

PHYSICOCHEMICAL AND BACTERIOLOGICAL ANALYSIS OF WATERS FOR OUED SEYBOUSE (NORTHEAST ALGERIA)

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Abstract

Water is a natural resource essential to all living beings.

Algeria is rich in surface and underground water, which varies from wilaya to wilaya depending on climatic conditions and location.

The Oued Seybouse is one of the most important rivers in eastern Algeria, formed near Guelma by the meeting of the Oued Cheref and the Oued Bouhamdane in the Medjez Amar region, its basin is the largest in Algeria; it joins the Mediterranean near Annaba.

Its hydrographic network is currently threatened by human activities (urban and industrial discharges, use of water for agricultural purposes). Studies on the bacteriological analysis and some physico-chemical parameters of Oued Seybouse water are important to assess the quality of these waters and identify potential risks to human health and the environment.

To this end, an experimental and quantitative study of the Oued Seybouse waters flowing through the Guelma wilaya was carried out monthly during 2022 (January to December) at four stations.

The bacteriological examination provided information on the presence of bacteria such as total and faecal coliforms, faecal streptococci and pathogenic germs that can cause illness in humans.

The results of the physico-chemical analyses showed a variation in the elements studied according to several factors such as rainfall and geological substrates.

Key words: Oued Seybouse, physicochemical and bacteriological analyses, Guelma, Algeria.

1. INTRODUCTION

Water is a necessary and irreplaceable element for all life on earth. However, it can also act as a vector for potentially dangerous agents, and consequently as a source of disease [1].

Surface water is the source most threatened by human activity.

They are the most exposed to pollution, as they serve as dumping grounds for various types of waste and as collectors of wastewater from built-up areas [2].

In Algeria, the water issue will undoubtedly be a major concern for the country during this century. Whether underground or on the surface, over the past thirty years or so, water has been deteriorating significantly and is becoming increasingly scarce throughout the country. [3].

The quantities of wastewater discharged annually in this country are estimated at around five hundred million cubic metres per year. Only 6% of urban wastewater and 15% of industrial wastewater is currently treated. [4].

The territory of the Wilaya of Guelma (North-East Algeria), according to hydrogeological data from the Guelma wilaya trade department, comprises 04 distinct hydrogeological zones (or sub-catchment areas):

- 1/ Zones of the Guelma and Bouchegouf plains (Middle and Lower Seybouse)
- 2/ Djebels zone to the north and north-west
- 3/ The Tamlouka plains and hills area
- 4/ The Djebels area overlooking the Sedrata and Hélia wadis.

The Oued Seybouse is home to a wide range of activities linked to the settlements along its banks (three wilayas: Guelma, El-Tarf and Annaba) [6].

Oued Seybouse, the main watercourse crossing the Guelma plain [7].

The Seybouse basin is formed by the meeting of Oued Cherf and Oued Bouhamdane in the Medjez Amar region [8].

The aim of this work is to analyze physicochemical and bacteriological data obtained from water samples taken from Oued Seybouse in the wilaya of Guelma.

2. MATERIALS and METHODS

2.1. Description of the study area

The study area is located in northeastern Algeria, about 60 km from the Mediterranean, in the Wilaya of Guelma. It is bordered to the north by the wilaya of Annaba, to the northwest by the wilaya of Skikda, to the northeast by the wilaya of Constantine and to the southeast by the wilaya of Souk Ahras and Oum-El Bouagui. It covers an area of 3686.84 Km² [9] [10]. (**Fig. 01**).



Fig. 01: Geographical location of the study area.

2.2. Sampling stations

The Oued Seybouse, located in northeastern Algeria, covers a total area of approximately 6471km². It is the largest basin, after the Medjerda, in the eastern part of North Africa.

The Oued Seybouse rises in the commune of Medjez amar, wilaya of Guelma (36°26.587"N, 007°18.740"E) to the west of the town of Guelma and flows for 134.74 km before emptying into the Mediterranean Sea, near the commune of Sidi Salem, wilaya of Annaba (36°51.689"N, 007°46.066"E) [7].

We chose four sampling stations along the Oued Seybouse watercourse in the following communes: **S1** :Mejdaz amar, **S2** :Hélopolis, **S3** : Boumahra Ahmed and **S4** : Bouchegouf in the wilaya of Guelma.

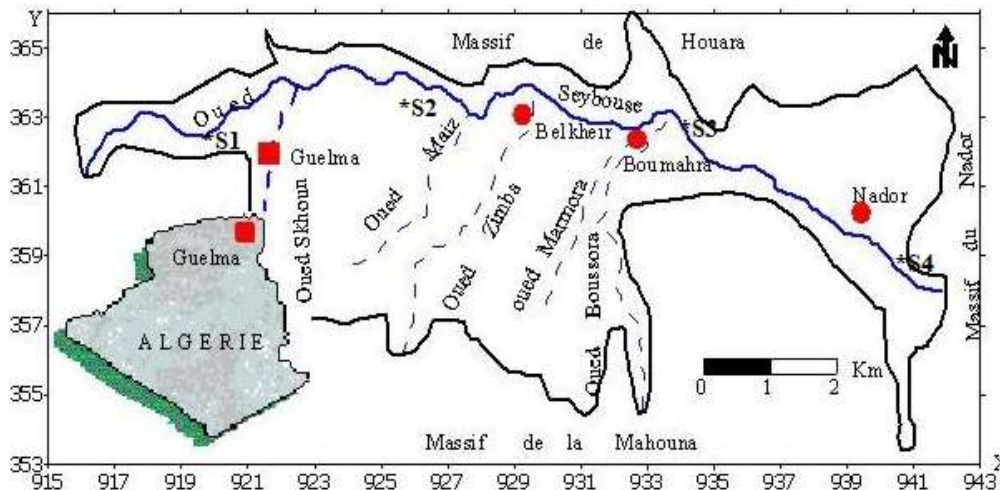


Fig. 02 : Sampling stations.

2.3. Physicochemical analyses

Physico-chemical indicators of water quality are often subject to patio-temporal variations induced by anthropogenic activities, which modify the characteristics of the water and affect its quality [13]. Sampling for physicochemical analysis is carried out in 1-liter plastic bottles.

The following parameters (Temperature, pH, Electrical Conductivity and Dissolved Oxygen) were measured directly in situ using a multi-parameter.

And the parameters measured in the laboratory are :

Salinity, Nitrates (NO₃), Nitrites (NH₄).

2.4. Bacteriological analysis

Samples for bacteriological analysis were taken in glass bottles steamed at 220°C. Samples were transported at low temperature (4°C) from the field to the laboratory.

Bacteriological analyses were carried out using the standard method of Rodier et al [11] [12].

For each sample, the bacteriological analysis concerned.

- Research and enumeration of total and fecal coliforms
- Detection and enumeration of fecal Streptococci, using colemetry
- Detection and enumeration of Anaerobic Sulfito-Reducing Reducing Anaerobes (RAS);
- Pathogen detection.

3. RESULTS AND DISCUSSION

3.1 Physicochemical analysis results

The results of temperature measurements show that the maximum T° recorded is 36.5°C at station 2 and station 3 during the month of August, while the minimum is noted at site 1 with a value of 12°C .

during December at station 1 (**Fig.03**).

pH: It's a factor dependent on natural and environmental conditions such as vegetation cover, rock nature, soil substrate and human activity[14.15].

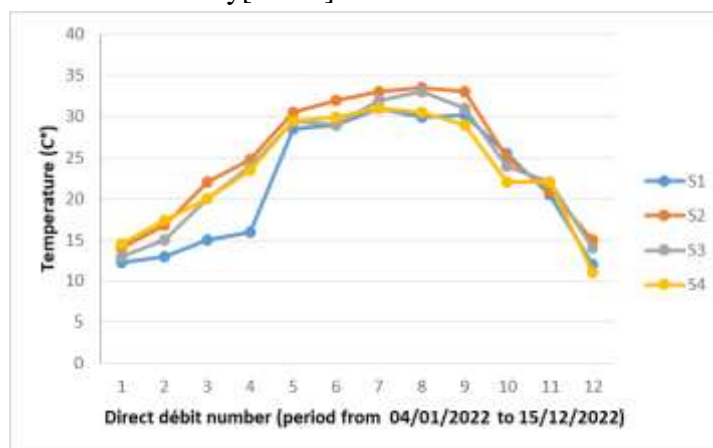


Fig. 03 : Variations of temperature over time at the four stations.

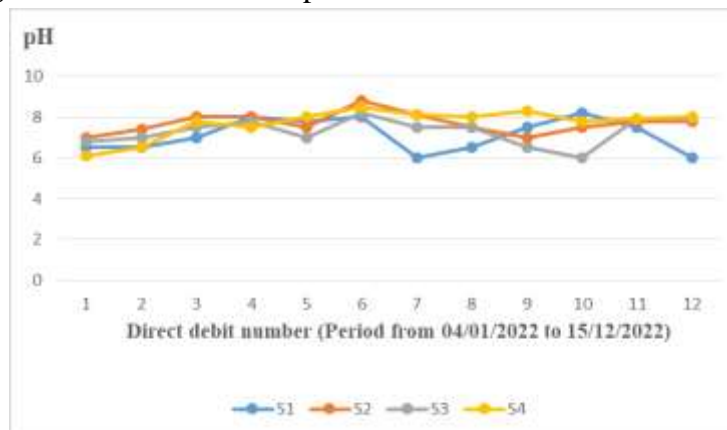


Fig. 04 : Variations of pH over time at the four stations.

For Oued Seybouse, electrical conductivity (EC) represents the water's ability to conduct an electric current.

It is proportional to the mineralization of the water, so the richer the water is in ionized mineral salts, the higher the conductivity [16].

It is also a function of water temperature, being greater as temperature rises [17].

Minimum values of $1500 \mu\text{S}/\text{cm}$ were recorded at Station 1.

According to our measurements, with values always above 2000 $\mu\text{S}/\text{cm}$, Seybouse waters are highly mineralized. (Fig.05).

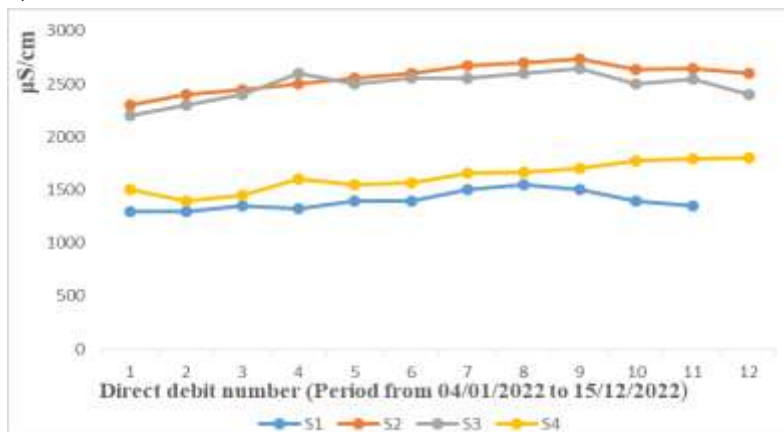


Fig. 05 : Variations of Electrical conductivity (EC) over time at the four stations.

Dissolved oxygen (DO): In general, the concentration of dissolved oxygen in natural surface waters is less than 10 mg/L [18].

Dissolved oxygen values obtained in this study ranged from 2.00 mg/L to 5.88 mg/L (Fig. 06).

The highest value was recorded at station 2.

This decrease in dissolved oxygen is probably linked to the organic-rich municipal wastewater, which has been degraded by aquatic micro-organisms that consume a substantial proportion of the dissolved oxygen.

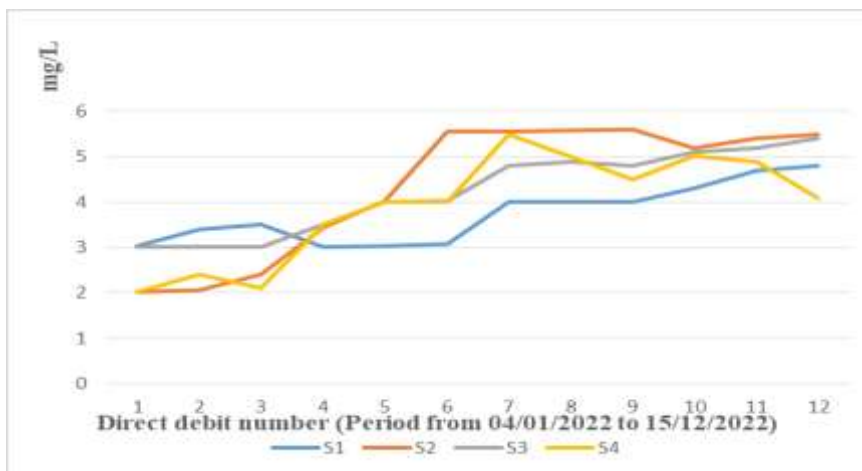


Fig. 06 : Variation of Dissolved oxygen (DO) over time at the four stations.

Nitrogen pollution can be estimated by measuring nitrate and ammonium ion levels;

Nitrate ions (NO_3^-) represent the most soluble form of nitrogen, and their presence in surface waters is linked to the intensive use of fertilizers (chemical or organic) [19] [20].

Nitrate analyses in Oued Seybouse show a minimum concentration of 1.5 mg/L at Station 01, while the maximum value is 57.5 mg/L, recorded at Station 2 (Fig.07).

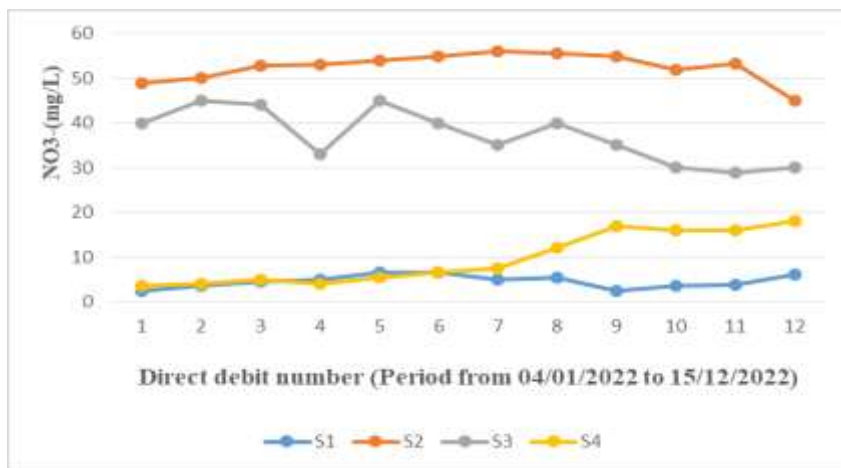


Fig. 07 : Variation of Nitrates (NO₃-) over time at the four stations.

The ammonium ion is the principal form of nitrogen in nature [21].

Nitrite concentrations observed during our study period and at the three stations ranged from 0.8 to 3.3 mg/L. The highest value was observed at station 2 with 3.5 mg/L (Fig.08).

The highest value was observed at station 2 with 3.5 mg/L (**Fig.08**).

High nitrite concentrations often indicate the presence of toxic substances.

Nitrites are particularly harmful to young fish [21]. Nevertheless, these concentrations remain below the critical value of 3 mg NO₂ / L.

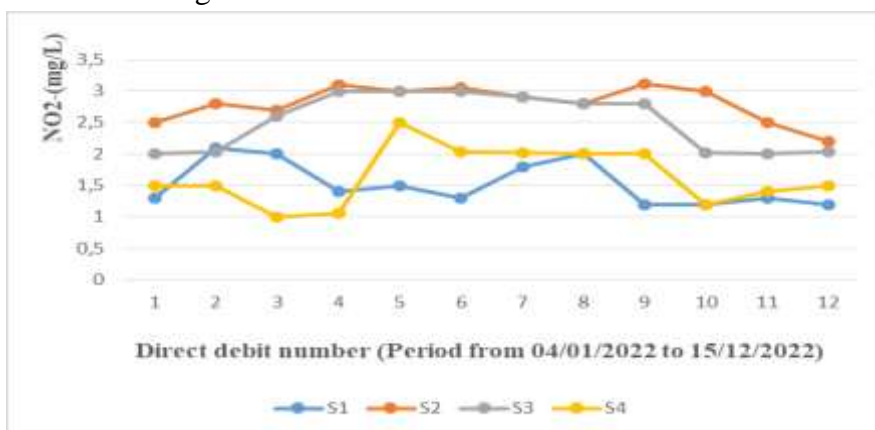


Fig. 08 : Variation of Nitrites (NO₂-) over time at the four stations.

3.2. Evaluation of bacteriological parameters

The results of bacteriological analysis show :

Total coliforms were found at all the stations studied. Low values ranging from 7.103 to 4.104 CFU/100ml were recorded at stations 1 and 3, while the high value of 17.103 CFU/100ml was recorded at station 2 (**Fig.09**).

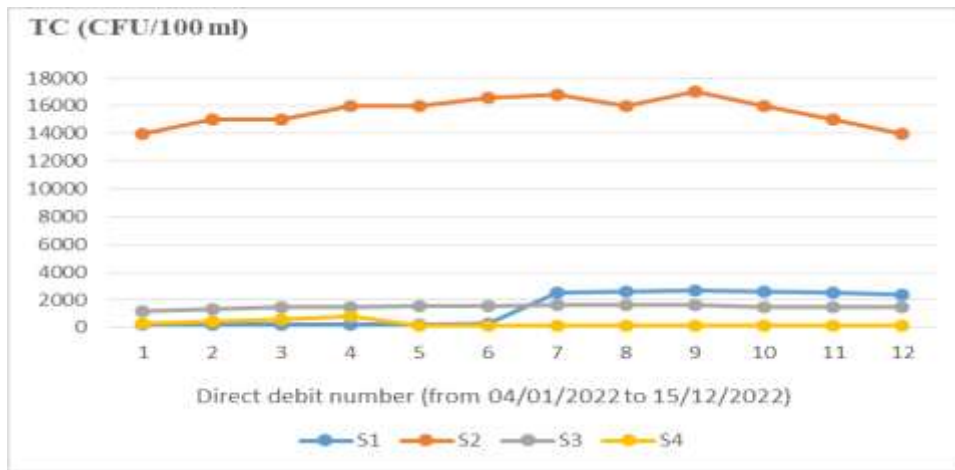


Fig. 09 : Variations of Total Coliforms over time at the four stations.

Based on the results of faecal coliform analyses, we observed the presence of faecal coliforms in the water at all stations monitored during the study period, with the exception of station 4, which showed low levels of E.coli. and station 2, where very high levels were observed (**Fig.10**).

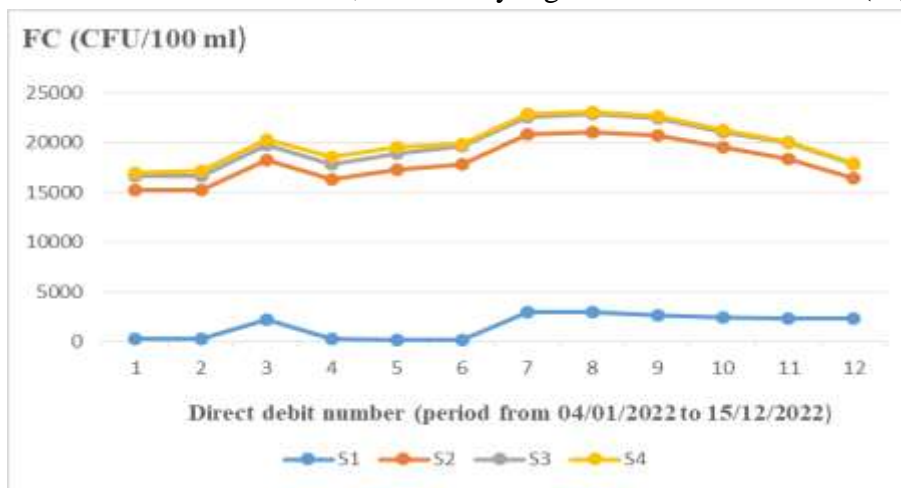


Fig.10 : Variations of Total Coliforms over time at the four stations.

Fecal Streptococcus analysis results show high levels at Station 2, with a value of 9,103 CFU/100ml. While the minimum value is recorded at Station 1 near 1.5.103 CFU/100ml. (**Fig.11**).

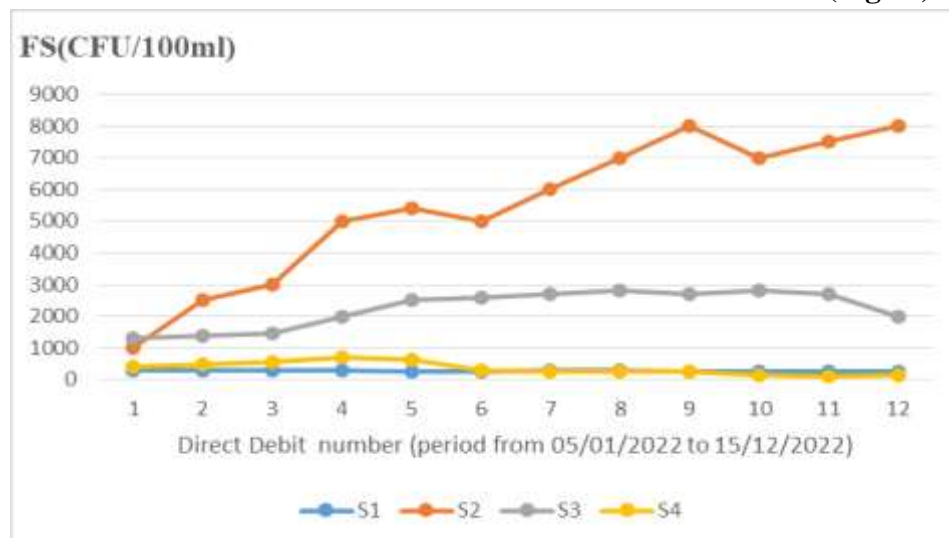


Figure 11: Variations of faecal streptococci over time at the four stations.

4. Conclusion

Data from analyses of physico-chemical parameters and bacteriological indicators of Oued Seybouse water pollution at the four sampling stations indicate recent urban pollution of the Oued Seybouse.

This pollution is characterized by high levels of nitrates and nitrites.

Bacteriological contamination at all sampling stations confirms the type is fecal, with the presence of fecal coliforms and fecal streptococci in concentrations exceeding admissible standards.

The results of our physico-chemical and bacteriological study, while essential, represent only point-in-time data, as they characterize a very specific time and place.

Further research is needed to deepen this approach.

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