International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Impact of Desalination of Sea Water on a Coastal Environment of Chatt El Hillal (Beni Saf – Western Northern Algeria)

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Abstract

Around the Mediterranean coast, 79% of the production of fresh water is assured by reverse osmosis *(SWRO)*. The great units are located in Spain, Israel and in Algeria, who chose the desalination of sea water as solution to solve the problems of drinking water shortage. Desalination thus will be essential like a resource alternative essential with the perenniality of great coastal cities where the need is felt. For to illustrate its strategic importance from now on it desalination became a vital need for great Algerian urban cities of the Mediterranean coastal such as Oran, Algiers, and Arzew. A number which the authorities aim to increase to 43 by 2019 but much of questions is currently posed on the impact of these installations on the environment. The principal environmental impact associated the processes of desalination comes from the production of the brine (salt concentrations maximum 36375mg/l). The other environmental impacts are: problems of landscape degradation, harmful effects sound, the emission of gas, or discharges associated like water coming from cleaning with the filter.

Keywords: desalination; sea water; fresh water; reverse osmosis; environmental impacts; brine; Chatt El Hillal station; Algerian west.

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1. Introduction

All over the world, access to potable water to the people is narrowing down day by day [1]. Development of new clean water sources is very important and urgent. Desalination of sea water is an important alternative, since the only unlimited source of water is the ocean. Today, more than 15 000 desalination plants are in operation in the world, of which 50 % are desalination plants by reverse osmosis *(SWRO)* [2]. Within this framework of study, we are interested with the unit of desalination of Chatt El Hilal, in Wilaya of Ain Témouchent, for understanding the various stages of desalination well while being interested more particularly in the membrane process of reverses osmosis and its environmental impact coastal of the Algerian West.

2. Study area

The station of Chatt El Hillal is located in the tourist zone of expansion which extends on a surface from 54,86km² and possesses a coast of 19 km length [3]. The station depends of the commune of Ouled El Kihel, of daira of BeniSaf, in the wilaya of Ain Témouchent, to West of Algeria (Figure1). It extends on a surface from 65 700 m² (Figure. 2).

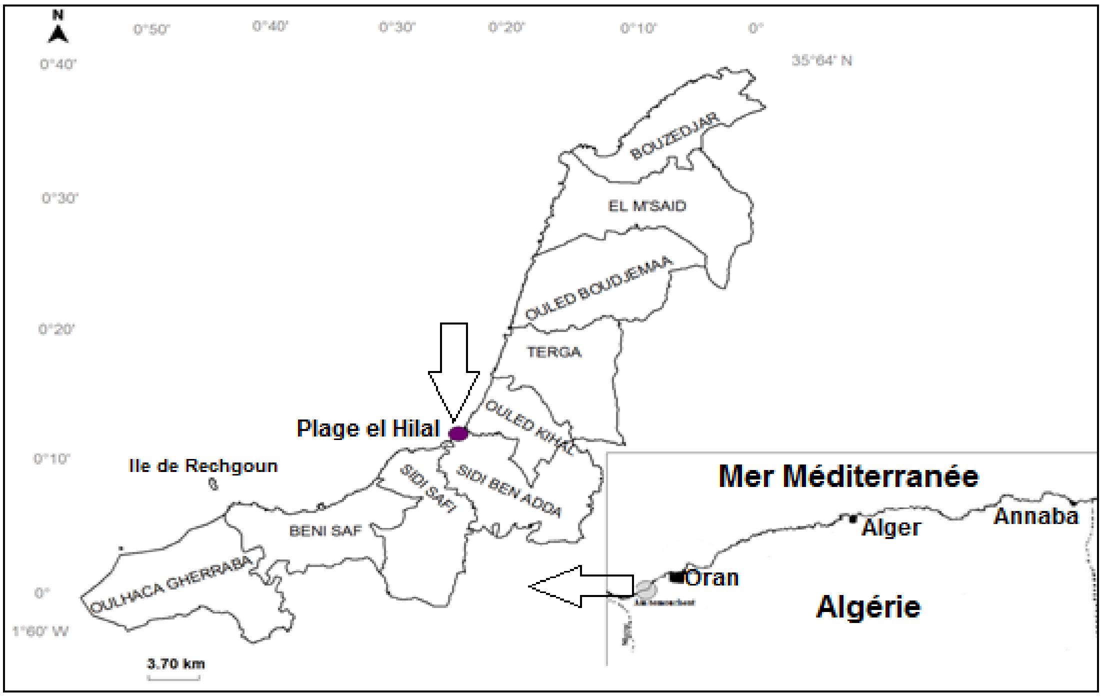

Figure 1: Study area: Chatt El Hillal on the West coast of Algeria.

3. Material and Methods

4. 3.1 Sampling and analyze

The station of pumping of sea water to feed the factory of dirtily Chatt El Hillal was used as point of sampling for the physicochemical of water, and this, before and after the treatment of water, as well as rejections of this station. Three samples are taken during the year 2013**.** The same experimental protocol of the sampling of rough sea water according to Rodier (2010) is used for each stage [4]. The parameters to be analyzed are selected according to the required objective. The temperature, conductivity, salinity (TDS) and the pH are measured *in situ*. The water samples are analyzed at the laboratory to evaluate the average contents of magnesium (Mg++), Phosphates, Bicarbonates $CaCO_3$, Chlorides, sulfates (SO_4-), Nitrates (NO_3 -) and Nitrites (NO_2 -).

Figure 2: Chatt El Hillal station: a (general view), b (Photo Landsat 2015 Google)

5. Results and discussion

The physicochemical analysis of the parameters carried out *in situ* and them analyses of the physicochemical parameters at the laboratory made it possible to observe and follow the tendencies of the operation of the water treatment, and determination of the physicochemical parameters of taken raw water of the sea (M), and of rejected water (R) resulting from this process of desalinization, in three operations: S_1, S_2 and S_3 during 2013 (Table 1).

Concerning rejected water (R), one notices that there is a significant increase in salinity, conductivity, Calcium as well as organic matter. One notes a rise in the following elements: chlorides, sodium, and potassium salts. The rate of all the parameters is higher compared to the rates of the other analyzed samples (sea water and treated water), what can explain the effectiveness of the process of desalination. Among his values, there are the rate of salinity which is higher probably had with the retention of various salts by the membranes of reverse osmosis, what can influence directly the conductivity and the mineralisation of these effluents. To also note, the high rate of chlorides due probably to the use of the hydrochloric acid during the pretreatment, like to its abundance in sea water.

The increase in turbidity is very significant with that of sea water and the treated water, which can be interpreted by the presence of the suspended matter (MES) like to the filling of the membranes. It can be a source of influence on fauna and the marine flora [5].

One also notes a degradation of the studied coastal sites: deterioration of the entertaining value of the site, visual obstruction of the access of the sea and the transformation of a tourist resort and wellbeing into industrial park due to the sound harmful effect (Pump High Pressure). The impact on the marine ecosystem is considerable by the destruction of marine organizations at the time of the hydrant. The in situ report shows a reduction in the biodiversity in the sites of pumping compared to other pilot sites of the same coast [6].

Table 1: Average values of the physicochemical parameters measured in rejected water (R) and raw water of the sea (M) of Chatt El Hillal Station.

Parameters	**S_1**		**S_2**		**S_3**		**Standards sea water** (WHO)
Samples	**R**	**M**	**R**	**M**	**R**	**M**	
pH	8.22	8,8	8,4	8,8	8,5	8 ,7	7,5-8,4
Conductivity (US/Cm)	59000	42000	51000	48000	58500	40000	49000
T (°C)	23	20	20	20	22	22	30
Salinity (mg/l)	36750	34900	36550	35000	45000	32500	35500
Calcium (mg/l)	2060	1500	2000	1500	2500	1800	453
Magnesium (mg/l)	8200	5780	8000	5700	8500	5700	1.30
Bicarbonates (mg/l)	128	57	120	50	140	50	
Phosphates (mg/l)	0,2	1,4	0,2	1,2	0,20	1,17	
Sulfates (mg/l)	4100	3070	4000	3000	4250	2750	
Chlorures (mg/l)	42900	21650	42500	21550	45000	23120	21500
Sodium (mg/l)	11690	14500	10690	13500	17350	13520	
SDT (sels dissous totaux) (mg/l)	13625	13600	14625	12600	36375	28000	
Nitrates No_3 (mg/l)	4,5	43	4,4	44	4,4	35,2	
Nitrites No_2 (mg/l)	0,039	2,68	0,033	2,64	0,0033	0,0033	
Turbidity (UNT)	**1.1**	**1,09**	**1.02**	**1,09**	**0.6**	**1,31**	

Following a diagnosis of the situation, one notes for sea water:

Chlorides can come from various sources, such deterioration of the rocks, and pollution with the discharges of worn water. Sodium, which east dissolves at the time of the rains and that the rocks of the emerged grounds contain, is pulled by the rivers in the sea, Potassium salts are not very present and slightly less soluble that sodium salts. While the other parameters, the temperature, which is always, lower than 30°C, has a great importance because it strongly influences the performance of the membranes:

- With low temperature (≤10°C), water becomes less viscous and to de-salt it one needs more energy,

- At high temperature (> 30°C), produced water is not good quality [7], pH is also lower than 8,5 resulting from the ionic composition, primarily from the presence of carbonates resulting from the exchange of carbon dioxide between water and the atmosphere, as well as dissolution of limestone [8].

Following a diagnosis of the situation, one notes for treated water:

The temperature of produced water varies between 16°C and 18°C and does not exceed 25°C in all the cases observed, therefore in conformity with the standard and has a great importance, because beyond the 25°C water is likely to support the development of microorganisms. The pH varies between 7.50 and 8.50, and remains in conformity with the standards of WHO. The conductivity of water probably exceeds the standards because of the filling of the membranes; and decreases after the chemical washing of these membranes. It generally translates a raised salinity, as it can lead to a scaling of the conduits.

Following a diagnosis of the situation, one notes for rejected water:

The rate of all the parameters is higher compared to the rates of the other analyzed samples (sea water and treated water), what can explain the effectiveness of the process of desalination. Among its values, the rate of salinity is higher, which is due probably to the retention of various salts by the membranes of reverse osmosis, which can influence directly the conductivity and the mineralisation of these effluents. To also note, the high rate of chlorides due to the use of the hydrochloric acid during the pretreatment, like to its abundance in sea water. The increase in turbidity is very significant with that of sea water and the treated water, which can be interpreted by the presence of the suspended matter like to the filling of the membranes. It can be a source of influence on fauna and the marine flora [9].

5. Conclusion

Usually, the rejections of the brines resulting from the desalination of marine water are carried out in the sea, either directly close to the coast, or by means of an underwater emissary. The impact of the brines thus poured in the sea (receiving system) is hardly known with precision, although at the present time of many studies are under development [10].

The process of produced desalination of other rejections that brines (less than 1% of the total). It is about water of washing of the sand filters (sand and organic matter, poured once per day), of the products of cleaning of the membranes (biodegradable detergents, once per year), additives coming from pre/post rough water treatment/produced (flocculating agents, scale-preventing, anti-corrosive).

Then, it is urgent to integrate and preserve the water resource de-salted, through an effective management of all the cycle of the use of water, starting from optimal management, the rough resource which is the sea as well as the effective management of the desalination plants until an effective treatment of the effluents salted before rejecting them into nature.

The organization of an integrated management of the services of desalination implies to reconsider the strategies of management in the majority of the stations. The reorganization must ensure, at the same time, the technical, economic effectiveness and education, as well as the use of suitable practices of the personnel and human resources necessary, to achieve the goal to satisfy the needs for the uses and to improve the conditions of their lives, as well as the respect of the environment and the watery ecosystem [11].

At present, the desalination of sea water through our country is done in the majority of the cases by reverse osmosis. In front of this fact, the fixing of the tolerance levels is significant; the brines must pass an exhaustive control of toxicity which takes account of characteristics of the receiving system and to pay a detailed attention to the dilution of the concentrate [12]. Other studies in two small stations on Algerian West coast (Bousfer and Bouzedjar), highlighted same impact but with a less degree [13] . Other work in other areas of the world confirms our diagnosis. Moreover, the increase in the salinity of the Red Sea water will also intensify in the time to come expectedly will cause the further deterioration of the seawater quality, in turn which will affect directly or indirectly the operational activities of the desalination plants [14]. Overall, future studies should attempt to quantify in greater detail the external effects of both desalination and agricultural landscape, as these two features will deter-mine the optimal timing of implementation of various water management options, including construction of new desalination plants. Furthermore, estimation of costs of other alternative water management options, including reclamation of contaminated groundwater, rainwater, and others, would provide an even fuller picture of cost-effective options available to decision-makers [15].

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