المؤتمر العلمي الدولي الثالث للعلوم و الهندسة

The 3RD Scientific International Conference in Science & Engineering

http://bwu.edu.ly/icse2024

Received 25/07/2024 Revised 16/08/2024 Published 10/09/2024

icse@bwu.edu.ly

STUDY OF THE QUALITY OF WATER DESALINATION BY REVERSE OSMOSIS METHOD

Abdulrahman Abdulsalam Bin Zayd [a*], Ismail Hmoda [b], Alfituri Ibrahim Abuala [c]

[a, b, c] Civil Engineering, Higher Institute of Engineering Technology, Libya /Zliten

* abdo.zaid1979@yahoo.com

Abstract: This study aims to evaluate the quality of desalinated water by the reverse osmosis process. The samples were collected in a 5-liter bottle from three different desalination factories (Alwaha, Alnawras and Alferdos) before entering into the factory (incoming water) and after leaving the factory (outgoing water). Then, the desired tests were carried out. The results were recorded for the incoming water for a PH ranged between 7.3 and 8.13, total dissolved salts between 3770 and 5801 mg/L, electrical conductivity between 4938 and 7332 µcm/s, nitrates between 19.8 and 27.6 mg/L, manganese between 0.07 and 0.12 mg/L and sodium between 930 and 1334 mg/L. And for the outgoing water, the results were recorded for pH ranged between 6.7 and 8.09, total dissolved salts (122.4-215.1) mg/L, electrical conductivity (193-330.1) µcm/s and nitrates (8.9-18.6) mg/L, manganese (0.03-0.05) mg/L and sodium (25.9-71.7) mg/L. These results showed that the specifications of the outgoing water samples satisfy the Libyan and the World Health Organization specifications.

Keywords: Incoming water, outgoing water, reverse osmosis process, Libyan specifications, World Health Organization.

Introduction

Libya is located in North Africa in arid or semi-arid region which is considered one of the driest regions in the world [1], [5]. Its area is about 1.7 million Km2 [5]. It contains five underground water basins which represent the main resource of fresh water [6]. The city of Zliten is considered one of the Libyan cities which relies mainly on underground water. In recent years, the city has flourished in various agricultural. Industrial and commercial fields. Also, its population has increased to 316.859 people in 2021 [2]. This increase in population requires large quantities of underground water that was exploited to meet the requirements, but the high consumption of underground water has led to the deterioration of underground water quality [3]. In the eastern rural area of the city, which lacks infrastructure, residents depend on individual solutions to obtain their needs of water depending on wells (random digging regulation 2003)[4], and to get rid of sewage and liquid materials for their industrial activities by digging underground tanks and draining those wastes into them, which led to underground water pollution. Hence, the search for available methods to obtain clean and safe fresh water, which was the most widespread and efficient method of desalination and purification of underground water through the reverse osmosis process, as this method has proved to meet all requirements for fresh water [7].

Material and methods:

Sample collection

This study was carried out in February 2023, by collecting two types of water samples from three factories that sell water to consumers, with a 5-liter bottle each, where the water was used before entering and after leaving the factories. The two types of water were transferred to the Environmental Sanitation Office in Zliten.

Results and dissection

All samples were collected from the eastern region of Zliten where desalination factories treat water and sell to consumers. The collected water is divided into:

2.1 Incoming water

It is the water entering the desalination factory, which is the underground water at a depth range between (30- 50)meters. The specifications of samples were obtained for the three desalinated water factories which use the reverse osmosis technique are shown in table (1).

Table 1: Results of tests of the incoming water for each factory.

Factory	Unite	Alwaha	Alnawras	Alferdos
Simple No		F1	F2	F3
TDS	mg/L	3770	5664	5801
PH	--	8.13	7.39	7.3
EC	µcm/s	4938	7184	7332
NO3	mg/L	22.4	27.6	19.8
Mn	mg/L	0.07	0.08	0.12
Na	mg/L	930	1215	1334

2.2 Desalinated water

It is the water that comes out of the desalination factory by the reverse osmosis process. This water is easy to obtain because it is used for direct sale to consumers. Table (2) shows the results of the water tests.

Table 2: Results of tests of the outgoing water for each factory.

Factory	Unite	Alwaha	Alnawras	Alferdos
Simple No		F1	F2	F3
TDS	mg/L	122.4	209.9	215.1
PH	--	8.09	7.3	6.7
EC	µcm/s	193	322.5	330.1
NO3	mg/L	8.9	18.6	9.3
Mn	mg/L	0.03	0.03	0.05
Na	mg/L	25.9	69.5	71.7

Total dissolved salts

Total dissolved salts express the amount of organic and inorganic substances that the water contains. According the obtained results, it was found an increase in the percentage of dissolved salts in the tested water of wells before entering desalination, and by comparing them to the specifications, they don't satisfy the scope of the Libyan specifications (Libyan Standards, 1992, No. 82) and the World Health Organization specifications (WHO, 2005). The dissolved salts of the outgoing water are lower than the mentioned specifications as sown in figure (1).

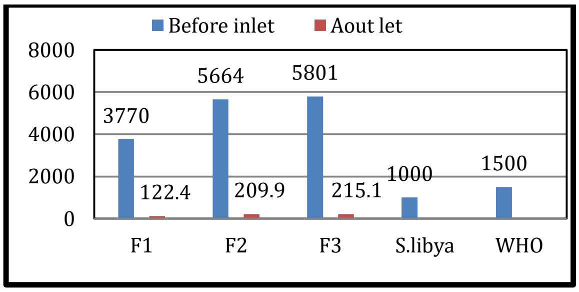

Fig. 1: TDS of incoming & outgoing water compared with specifications

PH

It is a measure that expresses whether the water is acidic, alkaline, or neutral, as it reaches the standard rate of PH (PH = 7). It can be noticed that from figure (2), the results of both incoming and outgoing water are in the range of the considered specifications.

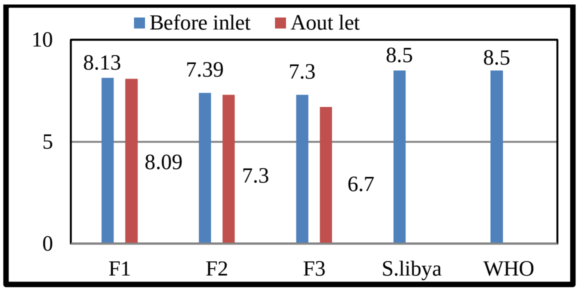

Fig. 2: PH of incoming & outgoing water compared with specifications

Electrical Conductivity (EC)

It is a measure of a material's ability to carry an electrical current. Its increase indicates to an increase in salinity of the water. The results shown in figure (3) clarify that the conductivity is high for the incoming water due to the rise in dissolved salts. The conductivity of the outgoing water satisfies the WHO, 1993 specifications.

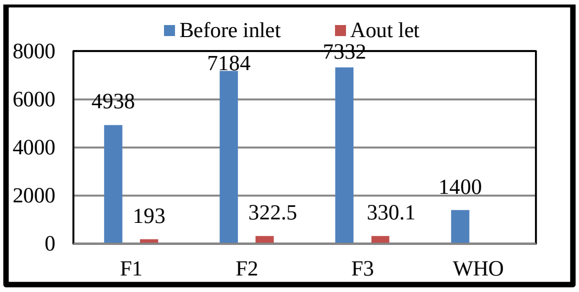

Fig. 3: E.C. of incoming & outgoing water compared with specifications

Nitrates (NO3)

It is a polyatomic ion that dissolves in water. It reflects contamination of human origin. Figure (4) shows that both of the incoming and outgoing water satisfy the specifications. (Libyan Standards, 1992, No. 82), (WHO, 2005).

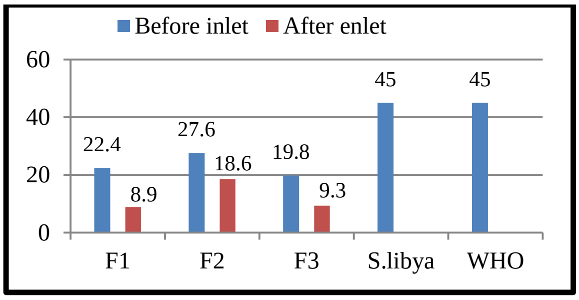

Fig. 4: Nitrates concentrations in the incoming & outgoing water compared with specifications

Manganese

The obtained results showed that the amount of manganese ranged between 0.07 and 0.12 mg/L for the incoming water, while for the outgoing water ranged between 0.03 and 0.05 mg/L, which is within the local and international specifications as shown in figure (5).

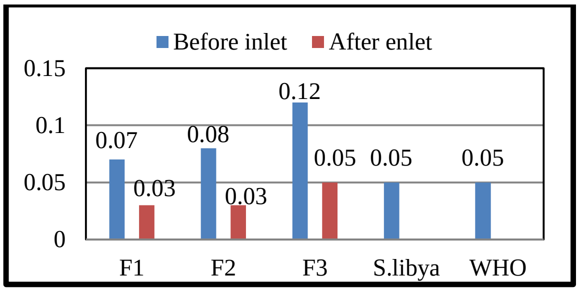

Fig. 5: Manganese concentrations in the incoming & outgoing water compared with specifications

Sodium

The results show high values of sodium in the incoming water of the three samples. It ranged between 930 and 1334 mg/L where as the amount in the outgoing water is between 25.9 and 71.7 mg/L. The results of the outgoing water satisfy the stated specifications as shown in figure (6).

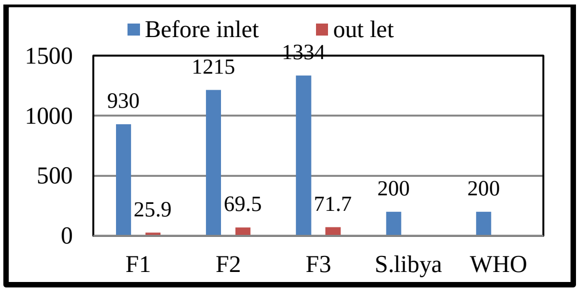

Fig. 6: Sodium concentrations in the incoming & outgoing water compared with specifications

Conclusions

The process of reverse osmosis method of human consumption water achieved a decrease in the concentrations of the tested elements in the water, and the results were within the Libyan and the World Health Organization.

Water before entering the desalination factory, which is surface water and is considered outside the Libyan and the World Health Organization.

الملخص بالعربي:

دراسة مدي كفاءة وجودة عملية تحلية المياه بواسطة التناضح العكسي

عبدالرحمن عبدالسلام بن زيد[1]، اسماعيل حمودة[2]،
الفيتوري ابراهيم ابوعلة[3]
[1 2 3] قسم الهندسة المدنية، المعهد العالي للتقنيات الهندسية، زليتن
*ترسل المقترحات علي snclibya@bwu.edu.ly

الملخص

تهدف الدراسة الحالية، إلي تقييم جودة المياه المحلاة بواسطة عملية التناضح العكسي، حيث تم جمع عينات بعبوة 5 لتر من ثلاث محلات تجارية لبيع مياه الشرب، المراد دخولها لمحطة التحلية (المياه الداخلة) وبعد خروجها من المحطة (المياه الخارجة)، واجراء الاختبارات لهما، ودونت النتائج للمياه قبل دخولها للمحطة للرقم الهيدروجيني تراوح بين (7.3- 8.13) والاملاح الذائبة (3770- 5801)مجم/لتر والموصلية الكهربية بين (4938- 7332)ميكروسيمنس/سم والنترات (19.8 – 27.6) مجم/لتر، والمنجنيز (0.07- 0.12)مجم/لتر والصوديوم 930-

1334)مجم/لتر. وبعد خروج المياه من المحطة القابل للاستهلاك البشري سجلت النتائج للرقم الهيدروجيني تراوح بين (6.7- 8.09) والأملاح الذائبة (122.4- 215.1)مجم/لتر والموصلية الكهربية بين (193- 330.1)ميكروسيمنس/سم والنترات (8.9- 18.6) مجم/لتر، والمنجنيز (0.03- 0.05)مجم/لتر والصوديوم (25.9 – 71.7)مجم/لتر. حيث تعتبر مياه الشرب الخارجة من محطة التحلية بعملية التناضح العكسي ضمن المواصفات الليبية ومنظمة الصحة العالمية.

References

[1] عبدالرزاق مصباح الصادق عبدالعزيز، ناصر مولود عبدالسلام (2020). " تقييم الوضع المائي في المنطقة الممتدة من ساحل البحر بمدينة صبراته إلى منطقة عقار". *Alexandria Journal of Agricultural Sciences*. مجلد 65 (1) ص 15.

[2] بلدية زليتن- 2022/5/29- الرقم الاشاري 2022/1095.

[3] إسماعيل إبراهيم احمودة، محمد فرج خوجة، & عبدالرحمن عبدالسلام بن زيد. (2021). التغير في الأملاح الكلية الذائبة والكلورايد للمياه الجوفية في عدة مناطق بمدينة زليتن. *مجلة الجامعة الأسمرية*، *6*(5)، 213-221.

[4] المادة رقم (9) لسنة 2003،بالقانون الليبي بشان رفع القيود المفروضة علي حفر ابار المياه المنصوص عليها القانون رقم (3) لسنة 1982.

[5] Brika, Bashir.(2019). The water crisis in Libya: causes, consequences and potential solutions. Desalination and Water Treatment, Doi 10, Pp351-353.

[6] Hamad, Jauda R. Jouda, Marlia M. Hanafiah, and Wan Zuhairi W. Yaakob. (2017). Water resources management in Libya: Challenges and future prospects. Malaysian Journal of Sustainable Agriculture 1.2 Pp3.

[7] Warsinger, David M., et al. (2016). Energy efficiency of batch and semi-batch (CCRO) reverse osmosis desalination. Water research 106, Pp 273.

[8] NO. 82, Drinking Water Standards. Libyan National Center for Specifications and Standards: Tripoli. Libya, 1992.

[9] WHO Guidelines for drinking water quality, second edn. World Health Organisation International Program on Chemical Safety, Geneva, (2005) pp 156-167.

[10] World Health Organization. Guidelines for drinking water quality, Recommendations. 2nd Edation. Geneva, Vol. 1, (1993).