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Determine The Quality Production and Operatıonal Efficiency of Abu-Taraba Desalination Plant During 2017-2019

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ABSTRACT

Abu-Taraba Desalination Plant uses multi-effect evaporation technology, which has received great attention in the past few decades, and has also introduced steam pressure technology to produce water. The capacity of the station is approximately 40,000 cubic meters per day. This study aims to determine the quality and operational efficiency of produced water from 2017 to 2019. The physical and chemical parameters included (PH,) T (temperature), NTU turbidity, Taste, Odor, electrical conduction (Ec), Total dissolved salts TDS, (T.H) (total hardness), T-ALK as $CaCO_3$, magnesium (Mg), (K) potassium., Fe, (Na) sodium, (K) potassium and (RC1) residual chlorine were used for assessment of water quality. At the same time, determined the operating efficiency, an equation is used, which depends on the actual water volume and the volume production in the "perfect" state from 2017 to 2019. The results showed the evidence for desalination plant's high efficiency in producing water with high specifications compared to the Libyan standard limits, guidelines for drinking, and WHO specifications. While, the average operating efficiency of Abu-Taraba Desalination Plant during 2017,2018 and 2019 were 42.6% ,21.6% and 13.38 % respectively. In fact, the operating efficiency ratio was very low in 2019. Therefore, it is necessary to make recommendations to support the technical requirements of Abu-Taraba Desalination Plant to carry out the necessary maintenance of the 82-83 production units to achieve the goals and meet the needs of Abu-Taraba Desalination Plant.

الملخص العربي

محطة تحلية أبو ترابة تستخدم تكنولوجيا التبخير متعددة التأثيرات، والتي حظيت باهتمام كبير في العقود القليلة الماضية. تبلغ سعة المحطة حوالي 40000 م3 / يوم. تهدف هذه الدراسة إلى تحديد الجودة والكفاءة التشغيلية للمياه المنتجة من عام 2017 إلى عام 2019. وشملت تحديد بعض المتغيرات الفيزيائية والكيميائية لتقييم جودة المياه. كما تم تحديد الكفاءة التشغيلية، باستخدام معادلة تعتمد على حجم المياه الفعلي وحجم الإنتاج في الحالة "المثالية" من عام 2017 إلى عام 2019. وأظهرت نتائج جودة المياه مطابقتها للمواصفات القياسية الليبية ومواصفات منظمة الصحة العالمية. في حين بلغ متوسط الكفاءة التشغيلية لمحطة تحلية أبو تربة خلال الأعوام 2017 و2018 و 2019 42.6 ٪ و21.6 ٪ و13.38 ٪ على التوالي. في الواقع، كانت نسبة الكفاءة التشغيلية منخفضة جدًا في عام 2019. لذلك من الضروري تقديم توصيات لدعم المتطلبات الفنية لمحطة تحلية أبو ترابة لإجراء الصيانة اللازمة للوحدات الإنتاجية 82-83 لتحقيق الأهداف وتلبية احتياجات محطة تحلية أبو ترابة.

INTRODUCTION

The major part of water on earth is marine water which cannot be used without processing by human beings. The protection and appropriate usage of water resources vary depending on sensitiveness of societies about this matter besides their awareness. Nowadays, the factors such as industrialization, increasing population and urbanization, global climate changes, wrong irrigation methods, unconscious usage, and excessive agricultural activities increase the pressure on protection of water resources(Ekrem Mutlu, Banu Kutlu, & Demir, 2016; Maraşlıoğlu, Gönülol, & Bektaş, 2017). In brief, the quantity and quality of water both surface or ground water have been deteriorated as a result of some significant points such as growing population, industrialization and social process(Bhadja, Poonam, Vaghela, & Ashokkumar, 2013; Imneisi & Aydin, 2016a). The quality of surface water and ground are equally important as the quantity. Water quality is defined as all an information of biological, chemical, and physical elements of water and their interaction to decide the suitable usage for water(Imneisi & Aydin, 2016b; Taner, Üstün, & Erdinçler, 2011). Desalination is a method of producing water for human consumption, irrigation or industrial use. In the past few decades, many desalination technologies have been developed, Increase water supply in dry regions of the world (Khawaji, Kutubkhanah, & Wie, 2008).

Desalination refers to the removal of excess salt and minerals from water and is used to provide pure water from seawater or brackish water. It is generally considered that the salinity below 500 ppm is suitable for drinking water. Generally, due to the scarcity of fresh water in many regions, some countries have resorted to using several desalination methods Sea water for use in different life fields. the water produced by a thermal distiller is characterized by extremely low salinity and high corrosiveness(Withers, 2005). There are numerous processes have been proposed for the desalination of water, but some of them can be disregarded because they do not offer a sufficiently attractive economic prospect. There are several ways to classify well-known desalination processes (Mousa S. Mohsena & Al-Jayyousib, 1999). Desalination systems are divided into two main design categories, namely thermal energy and membrane type(Buros, 1990). Thermal design includes multi-stage flash evaporation (MSF) and multi-effect distillation (MED), which use flash evaporation and evaporation to produce drinking water, while membrane design uses reverse osmosis (RO) method. With the continuous improvement of membrane performance, RO technology It is constantly evolving. By combining RO with MED or RO with MSF, more and more markets are obtained in desalination and mixed configuration (I.A.E.A, 2006). Quantitative and spatially clear information about Abu-Taraba Desalination Plant is needed to descript this resource through strategies that provide for adapting to the growing water demand associated with population growth and water shortages. The objective of this paper is to evaluate Butrabah desalination plant in terms of the production quality and operatıonal efficiency during 2017-2019.

MATERIALS AND METHODS

2.1. Study area

2.1.1. Abu-Taraba Desalination Plant.

The State Water Desalination Company (Abu-Taraba Desalination Plant) was established under the former General People's Committee Resolution No. (924) issued on 28/10/2007. Abu-Taraba Desalination Plant uses multi-effect evaporation technology that has taken great attention during the past decades and also with the introduction of steam pressure technology with it to produce water. The station consists of 3 evaporators with a total capacity of 40,000 cubic meters and 3 boilers with a capacity of 80 tons per hour, in addition to the auxiliary systems (system Fuel cooling system air system) the design capacity of the station is about 40,000 m3 /d, and these units operate with light and heavy fuel. The station occupies an area of 16 hectares, and aims to provide safe water to the residents of Al-Marj, Tocra and Talmitha. This desalination plant consists of several compartments as (Sea water intake system, Sea water pump system, the chlorination unit system consists of a chlorine production unit and chlorine injection pumps, Fuel system, Boiler feeding system, boiler system, Evaporators system, unit hardness system, a system of drinking tanks, drinking water pumping system, Extinguishing system., air compressor system). Figure1. described the main units in sea water Desalination Plant.

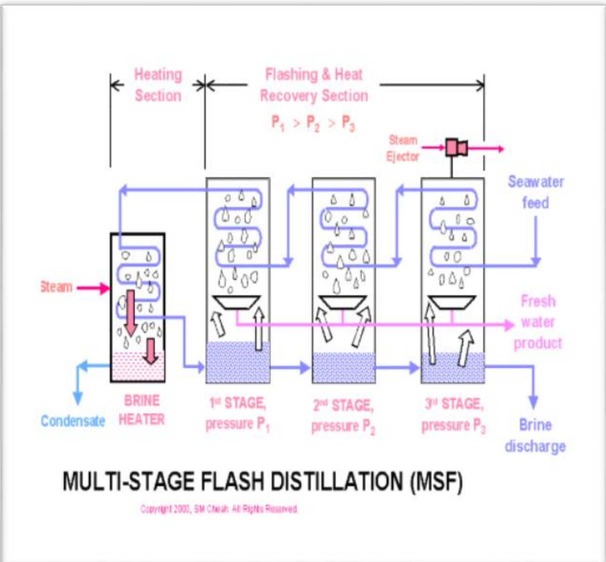

Figure. 1. Schematic design of the desalination plant (MED-TVC-3units).

2.1.2. **Description of the study area.**

Abu-Taraba Desalination Plant is located on the northeastern coast of the Benghazi Plain, 40 km from the city of Maraj to the south, 10 km from Talmitha, 10 km to the east, and 25 km from Tocra to the west. Between two circles width of 32 10 39 and 32 38 35 north and longitude 20 49 58 and 20 07. 49

Figure (2) shows Explains the Abu-Taraba Desalination Plant.

2.2. **Methodology of the Study**

This study relied on the available data for water productivity from Abu-Taraba Desalination Plant and the sources that dealt with the subject, as well as research and studies published in scientific journals and reports of government agencies and frequent field visits to the plant starting (2017-2019) to identify its components and obtain information on the productivity of the desalinated water entering and leaving, the most important problems faced by the station during the period 2017-2019.

2.2.1. **water quality data and the quantities of desalinated water produced.**

Desalination plants producing up to several thousand gallons per day are commercially available and already used for domestic and industrial purposes in some very arid regions. The average monthly of some chemical characters of water production from Abu-Taraba desalination plant during 2017-2019.which it includes total dissolved solid, electric conductivity, pH meter, ferric, total alkalinity, sodium, potassium and residual chlorine. The values of physic-chemical parameters were compared to WHO guideline(WHO, 2011). And calculation the operatıonal efficiency from get some information including the quantities of desalinated water produced in Abu-Taraba desalination plant during 2017-2019 by using formal that described in equation. 1.

$$\textbf{operational efficiency} = \frac{\textbf{total production}}{\textbf{Max potential}}\ \textbf{100}\ \textbf{eq..(1)}$$

RESULTS AND DISCUSSION

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2.3. ***The Quality Production Assessment.***

The physical and chemical analyzes included (PH,) T (temperature), NTU turbidity, Taste, Odor, electrical conduction (Ec), Total dissolved salts TDS, (T.H) (total hardness), T-ALK as CaCO3, magnesium (Mg), (K) potassium., Fe, (Na) sodium, (K) potassium, and (RC1) residual chlorine. As seen in Table 1and 2 showing the Descriptive statistics for The Production Quality during 2017-2019, and illustrated in Figure 1,2, and 3 illustrating the average T. alkalinity, sodium, Fe, k, residual chlorine and TDS concentration compared during 2017-2019, it is observed that All water samples were found to be lower than the allowed concentration level as compared with WHO and Libyan standards.

Table (1) shows Descriptive statistics of chemical water quality from 2017-2019.

Descriptive Statistics

	N	Min	Max	Mean		Std.Dev
Parameter	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
pH	36	5.94	7.87	6.87	.061	.366
(EC)	36	130.0	480.0	309.	16.70	100.23
NTU	36	65.0	240.0	154.	8.35	50.14
Taste	36	.01	.03	.016	.0015	.0095
Odour	36	6.00	26.0	14.2	.799	4.794
Tempera	36	5.80	57.5	30.0	1.79	10.76
(TDS)	36	.20	2.4	1.03	.077	.463
Iron (Fe)	36	.00	.28	.118	.009	.059

As shown in Table 2. Comparison Statistics Mean for The Production Quality During 2017-2019. The most average concentration of the parameter in 2017 is lower than 2018 and 2019.

Table (2) Shows Comparison Statistics Mean of chemical water quality from 2017-2019.

parameter	WHO	2017	2018	2019
pH	6.5-8.5	6.97	6.71	6.94
Electrical cond(EC)	µS/cm<1500	215	360.5	353.4
Turbidity	<5 NTU	0.19	0.16	0.13
Taste	NIL	NIL	NIL	NIL
Odour	NIL	NIL	NIL	NIL
Temperatuer C	20	24.3	23	23.25

Total dissolved	500-1000 mg/l	107.58	180.41	176.6
Iron (Fe)	<0.3 mg/l	0.03	0.01	0.01
Total alkalinity	<250 mg/l	11.2	16.5	11.91
Sodium (Na)	<200 mg/l	22.14	31.44	37.29
Potassium	12 mg/l	0.71	1.10	1.29
Residual chlorine	<0.5 mg/l	0.129	0.12	0.095

As shown in Figure 3 Abu-Taraba Desalination Plant has an average of three years for alkaline concentration and sodium. The alkalinity ranges between 6 and 26 mg/l, while the sodium ranges between 5.8 and 57.5 mg/l. The average of sodium concentration was 30 mg/l which it was in conformity with the Libyan standard specifications. while the average of alkalinity was 14.2mg/l.

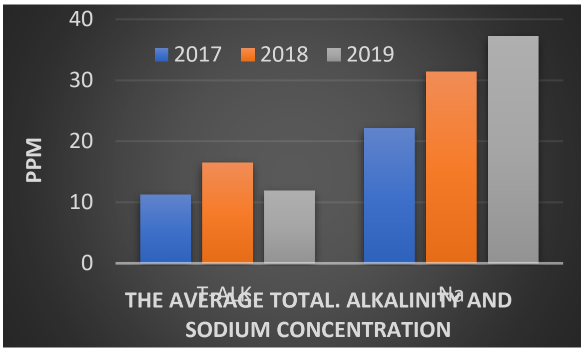

Figure 3. Diagram showing the average T. alkalinity and sodium content from 2017-2019.

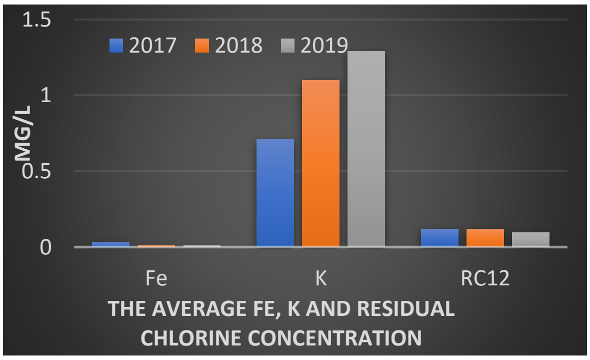

Figure 4. Diagram showing the average Fe, k and residual chlorine content from 2017-2019.

Figure 5 shows The Average T.D.S concentration compared during 2017-2019 in the drinking water samples which taken from of Butrabah Desalination Plant. The levels of TDS concentration in all water samples taken from Butrabah Desalination Plant was ranging from 65 to 240 with an average of 154.88mg/l. TDS of the product water is usually below 250 ppm, making it within the WHO guidelines (Table 1).

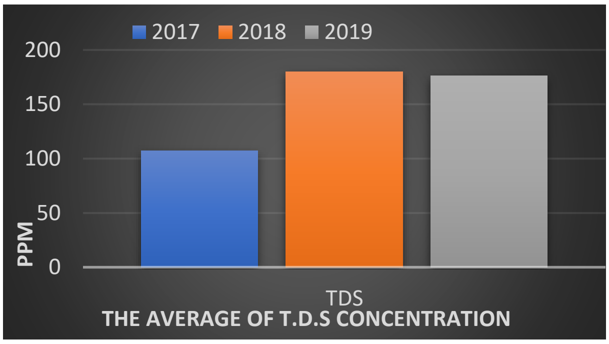

Figure 5. Diagram showing the average T.D.S concentration compared during 2017-2019.

2.4. Operational Efficiency Assessment

Table 3 presents the results for the quantities of desalinated water produced and the average operational efficiency % in Abu-Taraba Desalination Plant During the Period 2017-2019. The target of desalination plant is 14600000 m3 /year. Table (3) shows The quantities of desalinated water produced and the average operational efficiency % in Abu-Taraba Desalination Plant During the Period 2017-2019.

Table (3)The produced quantities m3/years

	2017	2018	2019
Unit 81 m^3 /years	3151111	2531239	1951619
Unit 82 m^3 /years	2531239	621986	0
Unit83 m^3 /years	542165	0	0
Total m^3 /years	6226532	3155243	1953638
Targeted m^3 /years	14,600,00 0	14,600,00 0	14,600,00 0
The operational efficiency %	42.65%	21.61%	13.38%

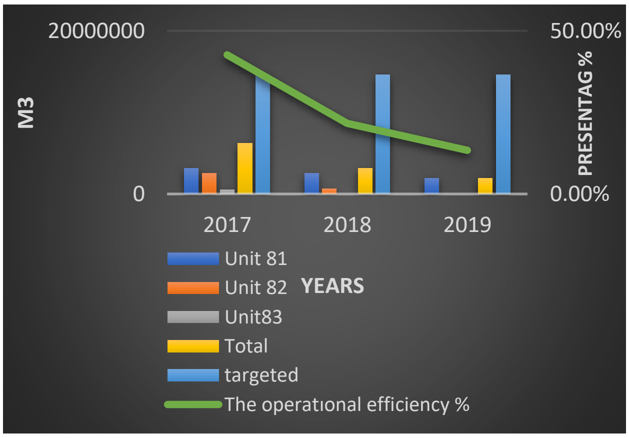

Figure 6. Diagram showing The Average quantities of desalinated water produced and the average operational efficiency % in Abu-Taraba Desalination Plant During the Period 2017-2019

DISCUSSION AND CONCLUSION

This study attempted to evaluate the Butrabah Water Desalination Plant through two criteria, namely, determining the quality of water produced and the criterion of productive efficiency, which is concerned with the quantity of final production compared to what is targeted. This study concluded.

- The results of the chemical analyzes showed the evidence for desalination The plant's high efficiency in producing water with high specifications compared to the Libyan standard limits, guidelines for drinking, and WHO specifications
- As the proportions of all the chemical elements in the produced desalinated water were less than the permissible limit, which confirms the quality of the desalinated water.
- It was evident that there was a decline in the production of the Butrabah plant in terms of the quantity produced.
- The study shows that the average operating efficiency% of Abu-Taraba Desalination Plant was 42.6 ,21.6 and 13.38 % respectively 2017-2019. In fact, the operating efficiency ratio was very low in 2019.
- Continuous decrease in the productivity of the station from 2017 to its lowest levels during 2019, and it was completely clear through the calculation of the rate of operatıonal efficiency %.
- A complete stop of production units No. 82-83 was observed during this study.
- The material and technological resources in any production unit are considered one of the inputs to improve production efficiency. Therefore, it is necessary to make recommendations to support the technical requirements of Abu-Taraba Desalination Plant to carry out the necessary maintenance of the 82-83 production units to achieve Abu-Taraba Desalination Plant goals and meet the needs of the station.
- Attention to educating citizens about the role of water resources in meeting their water needs and covering the water deficit.
- Rationalizing water consumption and increasing environmental awareness by installing meters to calculate the amount of consumption and collect the price of the water it consumes.

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REFERENCES

Bhadja, Poonam, Vaghela, & Ashokkumar. (2013). Assessment of physico-chemical parameters and water quality index of reservoir water. *IJPAES, 3*(3), 89-95.

Buros, O. K. (1990). *The ABC of Desalting", International Desalination Association Publication*

Ekrem Mutlu, Banu Kutlu, & Demir, T. (2016). Assessment of Çinarli Stream (Hafik -Sivas)'S Water Quality via Physico-Chemical Methods. *Turkish Journal of Agriculture - Food Science and Technology, 4(4):267-278, 2016*.

I.A.E.A. (2006). Desalination Economic Evaluation Program (DEEP-3.0)User's Manual *COMPUTER MANUAL SERIES No. 19 INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 2006*.

Imneisi, I. B., & Aydin, M. (2016a). Water Quality Index (WQI) for Main Source of Drinking Water (Karaçomak Dam) in Kastamonu City, Turkey. *Journal of Environmental & Analytical Toxicology, 6*(5). doi:10.4172/2161-0525.1000407

Imneisi, I. B., & Aydin, M. (2016b). Water Quality Index (WQI) for Main Source of Drinking Water (Karaçomak Dam) in Kastamonu City, Turkey. *J Environ Anal Toxicol, 6*(407), 2161.

Khawaji, A. D., Kutubkhanah, I. K., & Wie, J.-M. J. D. (2008). Advances in seawater desalination technologies. *221*(1-3), 47-69.

Maraşlıoğlu, F., Gönülol, A., & Bektaş, S. (2017). *Assessment of water quality in Mert Stream (Samsun, Turkey) base on some physicochemical parameters.* Paper presented at the Ecology Symposium 2017 Proceedings Book of Full Papers' ın içinde, Kayseri, Turkey.

Mousa S. Mohsena, & Al-Jayyousib, O. R. (1999). Brackish water desalination: an alternative for water supply enhancement in Jordan. *Presented at the Conference on Desalination and the Environment, Las Palmas, Gran Canaria, November 9–12,*.

Taner, M. Ü., Üstün, B., & Erdinçler, A. (2011). A simple tool for the assessment of water quality in polluted lagoon systems: A case study for Küçükçekmece Lagoon, Turkey. *Ecological Indicators, 11*(2), 749-756.

WHO. (2011). *Guidelines for Drinking-water Quality*. Printed in Malta by Gutenberg.

Withers, A. J. D. (2005). Options for recarbonation, remineralisation and disinfection for desalination **plants. *179*(1-3), 11-24.**