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STUDY OF THE PHYSICO-CHEMICAL PARAMETERS CHARACTERIZING THE QUALITY OF EL'MENIA LAKE. ALGERIA

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ABSTRACT

The objective of this work is to evaluate the physico-chemical quality of El-Menia Lake, experiencing the effect of the discharges of waste water in this lake. The results of physico-chemical study show that El-Menia Lake is characterized by a high conductivity and very hard quality with remarkable pollution in most points.

Concerning the concentrations of heavy metal elements we found a high concentration in some metals like the lead, cadmium, cobalt and some metals less than standard value of surface water.

Keywords: El-Menia Lake, physico-chemical analysis, heavy metals.

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1. INTRODUCTION

Wetlands are among the most productive ecosystems on Earth. Sometimes described as the "landscape kidneys" for the functions they perform in the hydrological and chemical cycles and sometimes as "organic supermarkets" because of the vast food webs and the rich biological diversity they sustain.

As a result, it becomes imperative to protect them from anthropogenic activity and climate change, since these ecosystems may be lost [1].

In the date 12/12/2004 EL-Menia Lake has been classified as ramsar area, characterized by its important role in maintaining Mediterranean and central Sahara biodiversity.

It is a site of international importance because it is a home to a large animal population.

Water inflow comes from rainfall, rising groundwater, excess irrigation water, waste water discharges from the village of Hassi El Gara and the emergence of springs.

The lake of El-Menia has an area of about 7000 hactar and a water level between two and three meters it was an area of relaxation and recreation frequented by a large number of tourists. Today, with regret, it receives waste water from El-Menia town. Consequently, it is threatened with degradation from days to days by the effect of organic, mineral and microbiological pollution

The objective of this study is to characterize the physico-chemical quality of this lake and as a result, their impact on human health and to know what affect it can have to the envoironnement [2].

2. MATERIALS AND METHODS

2.1. Geographic situation

The region of El-Menia is in the center of the Algerian Sahara, located between the two Sahara, northern and southern. El-Menia is located, 870 km from the Mediterranean Sea, it belongs to the Saharan basin, it is 270 km from Ghardaïa wilaya and 360 km from Ain Saleh [3].

El-Menia is a region of the wilaya (province) of Ghardaïa in Algeria (fig. 1) (table 1);

It is limited to the north by the commune of Hassi Lefhel.

In the east we find the wilaya of Ouargla, in the South we have the wilaya of Tamanrasset and in the West the wilaya of Adrar [3].

The lake is spread over an area of 18,947 ha.

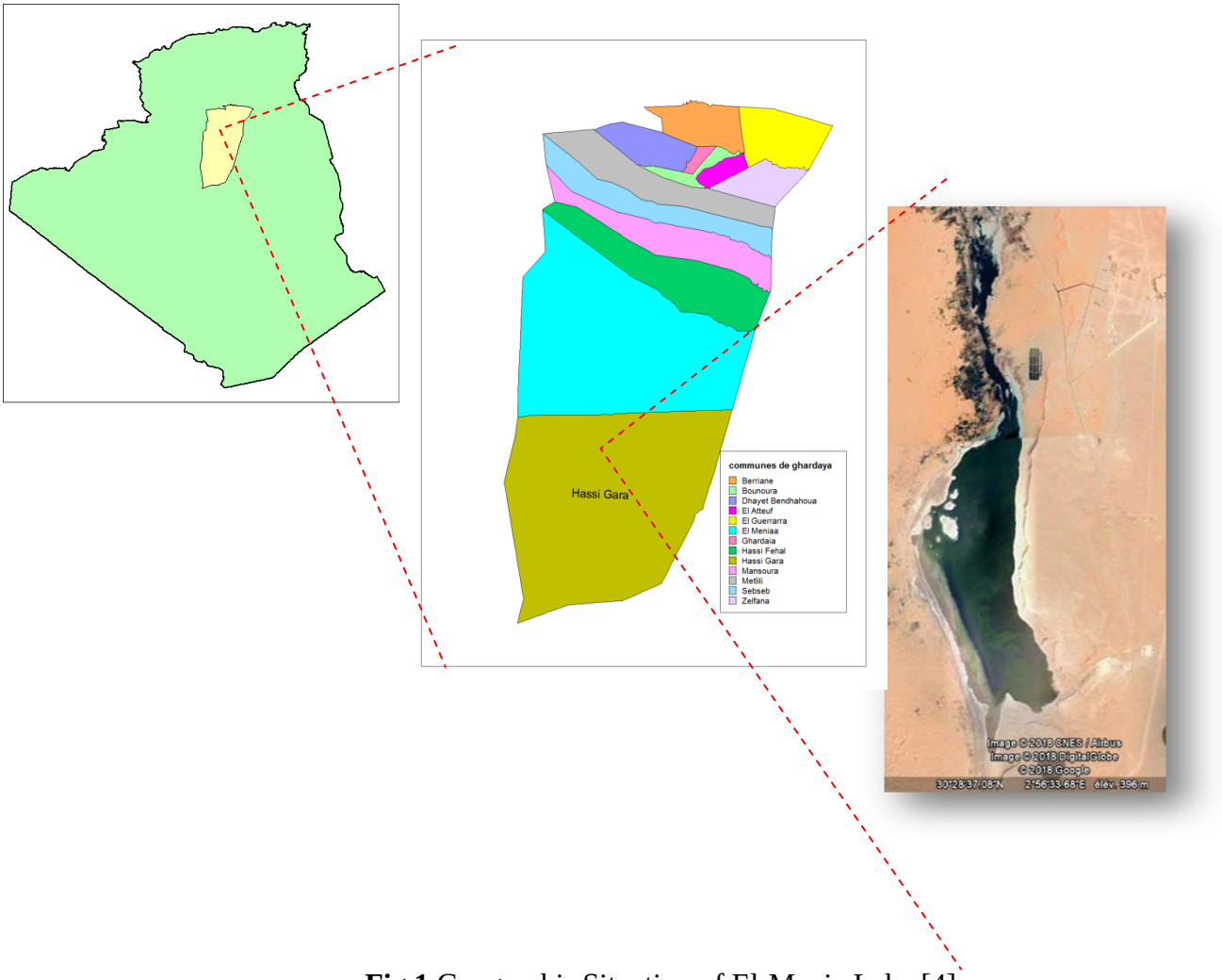

Fig.1. Geographic Situation of El-Menia Lake [4]

Table 1. Geographic coordinates

	North altitude	East longitude	Altitude
EL-MENIA	30°34’	2°52’	397 m
The lake	30°25’	2°75’	364 m

2.3. Geology

The Sahara is, more than any other deserts in the world, a country at the scale of geological phenomenon, from the local scale to that of the continent: tectonic structures, sedimentary phenomenon, glaciations, etc… [5].

Secondary terrains characterizing the region of El-Menia, a gorged plateau to the north, and flat in the south, these layers of secondary age have marked by small cliffs, occupied by wadis

such as Oued Seggueur and Oued Sbaa.

The region of El-Menia formed of the following ensemble:

- The Oued Segguer valley occupied by Oases.
- Western Erg West, sand dunes of Aeolian origin.
- Plateau Tademait in the South and East, mostly limestone.

The soil is sandy in nature, surrounded by alluvial beds of clay nature in the east, and in the south there is a limestone plateau and in the west a huge dune forming the western Erg.

Several geological sections have been made on the ground, the outcrops are started with red clay's (called El-Goléa clay) with evaporates, marked a shallow lagoon environment, then a transgression of the Cenomanian Sea [3].

2.4. Study on climate

The region of El-Menia is characterized by the Sahara climate no rain over allmonths throughout 2000 and 2017, except for a few days where there is an intense minutes of rainfall.

The region of El-Menia is characterized by a dry season over all months throughout 2000 and 2017.

The temperature study indicates that the month of august is the hottest month and the coldest, is the month of January with an annual average of 22.74ºC.

2.5. Hydrogeological framework

In the Algerian Sahara, the water has a vital, because climate and hydrological contexts are extremely fragile. The spatial and temporal irregularity of the availability of water, the impact of droughts and floods, and the pressure of water demand are continually increasing in the face of limited resources [6].

The potential water resource in Algeria is 17 billion m^3 (10 billion m^3 of surface water to groundwater of 6.8 billion m^3 mainly in the Sahara [7].

2.5.1. Groundwater:

It is near to the surface, 0.65 m at the Superior Lake, and varies according to the place, it rises to 1.40 m Bel-Bashir district, and 0.7 m to Hassi Gara [5].

2.5.2. The intercalary continental "CI" : The CI is immense water reservoir; it consists of medium to coarse grain sands, covering more than 30,000 square kilometers on a strip from the

Tinrhert plateau to southern Libya (fig.2). It is about 200 m deep, at El-Menia. It is fed by rainwater which falls to the nort, and infiltrates with the help of the western erg, this erg is a set of very permeable sand dunes with a large surface, go from El-Menia to East, Bechar to the West, and Timimoune to the South [8] (fig.2)

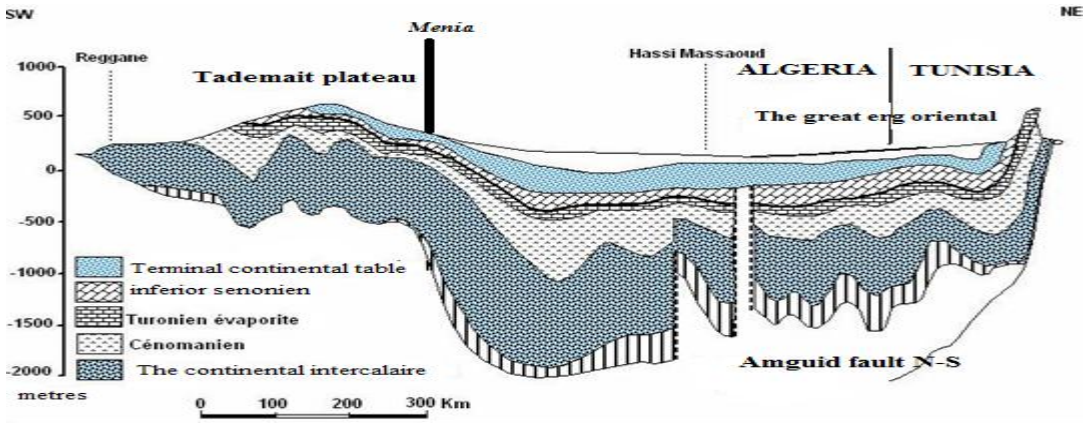

Fig.2. Hydrogeological section through the Reggan Basin in Tunisia [9]

2.6. Materials

2.6.1. Sampling

In the case of physico-chemical analyses: The samples are taken from plastic bottles of 1.5L mineral water, rinsed with lake water 3 times and then filled to the end. The samples were taken a few centimeters below the surface of the water. We have conducted a total of 12 samples presented in the fig.3. The water samples have been conserved in a glacier, and then transported to the laboratory [10].

Fig.3. Positioning of sampling points in EL-MENIA Lake [3]

2.7. Methods

The various analyses of the physico-chemical parameters of samples were conducted in the laboratory of the ADE (Algérienne Des Eaux) of Ghardaia. Some analyses (heavy metals analyses) were conducted in the measurement laboratory of Mostaganem.

Dosing procedures are deducted from the standard analytical methods.

- The pH was measured by a pH meter; conductivity is given directly in *µS/cm* by conductivity meter.
- The salinity was measured in (*g/l*) with multi parameter.
- The chemical parameters by different methods :
- The calcium (Ca^{+2}) and magnesium (Mg^{+2}), chloride (Cl^{-}) by titrimetry.
- The total hardness or the Hydrotimetric title of the samples is determined by Complexometry by titration with acid ethylene-diamine-tetracetique (EDTA) [11, 12].
- Sodium Na^{+}, potassium K^{+} are dosed by photometry of the flame.
- Ions sulphate (SO_4^{-2}) rushed to the State of barium sulfate and assayed by gravimetry [13].
- The pollution parameters are measured by spectrophotometry.
- The heavy metals with SAA (Atomic Adsorption Spectrometry).

3. RESULTS AND DISCUSSIONS

3.1. The physical facies

- **pH**

The pH depend the geological nature of the area it overflows.

We notice a great alkalinity in the superior lake PH 8.21 and a PH 7.93 at the discharge of waste water point in the above of inferior lake (fig.4).

The matter value changes in the point of water source (S13) where the pH will be neutral 7.21, the pH increases to 9.35 at the center of the lake and begins to decrease to neutrality in downstream of the lake.

- **The conductivity**

The conductivity is very high in the superior lake 22220 µs/cm.

The results obtained in the inferior lake shows a significant conductivity value (fig.5) varying

between 948 and 1412 *µs/cm* after the point of discharge 435 *µs/cm* to the natural water source point 239 *µs/cm*. The conductivity increases from the center of the lake to the lake's downstream to achieve 121200 µs*/cm*.

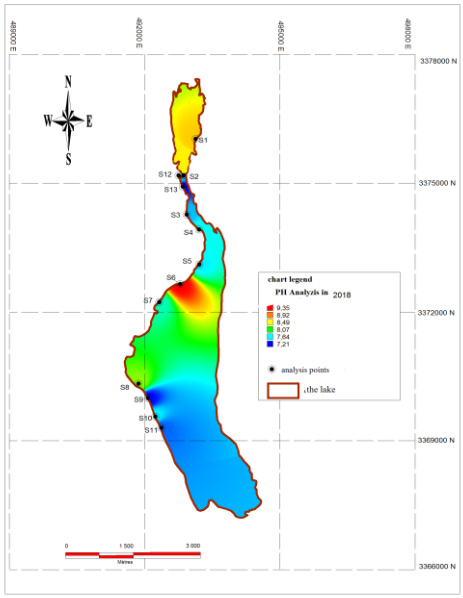

Fig.4. Variaton of PH

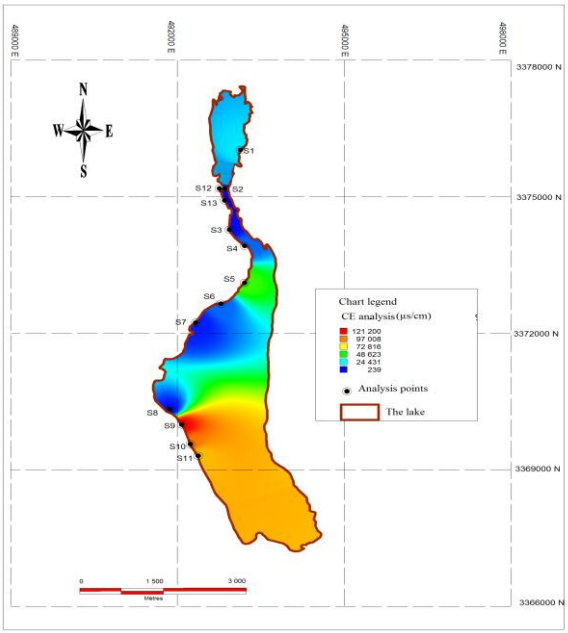

Fig.5. Variation of conductivity

- **The salinity**

El-Menia Lake is characterized by high salinity (fig.6).

The decrease of the salinity in the above of inferior Lake 0.3 a 0.5, where there are two inflows of water, favours a decrease in the concentrations of the chemical elements in this place.

The map shows an elevation of salinity in the center of the lake 36.8 results from the accumulation of chemical elements in this part.

A very important value of salinity in the downstream of Lake 88.2 this is due to the precipitation of minerals and intense evaporation.

The hydrotimetric title

The hydrotimetric title or the hardness of water corresponds to the sum of the concentrations of calcium and magnesium [14].

The superior lake is characterized by a hard water 380 *mg/l* following the evaporation (fig.7).

The inferior lake is characterized by a very hard water in the discharge point 720 *mg/l*, the increase from hard to very hard in the downstream lake achieved 910 *mg/l*, this high

concentration following the water evaporation.

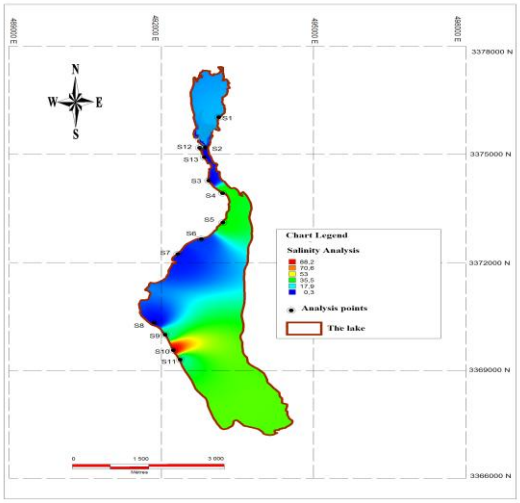

Fig.6. Variation of salinité

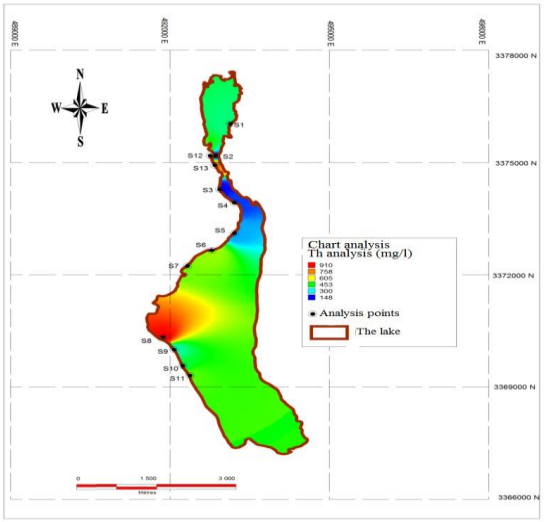

Fig.7. Variation of hydrometric title

3.2. The Chemical facies

The representation on the diagram of Piper allowed us a rapid approach of analytical results with a view to characterize the waters and to classify the anions and major cations for the lake.

- **Water table**

The graphic representation (fig. 8) of points in the water table shows that all the points analysis are characterized by the waters of Sodium and potassium type.

The dominant chemical facies in most points are sodium chlorides and potassium or sodium sulphated and sodium chloride facies.

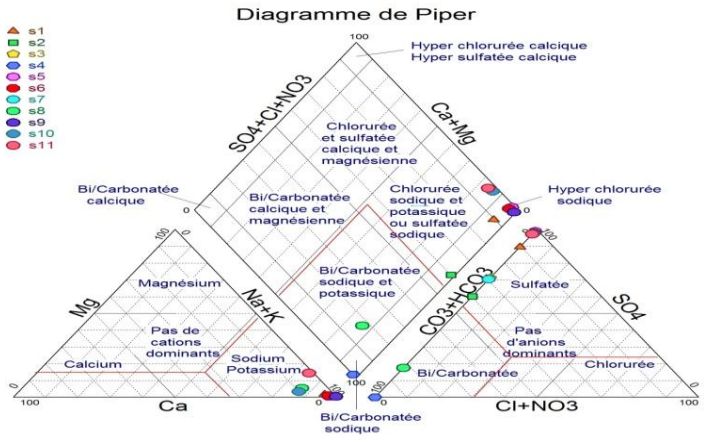

Fig.8. Diagram of Piper

3.3. Pollution parameters

- **Ammonium**

The presence of the ammonium in the water is indicator of pollution by human or industrial origin [15]. The superior lake is characterized by admissible value 0.14 *mg/l* (fig.9).

A very high value in the discharge point 17.4 *mg/l*, this value indicates a significant pollution in the above of the lake 18.84 *mg/l*, these latter decreases at the center of the lake because of the natural water supply. The ammonium concentration exceeds the standard 0.5 *mg/l* downstream and achieves 11.56 *mg/l*.

- **Nitrite**

Nitrites (NO_2^-) come either from an incomplete oxidation of ammonia (NH_3), or a reduction of nitrates under the influence of a denitrifying action [15].

The Superior lake is characterized by a value of 0.321 *mg/l* (this value exceeds the standard 0.1 *mg /l*).

The inferior lake is characterized by a value exceeds standards in the above from 0.321 *mg/l* to 0.495 *mg/l*, this value is the resent of discharge waters, followed by a decrease to 0.07 *mg/l* attribute the natural water 0 *mg /l* located in the vicinity (fig.10).

The center of the Lake is characterized by an increase to 0. 57 *mg/l*, the nitrite achieved a maximum value equal to 0.75 *mg /l* in the downstream.of inferior lake.

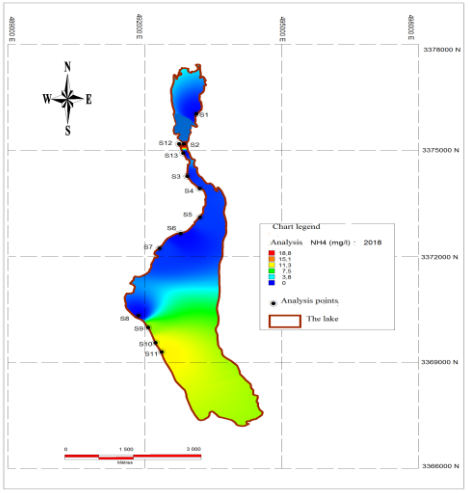

Fig.9. Variation of Ammonium concentration

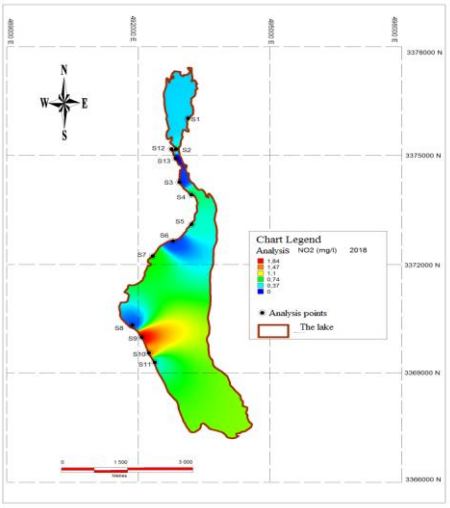

Fig.10. Variation of Nitrite concentration

- **Phosphate**

The ions (PO_4^{3-}) contained in surface water can be of natural origin (product of decomposition of organic matter, leaching of minerals), but at present, their presence in water is essential due industrial, domestic or agricultural discharges [15].

In surface water, the natural content of phosphates or orthophosphates is of the order of 0.1 to 0.3 *mg /l* [14].

We notice a value in the standard in the superior and the inferior lake except points S5 in the center 0.568 *mg/l* and S11 in the latter 1.61 *mg/l* (fig.11).

- **Ratio DCO/DBO$_5$** The assays carried show that the concentrations reached respectively 260.5 mg / l in COD and 160 *mg/l* in BOD_5.

The ratio COD / BOD_5 determines the possibility and the degradation yield that can be expected by a biological oxidation treatment [16].

The ratio COD/BOD_5 is equal to 2.58 mg/l indicate an urban origin of the discharges of waste water, this allows us to say that the influence of the latter in the degradation of water quality is important. The values obtained show that the wastewater discharges can pollute lake water, but this pollution can only be local, hence the search for other sources of observed water pollution (fig.12). We conclude that there are two sources of pollution (geology and wastewater discharges). For the ratio between COD and BOD_5 we have: 1.07 <COD / BOD_5 < 2.37. The lower ratio then 3 we can say that the effluent is readily biodegradable, a biological treatment able to eliminate most of pollution.

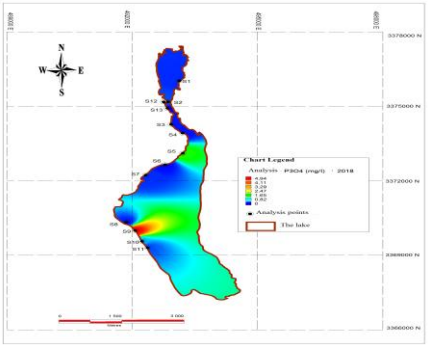

Fig.11. Variation of orthphosphate concentration

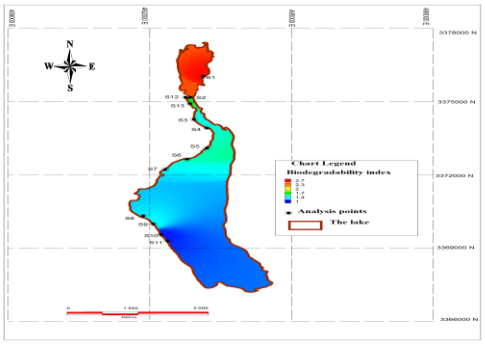

Fig.12.varation of the ratio COD/DBO_5.

3.4. Heavy metals: Most heavy metals such as chromium, nickel, iron, zinc, copper, manganese are essential elements because they have biological functions; while others such as cadmium, mercury, lead, arsenic are non-essential because they do not have any biological

function. Essential heavy metals become toxic when their concentration exceeds tolerable limits, while non-essential metals are highly toxic even at low concentration [17].

Our study is based on the following metals: Lead, Copper and Cadmium, Chromium, Nickel, Zinc, Manganese, Iron, Cobalt with a comparison to the WHO table standards.

Table 2. Standard value's for Heavy Metals in Surface Wate by the WHO.

Polluant	WHO standard (mg/l)
The lead	0.05
The cadmium	0.005
The copper	0.2
The zinc	0.5
The nickel	0.02
The manganese	0.1
The Cobalt	0.005
The iron	0.3

Table 3. Variation of metals concentration (en mg/l), in EL-Menia lake

	Cd	Cu	Pb	Mn	Cr	Ni	Zn	Co	Fe
S1	0,034409	0,00610	0,2163	0,02165	0,00060	0,002169197	0,000	0,0574	0.1423
S12(Reject)	0,029552	0,0149	0,1758	0,02876	0,00000	0,004609540	0,000	0,0411	0.1720
S2	0,027325	0,00880	0,1307	0,04469	0,00000	0,006507592	0,000	0,018	0.1697
S5	0,026313	0,01560	0,0000	0,01102	0,00000	0,000813449	0,000	0,018	0.1868
S11	0,024100	0,01200	0,0000	0,01000	0,00000	0,000654300	0,000	0,0473	0.2134

- **Lead Pb:** We note a high concentration of lead in the superior lake 0.1758 mg/l.

  For the inferior lake a high concentrations attributed by the discharge of waste water , a decrease in the concentrations of lead in thedownstream of inferior lake attributed to trapping of the lead by the soil.
- **Iron :** Absence of iron pollution in all stations**.**
- **Cadmium Cd :**We note a high concentration exceed the standard value in the superior and inferior lake.
- **Cobalt (Co) :** We note a high pollution in all stations
- **Other metals :** We note, that copper concentrations in the standard value, thus an absence of pollution for iron, manganese and chromium, nickel and zinc.

4. CONCLUSION

Our study has concerned the physico-chemical characteristics relating to the quality of the

lake water, at different points.

The waters of El-Menia Lake are confronted with pollution of multiple origins; it is either natural or anthropogenic since it receives directly the discharges of waste water.

The results show that the lake water is characterized by an alkaline PH, very hard and very high conductivity.

EL-Menia Lake is characterized by waters of Sodium and potassium type.

The dominant chemical facies in most points is sodium chlorides and potassium or sodium sulphate and sodium chloride facies.

The value of COD/BOD_5 ratio, confirm the impact of the wastewater in the degradation of the water lake quality. A high concentration exceeds the standard value of all of the lead, cadmium and cobalt. Some metal are observed in the place of the discharges, but when we move away we find a decrease in the concentrations of some metals, the latter is being explained by the sediment trapping of these metals.

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