage plants far exceeded the natural values of irrigation water, ranging from (405.2 to 474.8) mg.L^{-1}, which means that this water is not suitable for irrigation, but in river water it was within the permissible limits for irrigation water (12) due to the use of detergents in homes [14,15,16].

Biological oxygen demand (BOD);

It is an indicator of the amount of biodegradable organic content that does not cause a risk to the environment; however, the increase in its quantities in sewerage indicates the severity of pollution. It is noticed from figure (2 - b) that the BOD values of sewerage plant water were high as they ranged from (339-364) mg.L^{-1} which is higher than the natural ranges of (160-280) mg.L^{-1}, which is not suitable for irrigation [18], compared to the river water which is low at 86.5 mg.L^{-1}, possibly due to the high concentration of biodegradable organic compounds in the sewerage water [17].

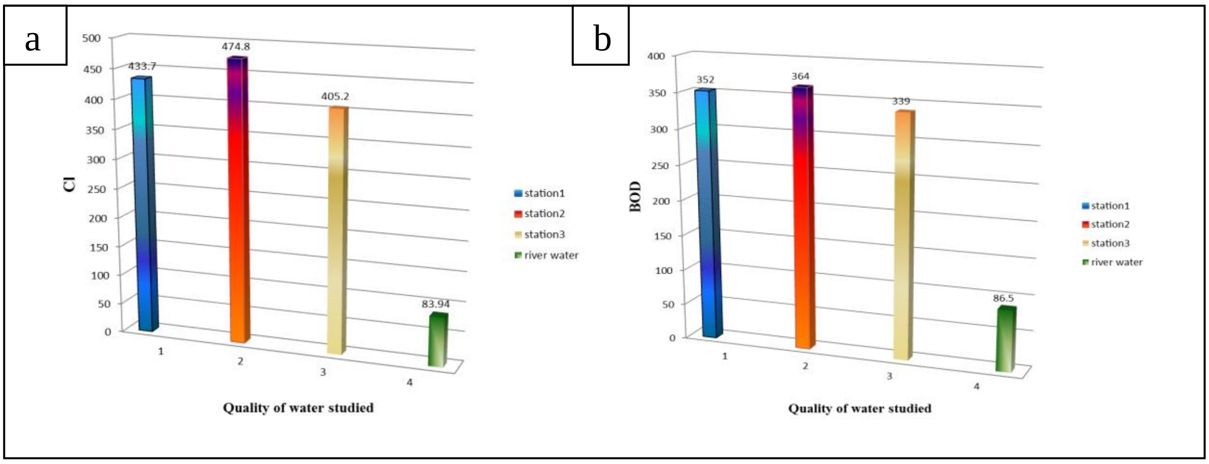

Figure 2: (a) shows the Cl of the studied samples, (b) shows the BOD of the studied samples

The results shown in Figure (3-a) also showed that COD values (chemical oxygen demand) for processed sewerage plant water are high, ranging from (655.8-834.7) mg.L^{-1}, which is higher than the normal permitted ranges (550-700) mg.L^{-1} [18]. Compared to river water, which is low at 293.4 mg.L^{-1}, we also note that COD values are greater than BOD, which means that the studied water contains a high amount of canine and hard-to-decompose organic matter collected from household waste and organic fertilizers [18].

Micro and heavy elements content (Fe, Cd, and Pb) in water;

Figure (3-b) shows the chemical composition analysis of sewerage samples for the three plants. The results indicate the presence of different concentrations of small and heavy elements (Fe, Cd, Pb). Significant differences on 5% significance level of Fe concentration in sewerage plants are observed to have a (5.3 – 7.67) mg.L^{-1} compared to river water of 1.19 mg.L^{-1}. These values that exceeded the permissible limits of Fe concentration in irrigation water according to (9) which is 5 mg.L^{-1}, possibly due to the role of autotrophic bacteria, through which ferrous is oxidized to Ferric $Fe(OH)_3$, which is deposited in sewerage water [19].

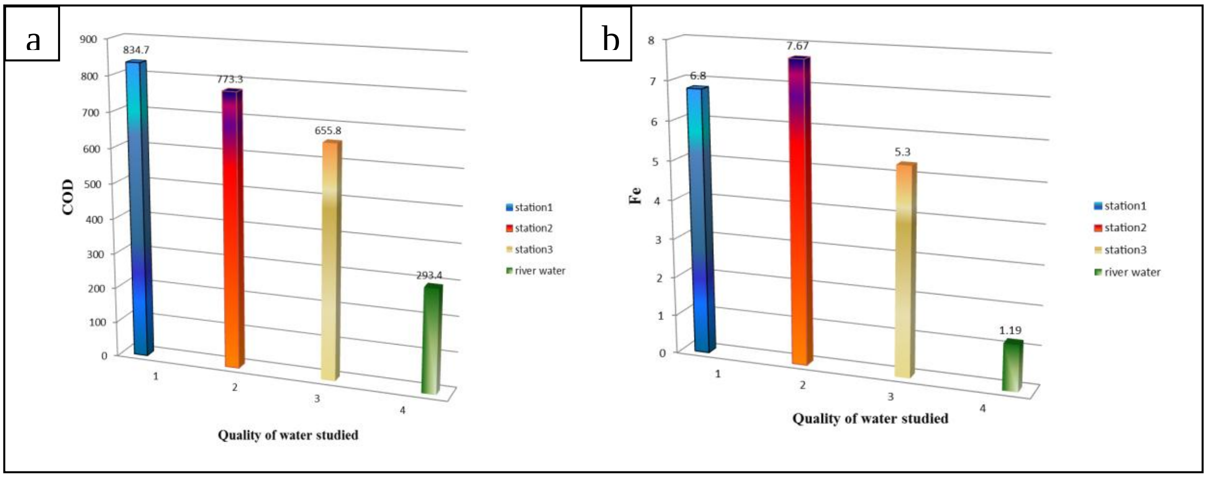

Figure 3: (a) shows the COD of the studied samples , (b) shows the Fe of the studied samples

Conclusions and recommendations:

Chemical analysis indicated that the water of the studied Ramadi sewerage stations was not within the safe limits of the use of water for agriculture, as the results showed high salinity EC, chlorides and the content of micro and heavy elements (Fe, Cd, Pb) as well as organic indicators (BOD, COD) and was above the limits allowed globally, possibly due to the lack of a processing unit for the city's sewerage processing at present, and this is one of the major problems the city is experiencing. Therefore, it is recommended that this water not be added directly to the river water, and that it can be used for agricultural irrigation purposes due to high pollutants only after modern methods of processing have been used and we highly recommend the establishment of a central processing unit southern the city.

References:

[1] WHO, 2019: Sanitation Safety Planning. A guide to safe use and disposal of wastewater and waste.9201.
[2] Al-Khair, Ayad. 2001. A modern method of wastewater treatment and its use in irrigation. The 7th Iraqi Technology Conference, University of Technology, Baghdad, Iraq 264-276.
[3] Al-Arousi, Hussein. 2004. Environmental Pollution and Pollutants. Modern Knowledge Library, Alexandria, Egypt.

[4] El-Araby, A. M., and M. M. Elbordiny. 2006. Impact of reused waste water for irrigation on availability of heavy metals in Sandy soils and their uptake by plants. Journal of Applied Sciences Research 2(2): 106-111.

[5] Al- Rawe, A. Abdel-Hadi, B. M. Karim and A. A. Khudair. 2015. The use of sewage water in the sustainability of the lands in the city of Ramadi. Planner and Development Journal. Issue 31.

[6] Standard Methods. 1995. The examination of water and wastewater , American water public Health Assoc. , American water works Assoc.19th ed., New York.

[7] Richards, A. 1954. Diagnosis and improvement of saline and alkali soils. Agris. Handbook No. 60.USDA.washington, USA.

[8] WHO, World Health Organization.2003. Guidelines for safe recreational water environment. Volume 1: coastal and fresh waters.

[9] FAO, 1976. Water quality for agriculture. Irrigation and drainage – paper No.29.Rome.Italy.Federation, Alexandria.VA.

[10] Sundara, K.K.; P. K. Sundara.; M. J. Ratnkarth.2010. Performance evaluation of wastewater treatment plant. Int. J. Sci. Teach. Vol.2 (12), pp. 7785-7796.

[11] Al-Dulaimi, Kamal H. Ohmaid.2016. Effect of organic matter and treated sewage water for irrigation in the growth and yield barley (Hordeum Vulgare L.) and content of some nutrients in Calcareous soil. PhD. College of agriculture. Anbar university. Iraq.

[12] Ayers, R .S. and D. W. West cot 1985. Water for agriculture. Irrigation and drainage Paper (29 Rev. I) FAO, Rome Italy.

[13] Al Salmani, Omar Kareem K. 2013. A study of the use of treated Fallujah sewage water in the environmental pollution of the soil and the growth of sorghum plant. PhD thesis. faculty of Agriculture. University of Anbar.

[14] Metcalf and Eddy.2003. Wastewater Engineering, treatment and reuse. In: Wastewater Engineering, Treatment, Disposal reuse. Techobanoglous G, Burton F L, Stensel H D (eds.), Tata McGraw- Hill Publishing company Limited, 4th edition. New Delhi, Inia.

[15] Abbas, Hassan H., Heba S.A.Rashed and Diaa El-Din A.A.El-Zaeaty.2015. Assessment of waste waters quality for irrigation purpose. Benha university. Egypt. Annals of Agric. Sci.,Moshtohor. Vol. 53(4). ISSN 1110-0419. Pages: 765-774.

[16] Al-Hashemi, Zeina Fakhry. 2008. Evaluation of the efficiency of wastewater treatment plants in removing heavy metals in some hospitals Mosul city. Center for Research and Pollution Control. Mosul – Iraq.

[17] Al-Dulaimi, Hamza Nuri Obaid. 2007. The use of calcium and sulfuric acid to improve the growth and productivity of wheat and yellow corn crops irrigated with salt water. PhD thesis, College of Education - Ibn Al Haytham - University of Baghdad.

[18] EPA.1977. Process design manual for wastewater treatment Facilities for severed Small communities. Report 625/1-77-009. US Environmental protestation Agency. Cincinnati, Ohio.

[19] Al- Amiri. Najla Jaber Mjoummed, 2006. Evaluation and reclamation of wastewater using various filters and reuse for irrigation. PhD thesis, College of Agriculture - University of Basra.