DRINKING WATER SUPPLY QUALITY OF SAMARRA CITY

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ABSTRACT

Drinking water supply quality of Samarra City in Iraq evaluated in a study started from December, 2004 to May, 2005. The investigation includes some important physical, chemical and bacteriological water quality parameters (turbidity, temperature, TDS, pH, residual chlorine, total plate count, and E-coli) at the city consumers tap. Results indicate that the monthly average turbidity was (8.327) NTU which gives a percent of violation to Iraqi Specifications (77.77%). Low percent of existence of residual chlorine was (35.8%) in the different locations of water supply network. Bacteriological examinations such as total plate count ranged from (2500-4000000) per ml and E-coli tests were positive in different locations of network when the residual chlorine is insignificant.

Keywords: Samarra City, Water, Technology, Conference, water quality, turbidity

1 INTRODUCTION

In the late 1800s and early 1900s, acute waterborne diseases, such as cholera and typhoid fever, spurred development and proliferation of filtration and chlorination plants. Identification in water supplies of additional disease agents (such as Legionella, Cryptosporidium, and Giardia) and contaminants (such as cadmium and lead) resulted in more elaborate pretreatments to enhance filtration and disinfection (AWWA, 1976). The first application of chlorine in potable water was introduced in the 1830s for taste and odor control, at that time diseases were thought to be spread by odors. Chlorination was first introduced in1908 (Ruth & Robin, 2003).

Quality of water is the most important aspect. There are international and national standards for the quality of water to be supplied for human consumption. The main aim is to supply safe and palatable water to the consumers. Water should also be free from any odor and minerals. The temperature of water should be reasonably good. It should neither be corrosive nor scale forming. If the pH and alkalinity of finished water are such that the water will not be stable, water quality in the distribution system may change sufficiently to cause corrosion problems (Nelson L.Nemerow, et al., 2009).

Impurities enter water, chemicals from industrial discharges and pathogenic organisms of human origin, if enter the water distribution system, may cause health problems (Ruth & Robin, 2003). The World Health Organization (WHO) estimates that some 3.4 million people die each year from water-borne diseases caused by microbial contaminated water supplies or due to a lack of access to sanitation facilities (WHO Report, 2000). Disinfectant residual, turbidity, and pH should be monitored continuously where possible (Cheremisinoff, 2002).

The main objective of this research was studying the quality of water supply system in Samarra City through evaluating the performance of water supply network according to some water quality parameters.

2 FEILED WORKES AND MEASURMENTS

Samples from water supply networks of Samarra City cover some important physical, chemical, and bacteriological parameters of water quality (temperature, TDS, turbidity, pH, residual chlorine, total plate count, and E-coli) were collected approximately weekly and tested for the period from December 2004 to May 2005. The sampling includes twelve districts of City shown in Fig. (1). Samples were taken from tap water and each reading represents an average of three readings. “Table 1” and “Table 2”show the names and symbols of the districts and the date of sampling respectively.

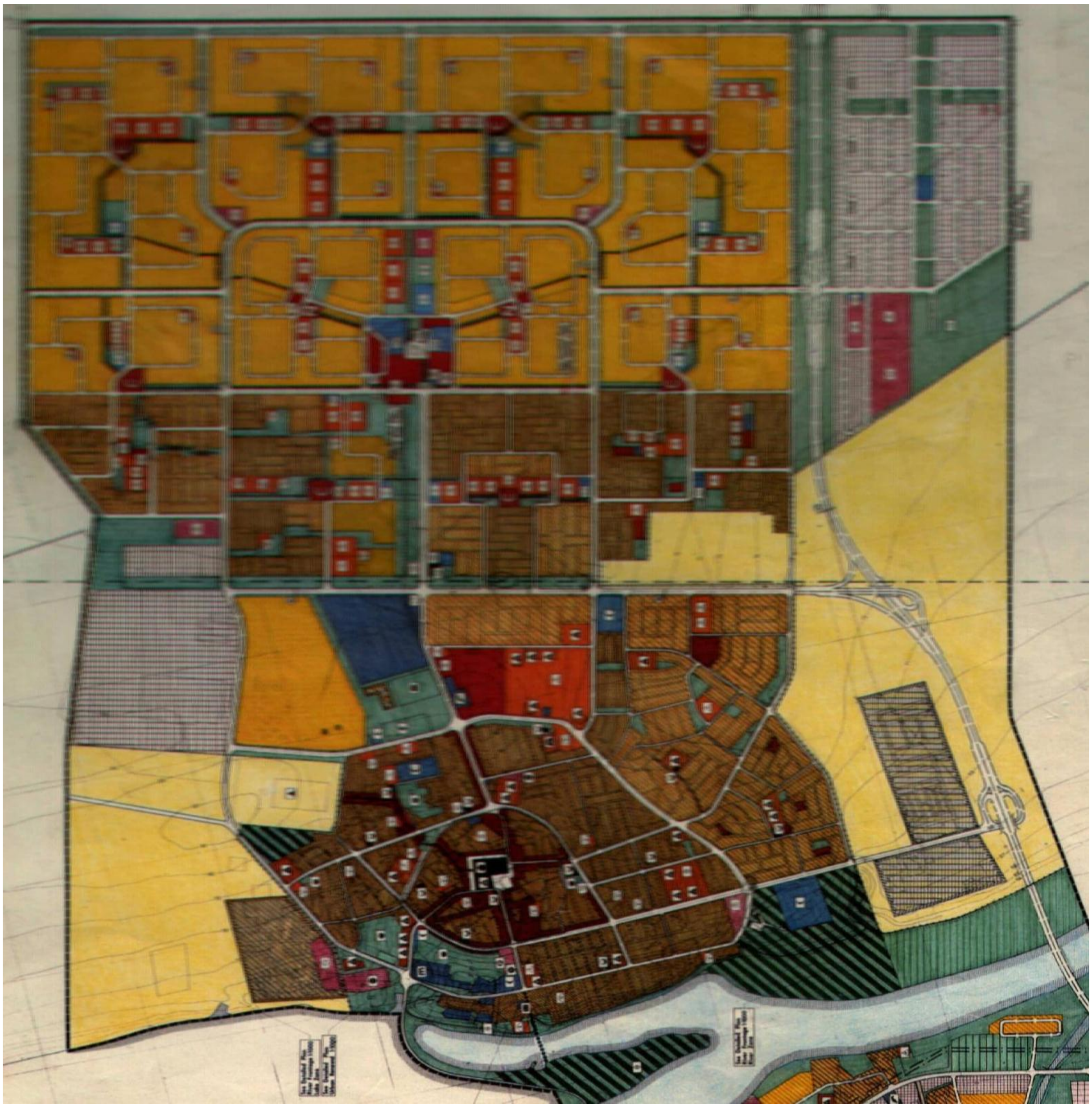

Figure 1. Master plan of Sammara’a city

Table 1. Regions name and symbols

No.	Regions name	Symbol	No.	Regions name	Symbol	No.	Regions name	Symbol
1	Al-Baladia	A	5	Al-Zeraa	E	9	Al-Dhobat	I
2	Al-Hadi	B	6	Al-Sekak	F	10	Al-Jeberia	J
3	Albo-Rahman	C	7	Al-Armoshia	G	11	Al-Khadhra	K
4	Al-Moatasim	D	8	Al-Qadisiya	H	12	Al-Shohadaa	L

Table 2. The date of runs number of sampling:-

Run No.	Date	Run No.	Date	Run No.	Date	Run No.	Date
1	01/12/2004	6	23/01/2005	11	13/03/2005	16	05/05/2005
2	10/12/2004	7	02/02/2005	12	23/03/2005	17	16/05/2005
3	22/12/2004	8	11/02/2005	13	03/04/2005		
4	02/01/2005	9	21/02/2005	14	12/04/2005		
5	12/01/2005	10	02/03/2005	15	24/04/2005		

3 RESULTS AND DISCUSSION

In spite of, low average supply water turbidity (2.1, 3.67, and 7.41) NTU of the December, January, and February respectively from Samarra water treatment plants (conventional water treatment plant and compact unit) all the turbidity readings exceeded the Iraqi Standards (5 NTU) as shown in "Fig. 2". At regions G and H, there were cracks in the conveying pipes supplies which lead to high turbidity. From "Fig. 3", twenty readings violate the Iraqi standards, while turbidity rates of supplied water for March, April, and May were (3.81, 3.21, 5.62) NTU respectively. The reasons were attributed to the old distribution system. Half of the distribution system is cast iron pipe resulting in continuous breaks of the pipelines, and the entrance of mud and dirt and microorganisms. "Table 3" gives descriptive statistics of the distribution system. The maximum value was (43.13) NTU in region A when the supplied water turbidity was (6.24) NTU because pipes of this region is the oldest one. Mean value of turbidity was (8.327) NTU, which was more than the Iraqi Standard, WHO and EPA.

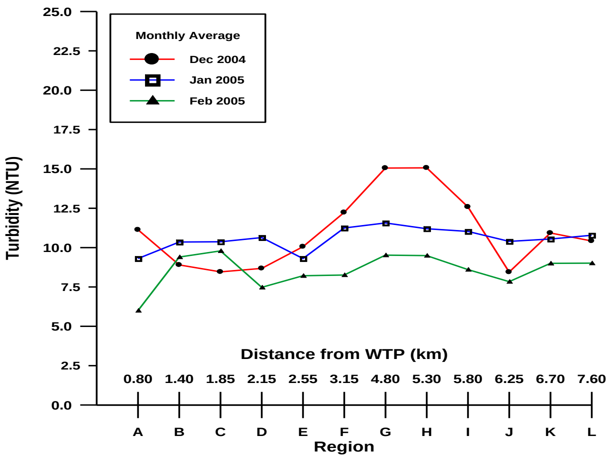

Figure 2. Monthly average turbidity during winter

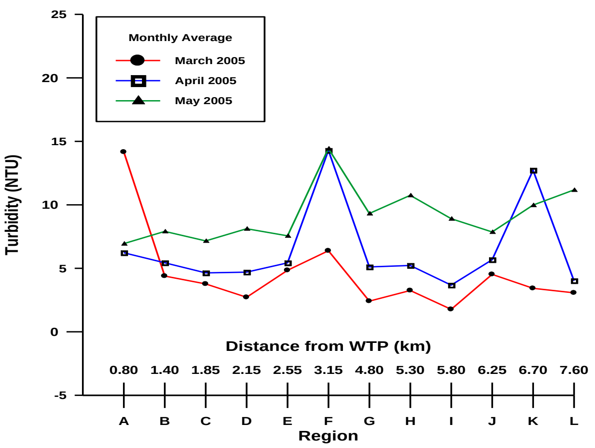

Figure 3. Monthly average turbidity during spring

"Fig. 4" and "Fig. 5" show the monthly average of residual chlorine. From "Table 3", the minimum value is (0) mg/L and the maximum value is (1.5) mg/L in region F in March with a mean value (0.2348) mg/L. There were (131) zero chlorine readings out of (204) as a result of not adding chlorine and the depletion of residual chlorine in far regions. Region F gives the minimum value because it consists of two old combined pipelines.

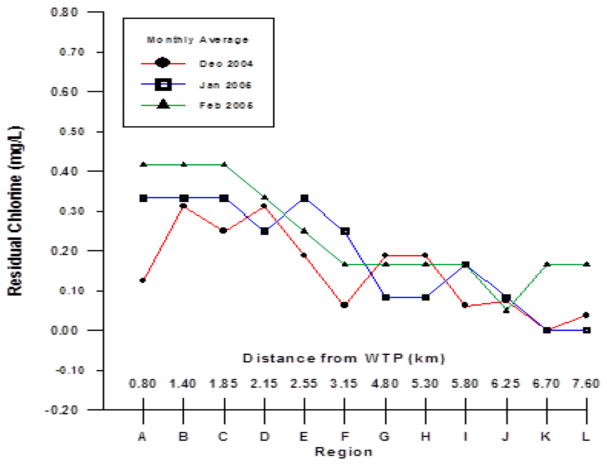

Figure 4. Monthly average chlorine during winter

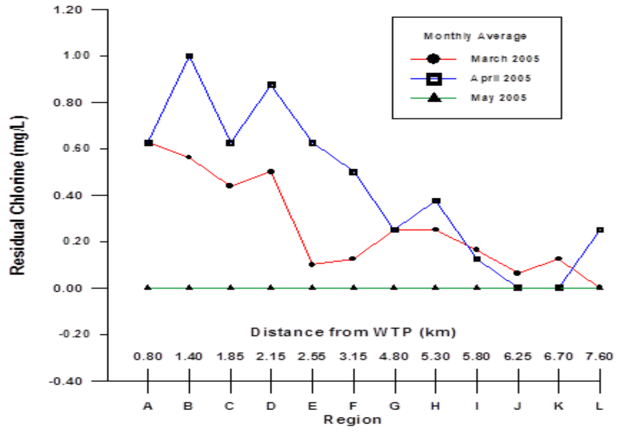

Figure 5. Monthly average chlorine during spring

"Fig.6" and "Fig. 7" show the monthly averages of temperature. From "Table 3"the minimum value was (9.5) C° in January in region A and the maximum value (22) C °, in regions K and L with mean value (14.17) C°. There was an increase in temperature seasonally and in distribution system as it reaches the far regions causing increases in the biological activity and the decay of residual chlorine.

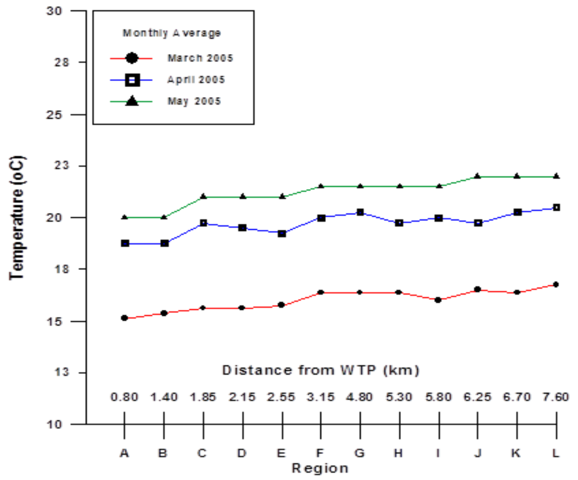

Figure 6. Monthly average temperature during spring

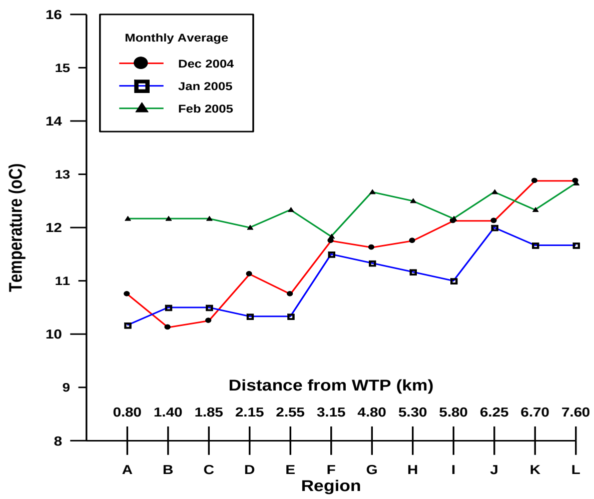

Figure 7. Monthly average temperature during winter

The monthly averages of TDS values for different regions are shown in "Fig. 8" and "Fig. 9". The minimum value was (208) mg/L in region D in May, while the TDS of raw water was (218) mg/L, and the maximum value was (277) mg/L in region K in February, and a mean value of (248.485) mg/L. The TDS values of spring are less than that of winter due to continuous increase of snow melting.

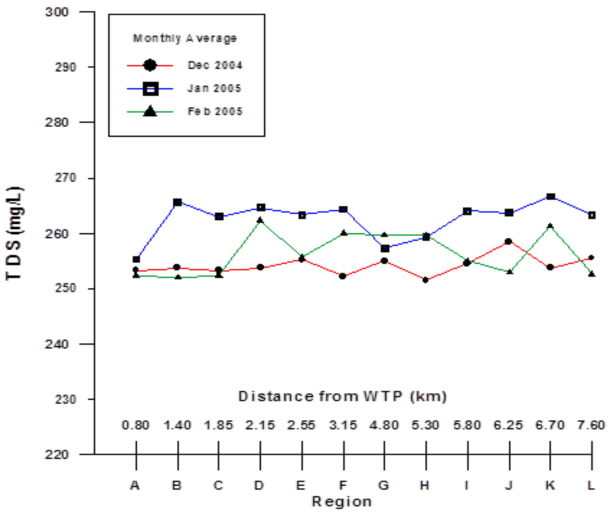

Figure 8. Monthly average TDS during winter

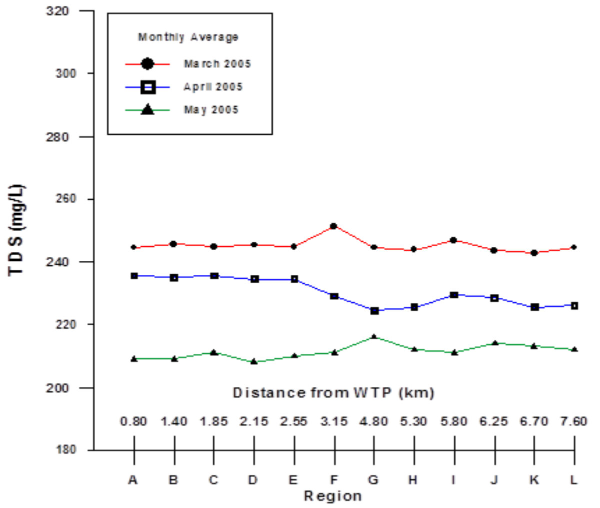

Figure 9. Monthly average TDS during spring

Monthly average pH values are shown in “Fig. 10” and “Fig. 11” From “Table 3”, the minimum value of pH was (7.01) in region E in May and the maximum value was (8.38) in region I in January with a mean value of (8.16). All pH values were within the allowable limits of Iraqi, EPA Specifications (6.5-8.5) and WHO Specifications (6-8.5). No clear change in pH values with distance.

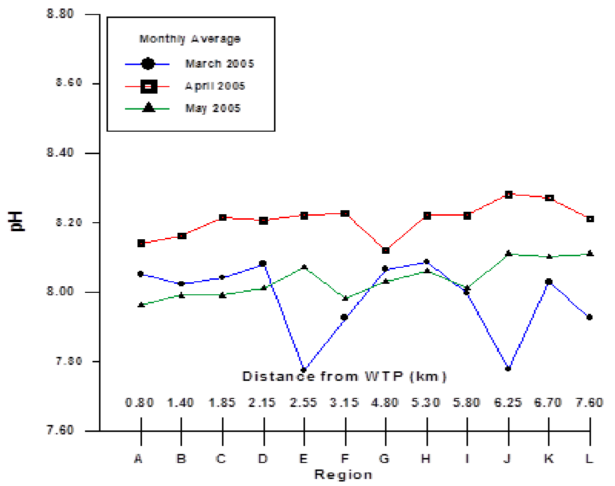

Figure 11. Monthly average pH during spring

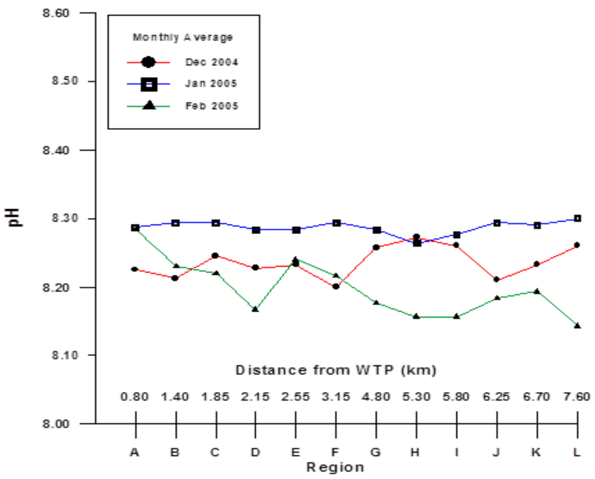

Figure 10. Monthly average pH during winter

Table 3. Descriptive statistics of the distribution system

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Temperature	204	9.50	22.00	14.1716	3.55533	.717	.170	-.544	.339
Residual chlorine	204	.00	1.50	.2275	.37605	1.544	.170	1.168	.339
pH	204	7.01	8.38	8.1622	.21160	-2.814	.170	9.983	.339
Turbidity	204	.00	43.13	8.3273	5.19682	1.684	.170	9.023	.339
TDS	204	208.00	277.00	248.4853	19.18653	-.728	.170	-.690	.339
Valid N (listwise)	204								

The results of the bacteriological tests are shown in "Table 4". At the beginning the effect of residual chlorine on bacterial activity of supplied water were investigated by taking the first sample from region F with a residual chlorine (0.25) mg/L, but the results of E-coli tests were negative so, the remaining examinations were done at regions of zero residual chlorine. The results were clear especially in region K which gives the maximum value of total plate count (TPC). The minimum value was also in region K. All these values exceed the Iraqi, EPA and WHO Specifications.

Table 4. Bacteriological Examination of Water Supply Network

No.	1	2	3	4	5	6	7	8	9	10
Region	F	K	K	I	K	B	H	L	K	J
Residual Chlorine (mg/L)	0.25	0	0	0	0	0	0	0	0	0
TPC no./mL	0	4000000	2500	4000	24000	45000	37000	30000	8500	12500
E.coli	-ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve

4 CONCLUSION

Temperature at consumers tap was ranging from (9.5-22) C °. There is no effect of water supply network on pH and TDS values. The percentage of residual chlorine in water supply network was (35.8%). Whenever there is no residual chlorine, there was a microbial pollution and region F gives the minimum value of a residual chlorine and maximum turbidity. Effect of the compact unit treatment plant is clear in regions (I), (J), (K) and (L), because there was an increase in the residual chlorine.

The total plate count ranges from (2500 - 4,000,000) per ml and E-coli values were positive for many regions and at different times because there was no addition of chlorine and the networks are very old.

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