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# Assessment of the Quality of Water Discharges from a Desalination Plant: Case of Honaine Station (Western Algeria)

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**Abstract**

Around the Mediterranean coast, 79% of the production of fresh water is assured by reverse osmosis *(SWRO)*. T many desalination plants have emerged in Algeria, who chose the desalination of sea water as solution to solve the problems of drinking water shortage. The deficit in drinking water was important in western Algeria, which explains the high number of stations: Macta, Bousfer, Bouzedjar, Chatt el Hillal, Honaine et Ghazaouet. A number which the authorities aims to increase, but much of questions are currently posed on the impact of these installations on the environment. It is in this context that a study has been carried out to determine the quality of the water discharges at sea, resulting from the desalination process. The principal environmental impact associated the processes of desalination comes from the production of the brine (salt concentrations betwin 36750 mg/l and 37800 mg/l). The other environmental impacts are: discharges associated like water coming from cleaning with the filter, harmful effects sound, the emission of gas, or problems of landscape degradation.

***Keywords:*** desalination; sea water; fresh water; reverse osmosis; environmental impacts; brine; Honaine; station; Western Algeria.

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## 1. Introduction

Today, in many parts of the world, freshwater resources for the production of drinking water are non-existent or insufficient for population growth or industrial production. As a result, solutions such as water reuse and salt water desalination, which represent the vast majority of available water on earth, are becoming key solutions, also meeting the requirements of sustainable development [1]. On the other hand, desalination is becoming a dominant method for the production of drinking water in areas of shortage in fresh water [2]. For example, seawater desalination plants are becoming more common on the coastlines. Algeria has launched in recent years, an ambitious program of desalination plant facilities to cope with its water supply problems which are accentuated by population explosion, industrial and agricultural development as well as drought. It is continuing its investment in the desalination of seawater [3]. The objective of this study is to describe the effects of reverse osmosis desalination plant (SWRO) discharges on the environment. Our work contributes to presenting the problem of seawater desalination for the production of drinking water in order to serve as a basis for discussions aimed at identifying a sustainable management approach for the protection of the coastal environment of the West Algeria.

## 2. Study area

It is located in the commune of Honaine (wilaya of Tlemcen) in the western Algeria (Figure1). It is projected on an area of 80000 m². It has a desalinated water production capacity of 200,000 $m^3$/day. The station of Honaine is delimited to the North by the sea, to the South, to the East and the West by a farmland and some houses (X: 35°10'44.79"N ; Y: 1°38'29.26"O) (Figure2). It is a coastal zone characterized by an important biodiversity [ 4] due to an absence of all anthropic activities [5].


**Figure1:** Geographical location of Honaine station.

**Figure 2:** General view of Honaine station

## 3. Material and Methods

The station of pumping of sea water to feed the factory of dirtily Honaine 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 (fig.3)**.** 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 3:** water sampling sites

## 4. 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 (Tab. 1).

The brine discharges resulting from the desalination plant take place in the sea, directly near the coast.

The impact of the brine discharged into the sea on the receiving system is not known precisely, although at present many studies are in progress. However, we must not forget the environmental impact caused by a desalination plant, such as the problems of landscape degradation, noise, gas emissions (CO, NO), or associated discharges such as water from cleaning (filters, sand, membranes and deposits).

The rate of all discharge water parameters is higher relative to the rates of the analyzed seawater samples, except for the pH and temperature that are up to standard, except for parameters that far exceed norms, such as conductivity, salinity, calcium, magnesium and chlorides. There is also the increase of bicarbonates in the releases, due to the use of different chemical treatments, as well as the increase of NaCl from 10500 mg / l to 12500 mg / l and TDS betwin 13625 mg/l and 13600 mg/l.

Conductivity is higher in releases compared to seawater because the overall mineralization has increased following the treatment of the latter, there is also a slight increase in pH thanks to chemicals used by the station such as bicarbonate.

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

| **Parameters** | **HONAINE** | |
|---|---|---|
| **Sample** | **R** | **M** |
| pH | 8,6 | 8,7 |
| Conductivity US/Cm | 59200 | 41900 |
| T ˚c | 21 | 21 |
| Salinity mg/l | 44800 | 35900 |
| TH (total hardness) mg/l | 10 500 | 7300 |
| Calcium mg/l | 2460 | 1600 |
| Magnésium mg/l | 8200 | 5780 |
| TAC bicarbonate mg/l | 135 | 57 |
| TA carbonate mg/l | 0 | 0 |
| Phosphate mg/l | 0,2 | 1,4 |
| Sulfate mg/l | 4160 | 3170 |
| Chlorure mg/l | 45000 | 21650 |
| Sodium mg/l | 16690 | 14500 |
| SDT (sels dissous totaux mg/l) | 13625 | 13600 |
| $No_3$ nitrate (mg/l) | 4,5 | 43 |
| $No_2$ nitrite (mg/l) | 0,039 | 2,68 |
| Turbidity (UNT) | 1.1 | 1,09 |

## 5. Conclusion

The results show that the physico-chemical, organoleptic and parametric values of the pollution are the subject of various analyzes, have shown that the brines produced by the desalination techniques have a high salt content which results from the concentration of water of desalinated sea (salinity 59.85 ‰ higher than that of seawater 36.55 ‰) [10]. As a result, these repercussions lead to a disruption of local aquatic life. This phenomenon fades rapidly as one moves away from the point of discharge by decreasing the concentration. In addition to the high salt concentration, high levels of sulphates are recorded. The latter decrease in contact with the sea, which indicates a transformation of sulphates into sulphures. In addition, the conditions of the sea: sea current, waves, calm or agitated water immediately affect the concentration of brine in contact with the sea. The dilution of these brines depends instantly on their dispersion in the case of rough seas and their location in the case of a calm sea. As for example, brines take a long time to dilute when the sea is calm. This directly affects the aquatic environment.

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 at stations on the Algerian west coast (Bousfer and Bouzedjar) have shown the same impact but with a lesser degree [13] and the same impact at the Chatt El Hillal station [14]. In addition, the conditions of the sea: sea current, waves, calm or agitated water immediately affect the concentration of brine in contact with the sea. The dilution of these brines depends instantly on their dispersion in the case of rough seas and their location in the case of a calm sea. As for example, brines take a long time to dilute when the sea is calm. This directly affects the aquatic environment.

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 [15].

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Table 1 - Annual values of the physicochemical parameters measured in rejected water (R) of Honaine Station.