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Measuring of Residual Chlorine in (Hilla City/Iraq) Al-Tayyara Water Treatment Plant

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Abstract: One of the most important disinfectants is being considered chlorine for its wide and moderate availability in most areas of the world. The presence of chlorine in different areas of the system is very important to ensure the occurrence of water disinfection. The research goals aimed to find the residual chlorine concentration in the water outside and inside the chlorine basin of Al-Tayyara water treatment plant in Babylon, Iraq. Some of its supplied water to the regions such as (Al-Tayyara and Abi-Gharaq) in Babylon which represent the first and the last region are equipped with water from Al-Tayyara water treatment plant. pH, temperature, turbidity and some important water properties Ca, TDS and EC are also measured during January and February. The results showed that residual chlorine concentration ranged from 0.29-2.3 mg/L. Most of the residual chlorine concentrations were obtained higher than the maximum permissible limit according to the Iraqi standers No. 417, 2001. The other properties were within the permitted level by the Iraqi standers.

Key words: Drinking water, disinfection, chlorination, Al-Tayyara water treatment plant, residual chlorine, properties

INTRODUCTION

The process of water disinfection by chlorination, beset by extensive processes of use in the early 20th century became technological development in water treatment immediately after the filtration process. The reasons of the success of this method are its simple availability in all countries, inexpensive, the mechanism of breaking organic matter and the residual effect (Al-Qaisi, 2005). All this allows this simple method to ensure the safety of drinking water from the moment of production to the use. This way benefit not only for small systems but also large cities with huge distribution nets. Although, chlorine and chlorine-related substances are not perfect antiseptics, they will have a number of features that make them extremely effective. They show a good degree of continuity in water distribution systems. Its remaining measurable properties can easily be verified in water nets after treatment to the hands of users. The feeding equipment is simple, reliable and cheap (Al-Qaisi, 2005). At the district level, there are many "appropriate technology" mechanisms that local operators can easily handle. Chlorine and its compounds can be easily found, even in remote areas of developed countries. There is a wide range of disinfectants used in the drinking water treatment. These include chlorine, chlorine dioxide, chloramines, ozone and ultraviolet radiation. But chlorine is the most common disinfectant for water treatment. This is due to the middle of 19th century (Karlin, 1999). John Snow concluded that water is a means of spreading diseases. As a result, the widespread development of public health in the developed world, chlorine is used in the treatment of drinking water according to Karlin (1999) indicating a reduction of cholera by 90%, typhoid by 80% and amoebic dysentery by 50% in the United States. As described by Wallace *et al*. (2002), sterilization is the process of treating drinking water by disabling microorganisms. According to Eigener (1988), it is used to prevent the spread of infection and pollution. Secondary, products of disinfection are formed when certain disinfectants interact with natural organic matter by Wallace *et al*. (2002) and/or organic pollutants (Chang and Young, 2000). To date, the most common types of by-products of scientists are known as chlorine. Probably due to the fact, chlorine wasthe first type of chemical used in disinfection by Karlin (1999).

Research objectives: Evaluate the quality of drinking water through field measurements on samples of water then compare with Iraqi Standards for Drinking Water, No. 417, 2001.

Evaluate some factors that effect on residual chlorine such as pH, temperature, turbidity and find the relationship between them. Evaluate another important properties of water such as (EC, TDS, SO_4, hardness, Ca+, *E-coli* and coliform).

MATERIALS AND METHODS

Field and laboratory works: Description of Al-Tayyara water treatment plant, the project of Al-Tayyara water treatment plant is located at the center of Al-Hilla City in the middle of Iraq. The plant started operation in 1975 with a capacity of 1400 m^3/h. The intake of this project is Shatt Al-Hilla River. The water in this plant is treated conventionally and stored before it is pumped to the consumers. This project serves by Abi-Gharak and Al-Tayyara Districts Babylon Water Office in 2012.

Sample collection: Samples have been collected from four locations of Al-Tayyara water treatment plant (before chlorination basin, after chlorination basin, treated water from Al-Tayyara Region and treated water from Abi-Gharaq Region). The samples were tested in the Laboratory of Al-Mustaqbal University College the parameters were analyzed according to the standard method for examination of water.

Parameter measurements

Residual Chlorine (Cl_2): The main test, used to measure the remaining free chlorine is DPD Colorimetric Method that it is suitable for measuring residual chlorine in treated water with concentrations of 0.2-4 mg/L. The test is to use a lovibond disk with a Detector (DPD). The measurement process is carried out by (10 mL) of the water sample and then a Detector (DPD) is added to it. As a result, a pink solution is produced with a varying degree of color according to the residual chlorine concentration in the sample. The cell is then placed in a lovibond disk and the sample color is compared with the color grades installed on the turntable (LeChevallier *et al*., 1981).

Hydrogen ion (pH): PH was measured by pH meter (Hanna Model HI98107) at sampling locations.

Turbidity (Turb.): Turbidity was measured by a turbid meter (a Hach Model 2100 N).

Electrical Conductivity (EC): Electrical Conductivity was measured by a conductivity meter (Model Corning Pinnacle "541").

Total Hardness (TH): Total Hardness has been tested by adding (1-2) drop Eriochrome Black T and (1 mL) ammonia buffer solution to a sample of 25 mL of water and then titration the mixture with EDTA solution.

Calcium (Ca): Calcium was tested by adding (2 mL) NaOH and Murexide indicator to a sample of 50 mL of water and then titration the mixture with EDTA solution.

Total Dissolved Solids (TDS): A well the mixed sample is filtrated through a weight typical glass-fiber filter and filtrated is evaporated to dryness in a weighted dish and dried to constant weight at 180°C, the increase in dish weight represents the total dissolved solids.

RESULTS AND DISCUSSION

The tests included many physical and chemical properties of drinking water produced by al-Tayyara water treatment plant as well as the received water regions of Al-Tayyara and Abi Gharq during January and February (Table 1 and 2).

Cl_2: The value of the residual Chlorine (Cl_2) was 0.29 mg/L in Abi- Gharaq Region but it is 2.3 mg/L as the highest value of Al-Tayyara region as shown in Fig. 2. From these values, we find that there is no problem for the ratio of free chlorine required in drinking water but we find the average is higher than the permissible upper limit to sterilize drinking water according to the Iraqi standers this causes health problems.

pH: The values obtained for pH as shown in Fig. 3 were within a small range (7-8.2). This is the normal rate of drinking water.

Temperature: The temperature was measured at the time of water samples collection where temperature ranged 13.4-17.4°C as shown in Fig. 4. The temperature was an important measurement because it is the critical factor related to the growth of microorganisms.

Turbidity: Turbidity is considered one of the important tests due to its direct effect on the quality of the water. The values ranged between (1.51-4.68) NTU according to the allowable limits of the Iraqi standards as shown in Fig. 5.

EC: The EC values ranged between (950-1100) as shown in Fig. 6. There is a strong relationship between TDS (the Total Dissolved Solids) and EC (Electrical Conductivity). As shown in the results obtained, the total dissolved solids increase the electrical conductivity increases too.

TDS: The Total Dissolved Solids (TDS) ranged between (472-572) are within the permissible limits to meet the specifications of the Iraqi standards as shown in Fig. 7.

Ca: The values of Ca ranged from (125-190) mg/L are within the permissible limits allowed to the Iraqi standards as shown in Fig. 8.

Table 1: Results of physical and chemical properties of water in January

Samples/Properties	Before cholorination	After cholorination	Treated water in Al-Tayyara Region	Treated water in Abi-Ghara Region
C1	0.0	2.3	2.0	0.34
pH	7.3	7.2	7.2	7.10
Temperature	13.4	13.4	13.4	13.40
Turbidity	4.1	1.7	1.7	1.62
EC	1100.0	1090.0	970.0	9650.00
TDS	572.0	566.0	487.0	4800.00
Ca	125.2	125.9	126.2	128.80
Hardness	410.0	420.0	420.3	424.20
E-coli and coliforn	-	0.0	0.0	0.00

Table 2: Results of physical and chemical properties of water in February

Samples/Properties	Before cholorination	After cholorination	Treated water in Al-Tayyara Region	Treated water in Abi-Ghara Region
Cl_2	0.00	2.00	1.70	0.29
PH	7.80	7.80	8.20	8.00
Temperature	17.40	17.20	17.20	17.20
Turbidity	4.68	1.56	1.62	1.51
EC	950.00	950.00	960.00	965.00
TDS	472.00	473.00	490.00	485.00
Ca	130.00	190.00	181.00	180.00
Hardness	310.00	360.00	350.00	345.00
E-coli and coliform	-	0.00	0.00	0.00

Fig. 1: Al-Tayyara water treatment plant

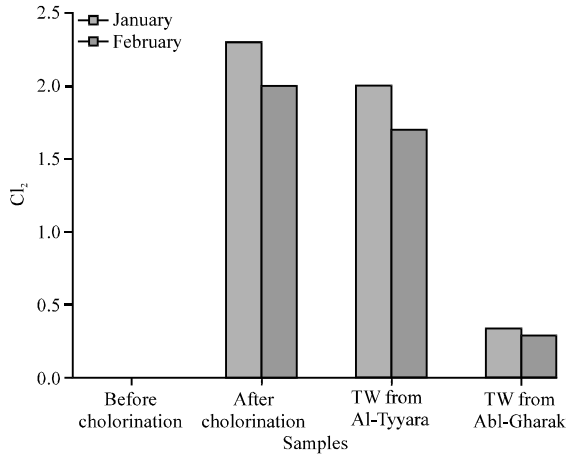

Fig. 2: The values of Cl_2

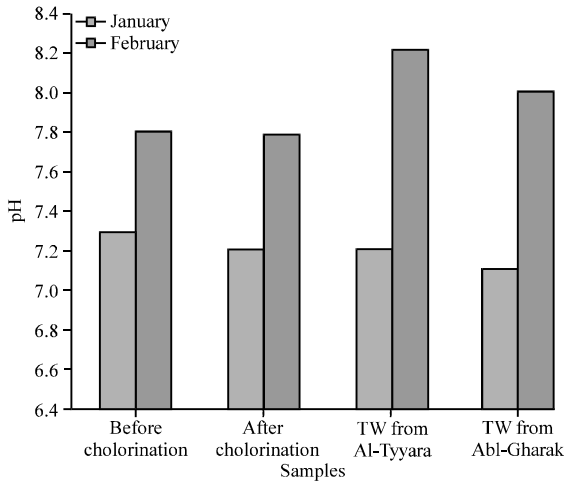

Fig. 3: The values of PH

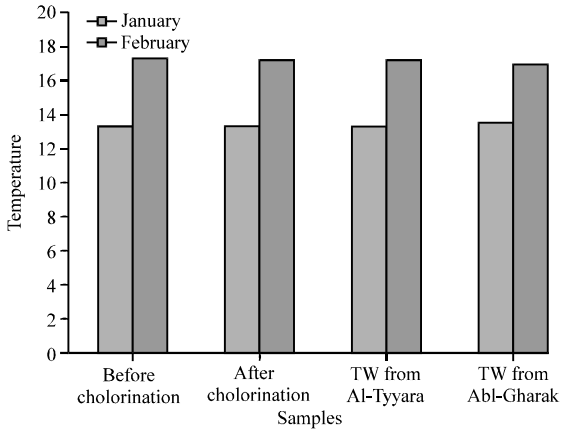

Fig. 4: The values of temperature

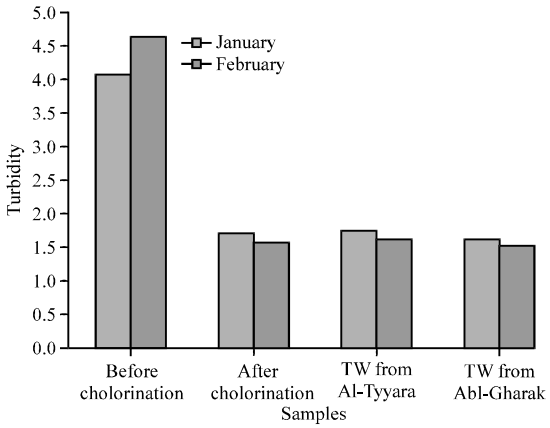

Fig. 5: The values of Turbidity

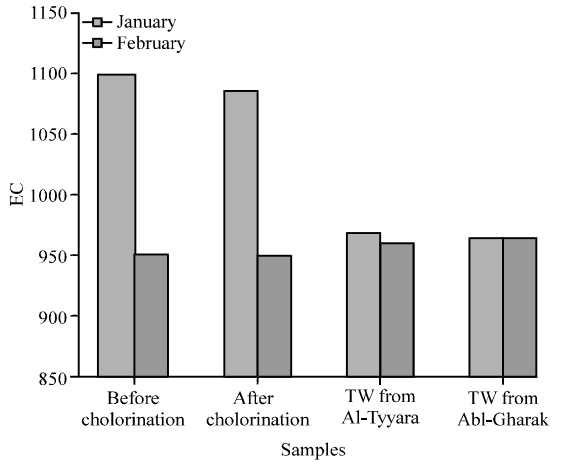

Fig. 6: The values of EC

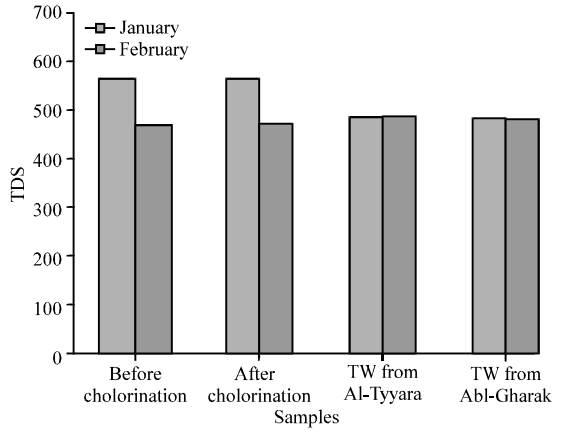

Fig. 7: The values of TDS

Hardness: Hardness ranged between 310- 424 mg/L are within the allowable limits to the Iraqi standards (Fig. 9).

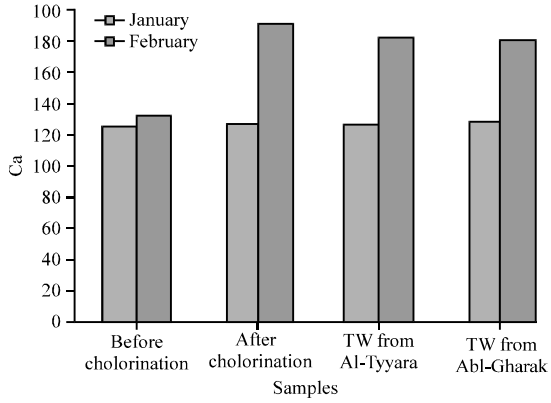

Fig. 8: The values of Ca

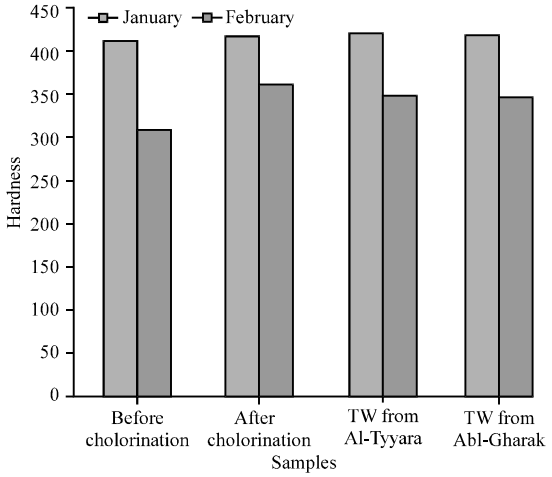

Fig. 9: The values of Hardness

CONCLUSION

The results showed that the ratio of residual chlorine in the treated water of study areas, Al-Tayyara and Abi-Gharaq Resgions, exceeds the permissible limit a ccording to the Iraqi standards and causes a lot of health problems. The measured values of chemical and physical properties were within the Iraqi standards.

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