EVALUATION OF THE EFFICIENCY OF FOUR WATER PURIFICATION PLANTS IN BASRAH PROVINCE

I. M.A ABD ALKAREEM[1], M. A.A DESHAR[2] AND N. M. ABD ALHALEM[3]

ABSTRACT

Laboratory tests were carried out to evaluate the treatment efficiency of water purification plants and the extent to which they were affected by the variance of rivers water at four plants in Basrah Governorate, where some physical and chemical properties were measured. The results of the study showed that the quality and efficiency of the treated water was very low and unacceptable for the four plants, The results proved that the treated water samples of the plants are unsuitable for drinking, and they showed that the imbalance in the low efficiency of the treatment was not only in the inability of the plants to treat dissolved salts in water, but there was a significant defect in the ability of plants to remove impurities and suspended substances, which is at the core of the work and tasks of plants. The study showed that the discharges rates and salts concentrations for the last ten years feeding the Shatt al-Arab river were insufficient to contribute to a positive change in water quality. Consequently, a more sophisticated technique of water purification should be adopted, which is the desalination at all plants of Basrah. This desalination should be complementary and subsequent to the purification process.

KEYWORDS: plants, treatment, river, efficiency, drinking, Basrah Governorate.

1. AIM OF THE RESEARCH

1- Assessment of the quality and efficiency of water produced at four purification plants with the comparison between them.

2- Determination of the compliance of produced water with Iraqi specifications, the United States, and World Health Organization.
3- The feasibility of implementing the system of water purification plants in Basrah with the current changes of water quality.

[1]Teaching, Faculty of Agriculture, Basrah University, , Iraq issam.abdalkareem@uobasrah.edu.iq
[2]Assistante Professor, Faculty of Agriculture, Basrah University , Iraq.
[3]Teaching Assistance , Faculty of Agriculture, Basrah University, Iraq.

2. INTRODUCTION

The earth contains abundant quantities of water resources, which constitute 75% of its total, where it is the basis for the life of man, animal, plant and all living things. However, most of the water available is in the form of seas and oceans characterized by high concentrations of salt. It is therefore unsuitable for human, agricultural and even industrial use. Water that is concentrated in ice poles or in many water surfaces such as rivers or located in rock cracks at a depth of up to 800 meters below ground represents freshwater, but its percentage does not exceed 2.98%. Despite this small percentage, what is available to use of this freshwater for humans is not more than 0.3%. The world today faces many problems related to the inability to access clean water, especially after the large population growth and industrial development, where 1.2 billion people lack access to safe drinking water. 2.6 billion people have access to only a little of this water or have no sewage networks. More than 80% of the world's diseases are directly caused by water pollution or lack of adequate availability for washing or other household uses. Millions of deaths have been recorded every year for the same reason, and 3,900 children die every day from water-borne diseases or the intermingling of drinking water with wastewater [1-2].

In order to reduce the pollution of what remains to be used for different uses of this wealth, and in order to deliver safe and non-polluting water to citizens, water specialists have constructed and developed water treatment systems, which are becoming more complex and costly as pollutants become more concentrated in water. Water purification plants are the main artery from which the cities are supplied, especially large ones, with water from the public water network, and it is one of the least complex water treatment systems. However, the use of this water in a safe and healthy manner is not possible until the plants have fulfilled their tasks in the treatment of water from the water source. The greater the concentration of pollutants and salts in water, the less likely it is to treat this water in one single stage. Therefore, it is necessary to use multiple stages where sophisticated water treatments may be needed to remove undesirable substances. Therefore, the energy needed for treatment is directly proportional to the salts and hence the cost, accordingly[3].

The purifications plants consist of many units, the most important of which are sedimentation basins and sand filters, as well as rapid mixing tanks and slow mixing basins that increase the efficiency of sedimentation to be removed. Sediments removal efficiency after initial normal sedimentation units usually is not less than the: for suspended solids (45 - 60%)and for total E-coli bacteria (40 - 60%), while the sediment removal efficiency after the sedimentation units with the addition of auxiliary chemicals is not less than: (60-80)% for suspended solids, and (60-90)% for total E-coli bacteria. And then comes the role of filters units to remove the remaining granular impurities and remove 80% of the bacteria and remove algae, iron and manganese as well as remove the taste and smell [4].

In order to know the effectiveness of the purification plants to remove impurities and suspended solids, the efficiency of treatment of the water discharged from these plants should be determined. This is done by carrying out laboratory analyses for various parameters before and after the water treatment, and whenever more parameters are measured, the more comprehensive and clearer the working system of the purification plant was.

3. MATERIALS AND METHODS OF WORK

3.1 Sampling and Analysis Sites

Samples of raw water and treated water samples were collected at four water purification plants and were selected at different locations in Basrah Governorate: AL-Medayna and the source of its water is the Euphrates River, Al-Hartha plant, Al-Jubaila,and Al-Bardeya and their water source is the Tigris River mixed with little quantities of

Euphrates River, as shown in Fig. 1, and the distribution of plants in the form of three plants in the center of the province and the fourth located north of the province. Samples were collected and stored in clean, sealed, and three- repeated plastic bottles. It has been estimated some of physical and chemical properties of the study samples [5] and which are as follows: electrical conductivity (EC), pH (pH), turbidity (Turb), total dissolved solid (TDS), total suspended solid (TSS), total hardness (TH), magnesium (Mg), calcium (Ca), sodium (Na), chlorine (Cl), and potassium (K). The study took 6 months starting from November (autumn) 2017, until April (summer) 2018, where each month water samples are taken once and tests were conducted to determine the concentrations of these parameters, Thus, the efficiency of each parameter is applied in the samples of the first site (raw water) as well as the samples of the second site (treated water), through which the rate of overall treatment efficiency is found which represents the efficiency of the total standards at each of these four plants, and the law of water treatment efficiency is (%) [6]:

Fig. 1. A map of the study areas start from the Euphrates and Tigris and till the last plant of the Shatt al-Arab.(Image taken from Google Earth).

$$\textit{Efficient removal } (E\%) = 100 \times \frac{C_{in} - C_{out}}{C_{in}} \quad \text{..........Eq (1)}$$

Where C_{in} is concentration of raw water samples, C_{out} is the concentration of treated water samples.

The statistical analysis of the various parameters for the study samples was performed using tow-Way ANOVA for (SPSS V.15.), as for the efficiency of the treatment was Paired Samples T test and Wilcoxon Test [7-8].

4. RESULTS AND DISCUSSION

4.1 The Rates of Dissolved Solids and Discharges of Rivers Water

Figure 2 shows the concentrations of dissolved solids in different areas of the province for the last ten years starting from the Al-Qurna, which feeds from the Tigris River, and then the area of the Al-Medayna where the source of water comes from the Euphrates River, and then the center of Shatt al-Arab, and area of Abi Al-Khasib and area of Seihan, In these last three areas, water is mixed between the Tigris and the Euphrates, where the Seihan area is the closest to the Gulf.

As illustrated by Fig. 2, that salts concentrations in the five regions which the data were taken in the last 10 years, decreased slightly in salinity but returned to the same or slightly lower levels of previous salinity, which indicates the stability and non-change of high concentrations of salt during the ten years exceeding the limits allowed in the specifications of drinking water approved, without recorded a marked drop in them [9].

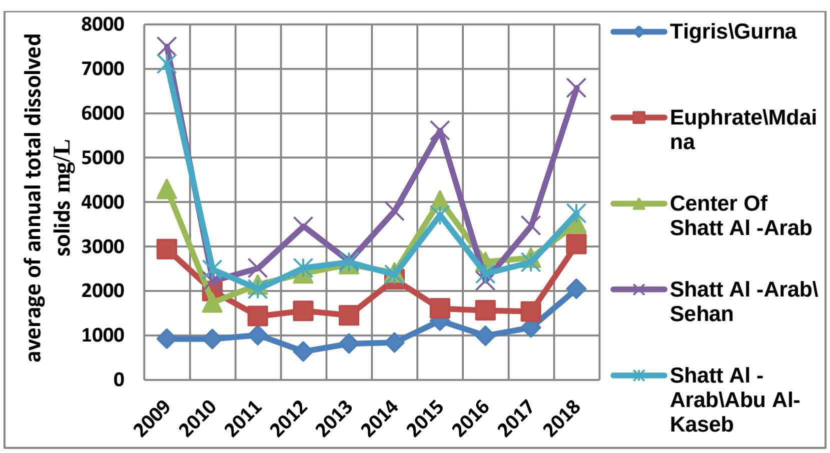

Fig. 2. Annual salts concentration curve in mg /L for different locations of the governorate for the last ten years [9].

All of the water concentrations for ten years were much higher than the maximum permissible drinking standards of 1000 mg /L [10], except for Al-Qurna site, which feeds directly from the Tigris River, which lies 70 km north of the center of the province. it was close to the maximum limits of specifications.

Figure 3 shows the annual rate of discharges of two areas: one within the administrative boundaries of Amara province, and the other on the administrative border of Basrah province. It is clear that the annual discharge rate during the last ten years until the study period in 2018, , ranged between (34 - 60) m^3/s at the border of the northern province of Basrah, where the total water discharge rate for the last ten years was 49 m^3/s [9], and therefore did not reach the discharge at the center of Shatt al-Arab to the minimum discharge required (75) m^3/s to maintain salinity below 2000 mg/L according to the specialized report [11], where it would have limited the deterioration of the water quality that covers the areas of life and livelihood of most of the population of Basrah, But it did not reach that amount even at the administrative border with other neighboring provinces, which are at least 70 km north of the Shatt al-Arab center.

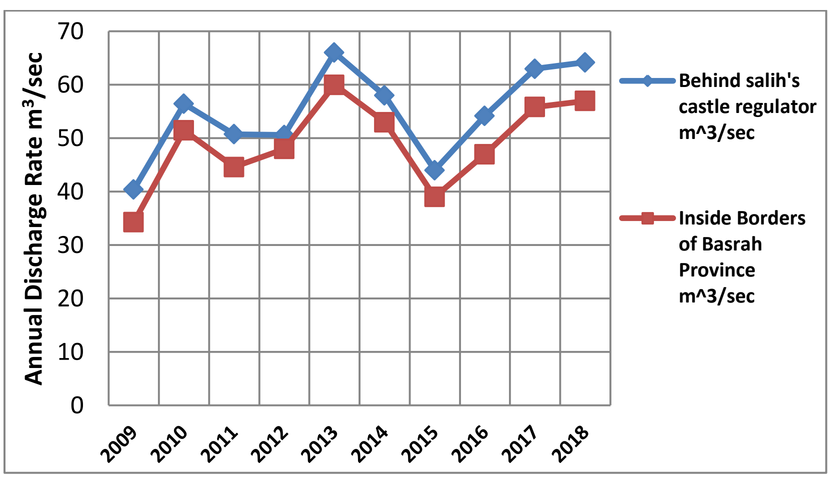

Fig. 3. Annual rate of discharge in m^3/sec in different locations for the last ten years [9].

Consequently, it is clear from the recorded data at the last ten years that there is stability and no changes in the high salt concentrations and it hasn't recorded a significant decrease, and the concentration of salts they were much higher than the maximum limits of approved drinking water specifications, also the discharges of water from the Tigris and Euphrates Rivers, which feed together the Shatt al-Arab waters and the center of the province with water of moderate quality, the amount of water in them did not reach even the minimum limits that recommended by the specialized report [11].

4.2 Physical and Chemical Properties Taken for The Study Plants

4.2.1 Temperature (T)

The temperature at the time of the laboratory tests was recorded at an average of 19.62 $^{\circ}$C and the highest score was recorded at 22.70 $^{\circ}$C, while the lowest was 15.15 $^{\circ}$C.

4.2.2 PH

Most of the study samples of the plants studied within the limits of the specifications of drinking water approved, and the highest value was recorded at Al-Medayna plant of 8.07, while the lowest value was 6.46 at the same plant.

4.2.3 Electrical conductivity (EC)

The highest value of raw water of this parameter for the four plants, was recorded at plant (D) Al-Bradeya with a concentration of 7.62 dS/m while the lowest concentration for raw water was recorded as 2.65 dS/m at plant (A) Al-Medayna. Whereas plant (D) was the highest concentration of treated water at 7.81 dS/m, the lowest concentration was at plant (A) at 2.65 dS/m. Statistical analysis has shown a significant differences between plants, as was recorded a significant differences between the months of the study, but no significant differences were recorded before and after treatment at this parameter. Plant (C) has been recorded the highest overall efficiency compared with the rest of the studied plants at 11.76%, however plant (B) recorded the lowest efficiency of 0.37%. In general, the treatment efficiency at the plants studied for this parameter was very low, and some of the reasons for the low efficiency of the plants for the parameter are due to the concentrations of the high raw water salts.

4.2.4 Total dissolved solids (TDS)

The highest raw water value of this parameter for the four plants was recorded at plant (D) Al-Bradeya with a concentration of 3810 mg /L ,while the lowest record concentration for raw water is 1330 mg/L at plant (A) Al-Medayna. Plant (D) was recorded with the highest concentration of treated water of 3900 mg/ L; however, the lowest concentration was at plant (A) of 1330 mg/L. The statistical analysis showed that there were significant differences between the plants with each other, and significant differences were recorded between the months of the study, but no significant differences were recorded between the samples before and after treatment in this parameter. Plant (C) recorded the highest overall efficiency of the studied plants at 12.20%, while plant B recorded the lowest efficiency of 0.37%. Overall, the treatment efficiency of the plants studied for this parameter was very low, and none of the samples treated were within the limits of approved drinking water specifications. In general, it is noted that the higher the concentration of salts in raw water, the more likely that the plants' ability to process will be weakened. References [3-12] recommend using more progressive and complex techniques than water purification if the saline concentrations of water exceed (1200-1500) mg/L. However, one plant may surpass the other in the technical and operational aspects, that may somewhat covers on the first factor, which is increasing of salt. Increased concentration of dissolved salts in water adversely affect the performance of purification units, as it causes damage and corrosion of machines, pumps, units and pipes quickly and increases the burden on the impurities treatment process. Increased salts in water also reduce the effect of auxiliary chemicals on sedimentation such as alum and convert to other chemical compounds, and increase the concentrations of pollutants to be treated. and to damage the medium of sand filters as well. Therefore there is the need for replacement and maintenance of the purification units in short periods[3-13], and Table.1. shows the parameters concentrations and treatment efficiency for plants samples during the study period[14-15-16].

4.2.5 Turbidity(Turb)

The highest raw water value to this parameter for the four plants has been recorded at plant (B) Al-Hartha with 91.10 NTU, while the minimum concentration was 1.89 NTU at plant (A) Al-Medayna. Plant (B) was recorded the highest concentration of treated water of this parameter at 120.00 NTU, while the lowest concentration was at plant (A) with 3.01 NTU. There were significant differences between the months of the study, and the statistical analysis showed significant differences between the plants with each other, but no significant differences were recorded between the samples before and after treatment in this parameter. Plant (A) has shown the highest overall efficiency compared with the rest of the studied plants of 13.34% at this parameter; however, plant (B) recorded the lowest efficiency of 3.88%. Overall, the efficiency of treatment at the plants studied for this parameter was insufficient, where there were only 4 samples within the limits of approved drinking water specifications.

4.2.6 Total suspended solids (TSS)

The results showed that the highest raw water value was recorded at plant (B) Al-Hartha with a concentration of 434.00 mg/L, while the lowest recorded concentration of raw water was 132.00 mg/L at plant (C)Al-Jubaila, whereas plant (B) recorded the highest concentration of treated water of this parameter at a value of 428.00 mg/L; however, the lowest concentration was at plant (C) with a value of 131.00 mg/L. Statistical analysis have showed significant differences between the plants with each other, There were statistically significant differences between the months of the study, but no significant differences were recorded between the samples before and after treatment at this parameter. Plant (A) has been recorded the highest overall efficiency compared with the rest of the other plants at 13.35%, while plant (B) was recorded the lowest efficiency of 3.91%. Overall, the efficiency of treatment at the plants studied for this parameter was very low. Also, none of the treated samples were within the limits of approved drinking water specifications. The reason for the low treatment efficiency of TSS through the observations of the Author is that the purification units and sand filters are not cleaned periodically and they remain long periods without cleaning, and when alum is added to the basins, the water does not leave a suitable sedimentation period. Instead, water comes out directly from the basins which can increase impurities in the product water at sometimes. The high concentration of TSS in raw water is due to the overlap of sea water with river water; wastewater is also drained along the river.

4.2.7 Total hardness (TH)

The highest raw water value of this parameter for the four plants was recorded at (B) Al-Jubaila plant at a concentration of 3480 mg/L, while the lowest concentration of raw water was 1070 mg/L at (A)Al-Medayna plant. Plant (B) recorded the highest concentration of treated water with a value of 3500 mg/L, while the lowest concentration was in plant (D) with a value of 710.00 mg/L. Statistical analysis showed significant differences between plants with each other, there were recorded significant differences between the months of the study, but no significant differences have been recorded between the samples before and after treatment at this parameter except in the plant (D) Al-Bradeya. Plant (D) has the highest overall efficiency compared to the other plants studied at 16.16%, while plant (B) has the lowest efficiency of 0.66%.Overall, the ratio of total treatment efficiency at the studied plants for this parameter was very low, and the high concentration of TH in raw water is due to the overlap of sea water with river water. Wastewater is also drained along the river. None of the treated specimens were within the limits of the approved drinking water specifications.

4.2.8 Calcium (Ca)

The results showed that the highest value of raw water was recorded at plant (B) Al-Jubaila with a concentration of 252.00 mg /L ,while the lowest concentration of raw water was recorded of 168.00 mg /L at plant (A) Al-Medayna. Whereas plant (B) has been recorded the highest concentration of treated water of this parameter at 252.00 mg /L, the lowest concentration was at plant (A) at 148.00 mg /L. Statistical analysis showed significant differences between the plants, As was significant differences were recorded between the months of the study, but no statistically significant differences were showed between the samples before and after treatment at this parameter except in plant (D). Plant (D) has been recorded the highest percentage of total efficiency compared to the other plants studied of 9.33% at this parameter, while plant (B) recorded the lowest efficiency of 2.08%. Generally, the overall treatment efficiency at the plants studied for this parameter was very low, and none of the treated samples have been within the limits of approved drinking water specifications.

4.2.9 Magnesium (Mg)

The results showed that the highest raw water value at this parameter for the four plants was at (B) plant at 144.94 mg/L, while the lowest concentration was 29.28 mg/L at (A) Al-Medayna plant. Whereas plant (B) recorded the highest concentration of treated water at 143.96 mg/L, the lowest concentration was at plant (D) value of 9.27 mg/L. The statistical analysis showed that there were significant differences between the plants, and significant differences were appeared between the months of the study, but no significant differences were recorded between the samples before and after treatment at this parameter. Plant (D) has been recorded the highest efficiency of the studied plants at 21.01%; however, plant (B) recorded the lowest efficiency of 0.11%. In general, the overall treatment efficiency at the studied plants for this parameter was very low. There have been 10 samples of treated samples within the limits of approved drinking water specifications.

4.2.10 Chloride (Cl)

The results of the study showed that the highest value of raw water was recorded at Al-Hartha plant (B) with a concentration of 1302.85 mg/L, while the lowest concentration of raw water was 454.40 mg /L at Al-Medayna plant (A), whereas plant (C) recorded the highest concentration of treated water with a value of 1526.50 mg /L, the lowest concentration for this parameter was at plant (A) with a value of 457.95 mg/L. The statistical analysis showed significant differences between the plants with each other, and significant differences were recorded between the months of the study, However, no significant differences were observed between the samples before and after treatment at this parameter except in plant (D). Plant (A) has been recorded the highest overall efficiency of the studied plants at 14.62% at this parameter; however, plant (B) recorded the lowest efficiency of 0.10%. Generally, the overall efficiency of treatment at the studied plants for this parameter was very low, and none of the treated specimens were within the limits of approved drinking water specifications.

4.2.11 Sodium (Na)

The highest value of raw water at this parameter has been recorded at Al-Bradeya plant (D) with a concentration of 635.90 mg/L, while the lowest concentration of raw water was 303.30 mg/L at Al-Medayna plant (A). Whereas the highest concentration of treated water was recorded at plant (B) at 631.20 mg /L, the lowest concentration was in plant (A) at 305.40 mg/L. Although the statistical analysis showed significant differences between the plants with each other, but there were no significant differences between the study months, as well as there were no significant differences between the samples before and after treatment at this parameter except in plant (D). Plant (C) has been recorded the highest overall efficiency of the studied plants at 9.09%; however, plant (B) recorded the lowest efficiency of 1.13%. Overall, the overall treatment efficiency at the studied plants for this parameter was very low, and none of the treated specimens were within the limits of approved drinking water specifications.

4.2.12 Potassium (K)

The highest value of raw water has been recorded at Al-Hartha plant (B) with a concentration of 26.10 mg/L, while the lowest concentration was 8.80 mg/L at Al-Medayna plant (A). Plant (B) was recorded the highest concentration of treated water at 26.40 mg /L, while the lowest concentration was at plant (A) at 9.10 mg L. Although the statistical analysis showed that there were statistically significant differences between the plants, but there were no significant differences between the study months, as well as there were no significant differences recorded between the samples before and after treatment. Plant (C) has been recorded the highest overall efficiency of the studied plants at 12.31%, while plant (B) recorded the lowest efficiency of 1.14%. Generally, the overall treatment efficiency at studied plants for this parameter was very low, and there have been only 6 samples of the treated samples within the limits of approved drinking water specifications [17].

5. CONCLUSIONS

1-The results showed that the efficiency of water treatment was very small for the four plants where the efficiency was variable in proportions, and that the quality of the water produced from the operation of the plants is not commensurate with the large sums expended from the process.

2-The results of the study showed that the Al-Hartha plant has been recorded the lowest treatment efficiency compared to the samples of other plants, which indicates a significant defect in its work, where the average of removal ratios of the total parameters of the plant

1.38%, while Al Bradeya plant was recorded the highest of removal ratios by 10.29%, followed by Al-Medayna plant by 10.20% and then Al-Jubaila plant by 10.10%.

3- Laboratory tests showed that the samples of the Al-Bradeya plant has been recorded the lowest percentage of negative samples followed by samples of the Al-Jubaila plant and then Al-Medayna, whereas Al-Hartha plant was the most plant had recorded negative samples.

4- Although the results showed that 23 samples of the treated samples were within the specifications limits of the pH parameter, and 4 samples of the turbidity parameter were within the specifications, 6 at k and 10 at Mg, it did not, however, record any conformity to the specifications at the parameters (EC, TSS, TDS, Cl, Na, TH, Ca), and therefore the treated water samples of all four plants are unsuitable for drinking uses.

5- The fault was not only in the inability of the plants to treat dissolved salts in water, but there was a defect in the ability of plants to remove impurities and suspended solids also, which is at the core of the work and functions of water purification plants.

6- Although the total dissolved salts in the Al-Medayna plant were lower than the Al-Jubaila and Al-Bradeya plant, which is supposed to improve their treatment capacity, the overall efficiency of the parameters at the three plants remained close, and Al-Bradeya plant exceeded the other two plants, albeit with a small margin due to technical, operational and design factors.

7- It was noted that the higher the concentration of dissolved solids in water, the less the purification plants capacity on the treatment, which were recorded between the Al-Modayna plant and Al-Bradeya. Although the Al-Bradeya plant was better than the Al-Modayna plant in operational and technical aspect, and this is evident through the total removal ratio of 10.29%, 10.10%, but Al-Modayna plant surpassed the first by the low concentration of dissolved solids in water, recording the highest removal ratio at this parameter at 9.08%, while the Al-Bradeya recorded 6.93%.

8-It is clear from the rates of discharge for the last ten years feeding Shatt al-Arab from the rivers water at the center of the province that it is insufficient to contribute to a positive change in the quality of water Shatt al-Arab, and that salts concentrations with the years of study have always recorded a large rise and relative stability in this rise and much exceeded than maximum specifications limits approved, which affects the efficiency of treatment in the purification plants negatively and makes them unable to cope with the deterioration in water quality to become useless without any hope of decreasing salinity or entering auxiliary factors on it in the near and medium future.

Table. 1. parameters concentrations and removal efficiency for plants samples.

Plant	Month	Sample	pH	T (°C)	Ec (ms)	TDS mg/l	Turbidity NTU	TSS mg/l	TH mg/l	Ca mg/l	Mg mg/l	CL mg/l	Na mg/l	K mg/l
(Al- Medyna)	November	A1	6.46	19.6	2.65	1330	1.89	384	2100	176	81.01	454.4	303.3	8.8
		A2	6.56	19.5	2.65	1330	3.01	410	2140	180	83.45	457.95	305.4	9.1
	Efficiency %		-	-	0	0	-0	-0	-0	-0	-0	-0	-0	-0
	December	A1	6.83	15.3	3.32	1697	3.73	391	2580	192	102.48	674.5	402	12.8
		A2	7.73	15.7	3.32	1667	3.34	350	2500	168	101.5	628.35	381.90	12
	Efficiency %		-	-	0	1.77	10.46	10.49	3.1	12.5	0.95	6.84	5	6.25
	January	A1	7.24	19.4	5.76	2880	14.53	283	2940	176	122	823.6	481	16.6
		A2	7.79	19.4	3.65	1821	8.53	166	2240	148	91.26	497	329.2	9.4
	Efficiency %		-	-	36.63	36.77	41.27	41.34	23.81	15.91	25.2	39.66	31.56	43.37
	February	A1	7.53	21.1	5.29	2650	11.73	183	1250	168	40.5	717.1	343.5	10.3
		A2	5.54	20.8	5.5	2760	13.08	203	1230	176	38.55	710	337.3	11
	Efficiency %		-	-	-0	-0	-0	-0	1.60	-0	4.82	0.99	1.80	-0
	March	A1	7.55	22.3	4.02	2010	8.86	276	1380	172	46.36	855.55	368.40	14
		A2	7.58	22.3	3.31	1654	6.35	198	1150	180	34.16	880.4	370.9	14
	Efficiency %		-	-	17.66	17.71	28.33	28.26	16.67	-0	26.32	-0	-0	0

Table. 1. parameters concentrations and removal efficiency for plants samples (cont.).

Plant	Month	Sample	pH	T (°C)	Ec (ms)	TDS mg/l	Turbidity NTU	TSS mg/l	TH mg/l	Ca mg/l	Mg mg/l	CL mg/l	Na mg/l	K mg/l
	April	**A1**	7.73	20.5	3.28	1636	6.9	231	1070	188	29.28	1057.9	360.3	9.9
		A2	8.07	20.8	3.42	1713	38.8	236	1300	184	40.99	631.9	383.1	10.5
	Efficiency %		-	-	-0	-0	-0	-0	-0	2.13	-0	40.27	-0	-0
	Total efficiency %		-	-	9.05	9.08	13.34	13.35	7.53	5.09	9.55	14.62	6.39	8.27
	Average of total removal ratios%		-	-	10.20									
(Al- Hartha)	**November**	**B1**	7.69	20.6	6.28	3130	25.18	374	2400	252	86.38	1302.85	568.6	21.7
		B2	7.78	20.4	6.28	3130	33.18	386	3360	252	133.22	1309.95	617.5	26.4
	Efficiency %		-	-	0	0	-0	-0	-0	0	-0	-0	-0	-0
	December	**B1**	7.69	15.5	5.46	2730	57.65	434	3420	224	139.57	1118.25	627.8	26.1
		B2	7.75	15.7	5.46	2730	56.89	428	3500	224	143.47	1164.4	631.2	26.2
	Efficiency %		-	-	0	0	1.32	1.38	-0	0	-0	-0	-0	-0
	January	**B1**	8	15.8	5.44	2720	33.6	384	3480	204	144.94	1146.65	578.7	21.7
		B2	8.04	15.8	5.37	2690	33.09	378	3500	220	143.96	1139.55	571.2	21.7
	Efficiency %		-	-	1.29	1.1	1.52	1.56	-0	-0	0.67	0.62	1.3	0
	February	**B1**	7.6	21	7.19	3600	3.82	258	1520	224	46.85	820.05	433.1	17.6
		B2	7.61	21.2	7.12	3560	3.04	205	1460	196	47.34	994	412.8	16.6
	Efficiency %		-	-	0.97	1.11	20.42	20.54	3.95	12.5	-0	-0	4.69	5.68
	March	**B1**	7.5	22.7	4.51	2250	91.1	248	1400	184	45.87	969.15	394.6	16
		B2	7.48	22.3	5.07	2540	120	268	1580	252	46.36	1171.5	448.9	19
	Efficiency %		-	-	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0
	April	**B1**	7.3	20.8	5.08	2540	35.8	224	1600	216	51.73	1065	538.6	17.4
		B2	7.37	20.4	5.15	2580	44.4	227	1730	224	57.1	1079.2	534.3	17.2
	Efficiency %		-	-	-0	-0	-0	-0	-0	-0	-0	-0	0.8	1.15
	Total efficiency %		-	-	0.37	0.37	3.88	3.91	0.66	2.08	0.11	0.10	1.13	1.14
	Average of total removal ratios%		-	-	1.38									
	November	**C1**	7.67	20.6	4.94	2470	41.73	242	3000	228	118.58	1004.65	547.2	19.9
		C2	7.75	21.5	3.07	1532	26.08	151	2300	176	90.77	568	371.3	12.6

Table. 1. parameters concentrations and removal efficiency for plants samples (cont.).

Plant	Month	Sample	pH	T (°C)	Ec (ms)	TDS mg/l	Turbidity NTU	TSS mg/l	TH mg/l	Ca mg/l	Mg mg/l	CL mg/l	Na mg/l	K mg/l
(Al-Jubaila)	**Efficiency %**		-	-	37.85	37.98	37.5	37.6	23.33	22.81	23.46	43.46	32.15	36.68
	December	**C1**	7.64	16.3	4	2090	22.13	328	2740	208	108.34	795.2	465.9	16.5
		C2	7.59	16	2.95	1477	17.52	260	2340	184	91.74	603.5	393.3	13.2
	Efficiency %		-	-	26.25	29.33	20.81	20.73	14.6	11.54	15.32	24.11	15.58	20
	January	**C1**	7.08	19.4	5.98	2990	11.76	203	3000	200	122	880.4	443.3	17.1
		C2	7.36	19.3	5.75	2880	12.03	207	2900	196	117.61	887.5	413.1	15.6
	Efficiency %		-	-	3.85	3.68	-0	-0	3.33	2	3.6	-0	6.81	8.77
	February	**C1**	7.35	21.1	6.87	3440	2.38	252	1320	172	43.43	923	376.6	14.3
		C2	7.17	22.1	7.16	3580	3.97	333	1520	224	46.85	1001.1	440.3	19.7
	Efficiency %		-	-	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0
	March	**C1**	7.35	21.4	5.43	2710	53.1	318	1710	236	54.66	1235.4	467.8	23.7
		C2	7.27	21.9	5.29	2650	50.16	300	1600	232	49.78	1526.5	579.4	21.7
	Efficiency %		-	-	2.58	2.21	5.54	5.66	6.43	1.69	8.93	-0	-0	8.44
	April	**C1**	7.11	20.9	5.27	2640	13.3	132	1510	200	49.29	1157.3	589	22.3
		C2	7.06	18.2	5.31	2650	13.2	131	1560	216	49.78	1171.5	619.6	23.8
	Efficiency %		-	-	-0	-0	0.75	0.76	-0	-0	-0	-0	-0	-0
	Total efficiency %		-	-	11.76	12.2	10.77	10.79	7.95	6.34	8.55	11.26	9.09	12.31
	Average of total removal ratios%		-	-	10.10									
	November	**D1**	8	19.4	4.79	2400	38.45	392	3020	236	118.58	940.75	527.1	19.2
		D2	8.02	19.2	4.39	2190	37.11	378	2840	196	114.68	887.5	490.7	17
	Efficiency %		-	-	8.35	8.75	3.49	3.57	5.96	16.95	3.29	5.66	6.91	11.46
	December	**D1**	7.48	16.5	3.61	1807	33.2	306	2640	200	104.43	688.7	438.9	14.7
		D2	7.65	16.9	3.34	1670	26.61	245	2580	180	103.94	639	410.8	13.1
	Efficiency %		-	-	7.48	7.58	19.85	19.93	2.27	10	0.47	7.22	6.40	10.88
	January	**D1**	7.29	18.8	5.52	2760	12.88	211	2880	184	118.1	830.7	398.1	15.7
		D2	7.51	18.8	4.59	2290	10.03	164	2660	160	110.29	656.75	344.1	11.2

Table. 1. parameters concentrations and removal efficiency for plants samples (cont.).

Plant	Month	Sample	pH	T (°C)	Ec (ms)	TDS mg/l	Turbidity NTU	TSS mg/l	TH mg/l	Ca mg/l	Mg mg/l	CL mg/l	Na mg/l	K mg/l
(Al-Bradeya)	**Efficiency %**		-	-	16.85	17.03	22.15	22.27	7.64	13.04	6.61	20.94	13.56	28.66
	February	**D1**	7.28	21.2	7.62	3810	5.13	210	1650	200	56.12	1178.6	454.7	21.3
		D2	7.45	21.3	7.81	3900	12.46	251	1470	200	47.34	1093.4	467.9	22.2
	Efficiency %		-	-	-0	-0	-0	-0	10.91	0	15.65	7.23	-0	-0
	March	**D1**	7.31	20.6	5.37	2690	52	270	1880	228	63.93	1199.9	588.1	22.4
		D2	7.46	21.5	5.35	2580	51.68	268	1550	200	51.24	1185.7	565.9	21.6
	Efficiency %		-	-	4.28	4.09	0.62	0.74	17.55	12.28	19.85	1.18	3.77	3.57
	April	**D1**	7.3	18.9	5.34	2670	12.5	218	1500	216	46.85	1199.9	635.9	24
		D2	7.13	20.9	4.88	2560	11.42	199	710	208	9.27	1143.1	605.6	21.8
	Efficiency %		-	-	4.12	4.12	8.64	8.72	52.67	3.70	80.21	4.73	4.76	9.17
	Total efficiency %		-	-	6.84	6.93	9.12	9.20	16.16	9.33	21.01	7.83	5.90	10.62
	Average of total removal ratios%		-	-	10.29									
The Limits of the Iraqi, EPA & WHO Specifications			**6.5 *- 8.5 ***	-	-	**1000.00***	**5.00 ***	**0.00 ***	**500.00***	**50.00***	**50.00***	**200.00***	**200.00***	**12.00 ****
Number of treated samples and conformed to specifications			23.00	-	0.00	0.00	4.00	0.00	0.00	0.00	10.00	0.00	0.00	6.00
The least significant difference at 0.05	**Plants**		-	-	0.00	0.00	0.00	0.022	0.00	0.00	0.002	0.00	0.00	0.00
	Months		-	-	0	0	0	0	0	0.04	0	0.01	0.06	0.61
	Before and After Treatment	**A_1 A_2**	-	-	0.31	0.30	0.49	0.25	0.38	0.41	0.42	0.17	0.38	0.43
		B_1-B_2	-	-	0.44	0.43	0.18	0.65	0.22	0.45	0.27	0.11	0.38	0.28
		C_1-C_2	-	-	0.2	0.19	0.23	0.56	0.24	0.86	0.15	0.71	0.79	0.53
		D_1-D_2	-	-	0.09	0.09	0.68	0.3	0.04	0.02	0.08	0.02	0.03	0.06

These symbols mean:

(A_1,B_1, C_1, D_1):Raw water samples which is entering to the studied plants, (A_2,B_2, C_2, D_2): Treated water samples which is exiting from the studied plants.

*:[14-15-16]. , ** : [17].

In order to make use of the previous points in the practical aspect, the Author suggests the following basic recommendations:

- Cleaning of purification units, especially sedimentation tanks and sand filters and the washing of filters periodically for studied plants.
- For plants that Influent TSS concentration is too high it is recommended to use auxiliary chemicals in the sedimentation removal.
- To achieve high removal efficiency of suspended solids when adding alum for studied plants, water should be left in the tanks for at least (2-4) hours before exiting in order to avoid adding other impurities to the treated water instead of reducing them [6-18].
- To treat the high salinity of the water source in Basra, desalination technology should be used in the treatment plants. Where water should pass through the primary treatment unit, which is the purification plant, and then transferred to desalination units.

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كفاءة معالجة بعض محطات التصفية في محافظة البصرة وتأثرها بتغاير نوعية المياه

اجريت فحوصات مختبرية لتقييم كفاءة المعالجة لمحطات تصفية المياه ومدى تأثرها بتغيرات مياه الانهار عند اربع محطات في محافظة البصرة، حيث قيست بعض الخصائص الفيزيائية والكيميائية. لقد بينت نتائج الدراسة أن جودة وكفاءة المياه المعالجة كانت قليلة جداً وغير مقبولة للمحطات الاربعة، فقد سجلت محطة الهارثة أدنى كفاءة معالجة عامة بنسبة 1.38% ، بينما سجلت محطة البراضعية أعلى معدل كفاءة عامة 10.29%. وبينت الدراسة أن عينات المياه المعالجة للمحطات هي غير صالحة الاستخدام للشرب، كما بينت النتائج أن الخلل في تدني كفاءة المعالجة لم يكن فقط في عدم قدرة المحطات على معالجة الاملاح الذائبة في الماء بل كان هناك خلل كبير في قدرة المحطات على ازالة الشوائب والمواد العالقة وهو ما يندرج في جوهر عمل ومهام المحطات. ولقد بينت الدراسة أن معدلات التصاريف وتراكيز الاملاح للعشر سنوات الاخيرة المغذية لشط العرب من الانهار كانت غير كافية لتسهم في الحصول على تغير ايجابي في نوعية المياه، وبالتالي ينبغي اعتماد تقنية اكثر تطور من تصفية المياه وهي التحلية في عموم محطات البصرة بحيث تكون تحلية المياه هي مكملة ولاحقة لعملية التصفية.