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## Physico-Chemical Water Quality in Some Regions of Southern Algeria and Pretreatment Prediction

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### Abstract

The aim of this study was to determine the physico-chemical and microbiological quality of drinking water regions of southern Algeria. For this purpose, 16 samples (15 water samples from the cities of El Oued, Ouargla, Ghardaia and Adrar were taken either at the consumer's tap, or from well water. Our results show that the physical and chemical quality of the waters of Southern Algeria is poor and rich in mineral salts: the conductivity is between a minimum of 1374  $\mu\text{s}/\text{cm}$  and a maximum of 4070  $\mu\text{s}/\text{cm}$  while the European standards recommend values between 180 and 1000  $\mu\text{s}/\text{cm}$ . The hardness is very high. It ranges between 42 ° F and 134 ° F. According to international and national standards, all waters have excessive fluoride levels. Moreover, Analyzed waters present an organic pollution represented by the concentration of the organic matter which is lower than the Algerian and European standards (5mg / l O<sub>2</sub> dissolved). Finally, analysis of physical parameters and indicators of mineralization, alkalinity, salinity and hardness, groundwater sampled showed a great diversity in nature that is a function of the water which they belong, that due to rock or agricultural and industrial activities in the region.

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Keywords: Saharan brackish water; physico-chemical quality; pollution source; sustainable water management

### 1. Introduction

The steady growth of demand for consumption of the population for several decades, has already posed various problems, both qualitative and quantitative.

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Among them, the salinity illustrates perfectly the need of management taking into account the consequences on the quality of groundwater.

This problem arises particularly in our country especially the south of Algeria. Water resources in the Sahara and in particular Northern are contained mainly in two major aquifers: These are sheets of Continental Binder (CI) and the Complexe Terminal (CT) [1, 2].

They are used on a scale more extensive for the feeding of a large majority of the population of the Sahara [8]. These are highly mineralized and often poor quality [3, 7]. In effect, they are harmful to crops and homes. In some cases the groundwater is not directly allowed for human consumption due to concentrations of certain pollutants exceed international standards and national rules on the quality of drinking water. However, it is important to prepare the brackish Saharan human consumption at pre-treatment with membrane technology: nanofiltration, reverse osmosis (WBRO), the physico-chemical and biological they are indispensable.

Indeed, some parameters are crucial for performance and efficiency of membranes in the context of treatment of water desalination. Based on this information, we are interested in this previous work to study the physico-chemical and biological integrity of waters of some South willayas Algerian. For this, we carried out 16 samples of tap water consumers and water drilling from El Oued, Ouargla, Ghardaia, and Adrar. The physico-chemical parameters were determined by standard techniques according to the AFNOR standards such as volumetric, gravimetric, potentiometer, photometry and spectroscopy of flames.

## 2. Analysis of drinking water in the region of southern Algeria

### 2.1. Sampling

The water samples analyzed were collected at the tap of consumers and drilling in several areas of the Algerian Sahara. The waters involved were from groundwater Terminal Complex for the city of El Oued, Ouargla, Touggourt, Hassi Messaoud and that of Continental Binder (water Albian) for cities of Adrar, Ghardaia. The sample can be graduated a few days but it is best to mix the chemical elements as soon as possible [5].

### 2.2. Analysis Method

#### Physical parameters

The temperature was measured with a thermometer at 1 / 10 of a degree, tempered in the sample for three (3) minutes. We measured the temperature at the sampling location (in situ).

The pH: We used a pH meter WTW inoLab level L D82362 fitted with an electrode previously calibrated with buffer solutions pH 4 and pH = 7. The method was to immerse the electrode in the sample in a beaker in which the bar with a magnetic stirrer homogenizes the sample. After stabilization of the display on the dial of the pH meter, we found the pH.

The conductivity is measured with an electrical conductivity meter type WTW inoLab level L D82362 which directly conductivity of the sample ( $\gamma$ ) in ms / cm or  $\mu$ s / cm.

#### Chemical parameters:

Calcium and Magnesium: The method allows distinguishing complexometry calcium magnesium samples by titration with disodium ethylene diamine tetraacetic acid (EDTA). Indeed the end of the reaction is demonstrated by using specific indicators, which are a different color than calcium and (or) magnesium are free or "complex".

Chlorides: The determination of chlorides is determined by the method of Mohr under neutral conditions with nitrate solution agent (0.1 N) in the presence of potassium chromate. The end of the reaction, it forms a brick red precipitate silver chromate  $Ag_2CrO_4$ .

Carbonates and Bicarbonates: The concentrations of carbonate and bicarbonate are measured by the neutralization of a certain volume of water by hydrochloric acid (0.1 N). The endpoint was determined by colored indicators [4].

Sodium and Potassium: The dosage of potassium and sodium was carried out by emission spectrometry flame apparatus flame spectrometry (Corning 400) [4].

Fluoride: Fluorine is determined by the potentiometric method (NF T 90-004), with an electrode specific to fluoride ion (crystal lanthanum fluoride). The potential measurement was made against reference electrode calomel (Hg/Hg<sub>2</sub>Cl<sub>2</sub>/KCl saturated), using a millivolt meter to measure the potential difference close to 0.1 mV. The electrode must be used within the range of pH 5 to 6 to avoid interference from hydroxide ions [6]. The detection

limit is 0.02 mg / l. The establishment of the calibration curve  $Emv = f(\log [F^-])$  allows to deduce the concentrations of fluoride ions in solution to the potential measured.

**Sulfates:** Sulfates are measured by gravimetry, they are precipitated by hydrochloric acid in the form of insoluble barium sulphate, and the amount of turbidity formed is proportional to the concentration of sulfates. The reagent also contains a stabilizing agent to maintain suspension.

**Spectrophotometric methods:** The spectrophotometer model pFotoFlex / pFotoFlex turb WTW is a single-beam device controlled by microprocessor for analysis in the laboratory or field. It is a spectrophotometer that uses the visible. It runs on battery or AC power using the transformer / charger. At a fixed wavelength, the concentration of a substance is proportional to its optical density by the relation  $DO = \epsilon l C$

**Measurement of PI (index of potassium):** Concentrations of organic matter were estimated by the method of permanganate index (PI) or testing of the oxidizability in  $KMnO_4$ , according to the analysis of water.

### 3. Results and discussion

We determined the physico-chemical and pollution water analysis. The results are presented in histogram in the following figures:

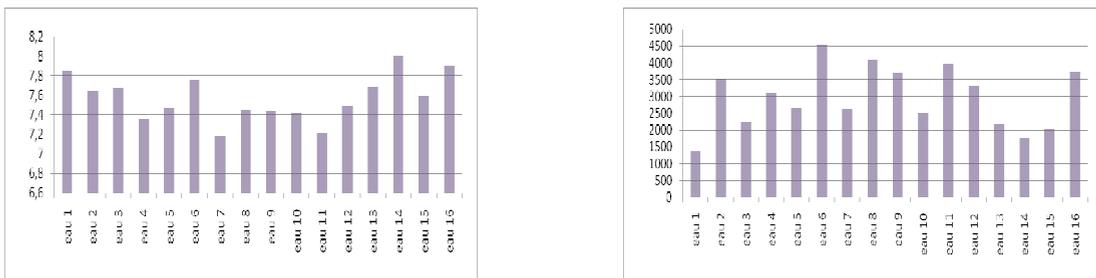


Fig 1:(a) Histogram of pH values of water analysis;(b) histogram of conductivity values of water analysis.



Fig 2:(a) Histogram of calcium values of water analysis.;(b) Histogram of magnesium values of water analysis ;(c) Histogram of Hardness values of water analysis

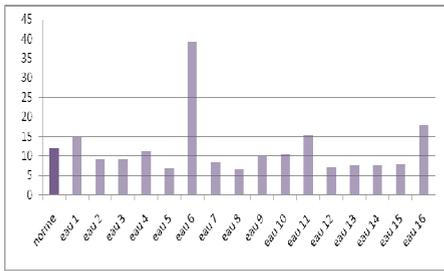


Fig 3:(a) Histogram of potassium values of water analysis.;(b) Histogram of sodium values of water analysis.

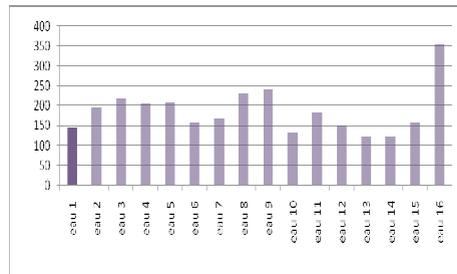
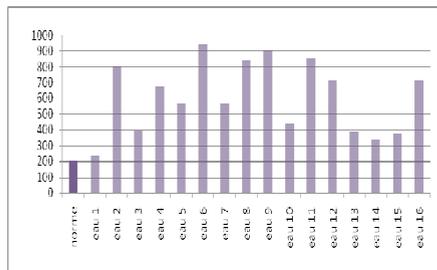


Fig 4:(a) Histogram of Chlorides values of water analysis.;(b) Histogram of Bicarbonates values of water analysis.

The results show that the pH of water is analyzed in standards between (7.18 and 8). On the other hand, we note that the measured values of conductivity are high indicating that these waters are rich in minerals: the conductivity is between a minimum of 1374  $\mu\text{s} / \text{cm}$  and a maximum of 4070  $\mu\text{s} / \text{cm}$  while European standards recommend values between 180 and 1000 / cm while the Algerian standards have a maximum admissible concentration of 2800  $\mu\text{s} / \text{cm}$  and the WHO provides a guideline value of 250  $\mu\text{s} / \text{cm}$ . According to WHO, there is no guideline value for tap water for hardness; the latter in turn is very high. It is between 42 <math>^{\circ}\text{F}</math> <math>^{\circ}\text{F}</math> <math>^{\circ}\text{F}</math>, it is important to note that the waters of southern Algeria are very hard since most of the total hardness exceeds 100F

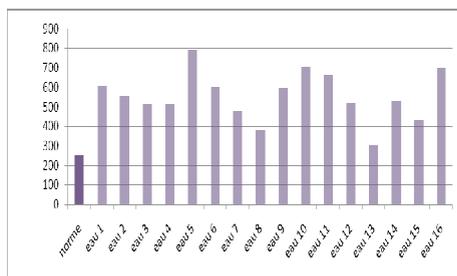
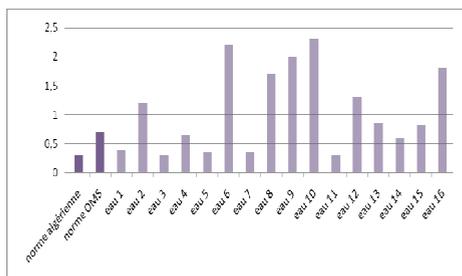


Fig 4:(a) Histogram of Fluorides values of water analysis.;(b) Histogram of sulphates values of water analysis.

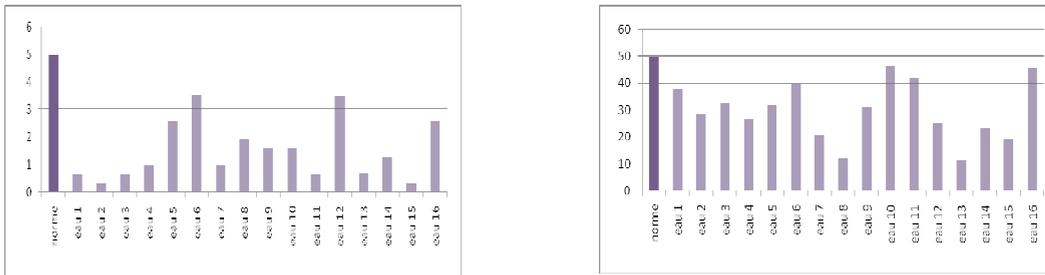


Fig 5:(a) Histogram of PI values of water analysis.;(b) Histogram of Nitrates values of water analysis.

Indeed, the fluoride content varies between 0.30 and 2.3 mg / l. (WHO standard: 0.7 mg / l for temperatures ranging from 25 to 30 ° C, standard Algeria: 0.3 mg / l). The levels of fluoride highest are found in the wilaya of El-Oued Souf, Ouargla and Adrar. Our results also show that most waters have chloride concentrations exceeding the maximum allowable concentration MAC. For sulphate, all the water samples have sulphate levels higher than the standard 250 mg / l. Similarly, the WHO standard provides no guidance concerning the bicarbonates. The bicarbonate content of samples analyzed varied between 122 and 356 mg / l. But all analyzed waters are rich in chloride ions because their concentrations exceeding 200 mg / l, they have salinity very important as illustrated in Figure 1. According to figure 3 for the results of sodium and potassium, most of the water samples had rates of sodium and magnesium above 150 mg / l and 12 mg / l respectively.

In contrast, the waters are analyzed organic pollution represented by MO which is lower than the Algerian and European standards (5 mg / l dissolved O<sub>2</sub>). While BOD<sub>5</sub> varies between 2 and 40 mg / l. Sidi Khouled (Ouargla) presents the maximum value while the European standard of 3mg / l. For results, ammonia nitrogen, phosphates, nitrates and nitrites, most waters have analyzed rates substandard 0,01 < PO<sub>4</sub><sup>-2</sup> mg/l < 0.19, 4 < NO<sub>3</sub><sup>-</sup> mg/l < 30, 0 < NO<sub>2</sub><sup>-</sup> mg/l < 0.06, 0 < NH<sub>4</sub><sup>+</sup> mg/l < 0.01.

#### 4. Conclusion

The physico-chemical and biological properties of waters south of Algeria from the consumer's tap and well water were determined, the data show that: the increase in conductivity is due to a high concentration of minerals, they pose a health risk because we have found good results for the parameters and bacteriological pollution. Therefore, we propose to complete the installation process by separation of dissolved salts by reverse osmosis to avoid the risk of contamination by toxic metals populations using the treated water. It also proposes to make a qualitative study of the waters of southern Algeria.

#### References

- [1] Achour S. La qualité des eaux du Sahara septentrional : Etude de l'excès en fluor. Tribune de l'Eau 1990, 42, **542** : 53-57
- [2] Megdoug. M, qualité des eaux de Sahara septentrional, Séminaire sur les journées techniques et scientifiques sur la qualité des eaux du Sud, Eloued; 2003
- [3] Khadraoui .A, DG /ABH SAHARA ; Conférence Euro –Africaine: Paris; 22-23Mars; 2005
- [4] Rodier J. Analyse de l'eau : eaux naturelles, eaux restauratrices, eaux de mer. 7<sup>ème</sup> édition Bordas : Paris ; 1984; p. 969-1013
- [5] Ferry .D, Machtinger .M, Bauer.D, Analysis; 1984; **2** 90-95.
- [6] A. Ramdani , S. Taleb , A. Benghalem , N. Ghaffour, Removal of excess fluoride ions from Saharan brackish water by adsorption on natural materials. Desalination 2010, **250**: 408–413.
- [7] Djellouli H. M, Taleb S, D. Harrache-Chettouh D, S. Djaroud S, Journal du Cahiers d'études et de recherches francophones/ Santé 2005, **2** : 109-112
- [8] Khadraoui .A, S. Taleb. Qualité des eaux dans le Sud Algérien : Potabilité- Pollution et Impact sur le milieu ,358p Edition Khyam ; 2008