Research Article

Physicochemical and Metallic Study of Sebou Basin, Kenitra Region

H. Houmani[1], H. Taouil[1, 2], M. Aboulouafa[1], M. Doubi[1], A. Amine[3], S. Ibn Ahmed[1]

[1]Laboratory of Materials, Electrochemistry and Environment, Faculty of Sciences, University IBN Tofail kénitra, Morocco.
[2]Laboratory of Analytical Chemistry and Physical Chemistry of Materials, Hassan II University of Casablanca., Morocco.
[3]Laboratory of condensed matter and renewable energy. Faculty of Sciences and Technology, Hassan II University. Morocco

Abstract In order to give an assessment of the waters pollution in River Sebou, sampling of water samples from the river was carried out during two campaigns (September and November of 2016). The analytical results presented in this work show that the comparison of conductivity, ammonium, chloride, and lead values measured in the waters of the Sebou estuary with those of the surface water quality grid places these waters in the bad to very bad class. On the other hand the pH values measured in the waters of the Sebou estuary classify these waters in the middle to good class. Thus the sulphate values obtained place these waters in the good class in September and very bad in November. In addition, the measured values of iron, chromium and nitrites, place these waters in the middle class.

Keywords Sebou River, Metallic Study, Physicochemical, kenitra region

Introduction

The quality of natural surface waters can be the result of natural and man-made constraints, as well as the management and economics of these waters. Indeed, the deterioration in the quality of water resources resulting from human activity constitutes a threat as important as that associated with the quantitative imbalance. This is why several researchers have worked on the physicochemical and metallic quality of surface waters [1-3]. So Baghdad *et al* [4] evaluated the metallic pollution of water in the vicinity of an abandoned mine in the Zaida- haute Moulouya-Maroc region. Azzaoui *et al* [5] investigated the metallic pollution of wetlands in the Gharb-Morocco region. Other authors [6] have noted that public works activities favour the pollution of River Roum and Rhumel waters in an area in Algeria. In the same context, H. Taouil *et al* [1] have worked on the physico-chemical quality of Waters in Tislit-Talssint River. These authors have shown that the physicochemical parameters of the water of the river in question, in most of the studied stations, meet the standards set for food and irrigation and are therefore of good quality. We were interested in the current situation of the water pollution of Oued Sebou and its evolution which are very important in order to be able to judge the quality of surface water.

Sampling

Water samples should be collected in clean containers, rinsed several times with the water to be analyzed and then sealed without leaving air bubbles in the vial. Samples for physicochemical analysis were collected during normal operating hours, approximately 20 cm below the surface of the water at distances of two meters from the edges of

the soil. This sampling was carried out at Sebou river level during September and November 2016 so that both of the analyze results could be compared.

Choice of stations

Three different stations were selected on Sebou River to determine which is the most contaminated. These three stations separate from each other about 10 km. Thus these stations noted as follows:
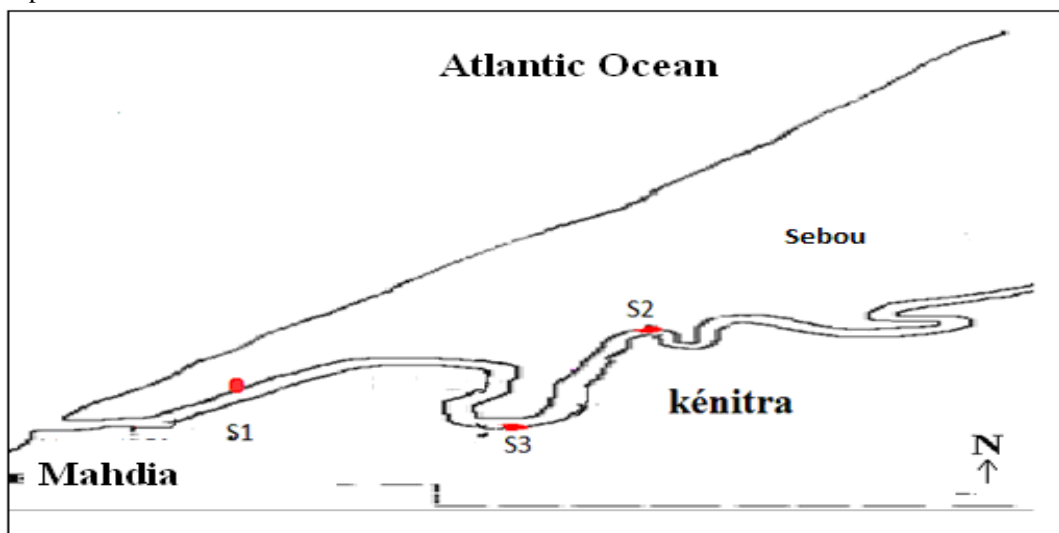

Figure 1: Location map of the study area

(S1): Station located in the vicinity of the mouth.

(S2): Station located in front of the thermal power station of the ONE and close to the company CMCP and agricultural activities.

(S3): Station located in the vicinity of the urban waste of the town of Kenitra.

Physico-chemical Parameters

Table 1: Physico-chemical parameters of surface water: Oued sebou

Parameters	Measurement Methods
Temperature	Thermometer
pH	pH meter
NO_3-, NO_2-, NH_4^+, DCO, MO…	Colorimetric determination by spectrophotometer
conductivity	Conductivity

Modes of Sampling

Water samples were collected and analyzed according to standards. After each sample, water is placed in appropriate 1 litter vials for physicochemical analyzes and 500 ml of water acidified with 4% nitric acid and then stored at 4 °C for analysis of metals.

Results

Temperature

The temperature of the water plays an important role in the modification of the chemical, physical properties as well as the biological reactions. In the studied waters, this parameter has values between 25.6 C (S1) and 26.5 C (S2), 26C (S3) (FIG. 2). It does not show large variations between stations and remains close to the temperature of the region during this period. It should also be noted that this phenomenon is accentuated by the temperature of the

industrial waste water of the paper and cardboard company (CMCP) and the relatively high thermal power plant of the ONEE. Moreover, the comparison of the temperature values measured in the waters of the Sebou estuary with those of the surface water quality grid places these waters in the middle class.

pH

The pH (hydrogen potential) measures the concentration of H ions in water and thus translates the balance between acids and bases on a logarithmic scale from 0 to 14. In addition, pH is a limiting factor in aquatic ecosystems. Indeed, if the pH is less than 4.5 or greater than 10 it becomes toxic to living organisms [7]. As for the surface waters of Sebou, they show no significant variations (Fig. 3) and tend to be basic with a minimum of 7.54 and a maximum of 7.68 in September. These values can be explained by the geological formations of the watershed of Oued Sebou which are of calcareous and marly nature which favours the release of the carbonates and bicarbonates and varies in November to become acid. Moreover, the comparison of pH values measured in the waters of the Sebou estuary with those of the surface water quality grid classifies these waters in the middle to good class.

Electrical Conductivity

Conductivity represents one of the validating ways of the water physicochemical analyzes. Indeed, contrasted measurements on an environment make it possible to demonstrate the existence of pollution, zones of mixing or infiltration. This parameter also makes it possible to appreciate the quantity of salts dissolved in the water. The surface waters of Oued Sebou are more mineralized with values between 4270μs / cm (S1) and 3260μs / cm (S2) in September and the decrease in these values in November until 1874 μs / cm (S1) and 1902μs / cm (S2), 2200μs / cm (S3) (FIG. 4). Therefore, these low values can be explained by precipitation which has led to a water dilution phenomenon and the high concentration of the electrical conductivity observed at the station1 can be linked to the increase in salinity at the estuary level under the influence of marine waters. Moreover, the comparison of the conductivity values measured in the Sebou estuary waters with those of the surface water quality grid places these waters in the poor to very poor class.

Dissolved Oxygen

Dissolved oxygen measures the concentration of dissolved oxygen in the water. It participates in the majority of chemical and biological processes in aquatic environments and its average content in unpolluted surface waters is 8 mg / L. Oxygen dissolved in surface waters comes mainly from the atmosphere and photosynthetic activity of algae and aquatic plants. According to Figure 5, the concentration of dissolved oxygen ranges from 3.25 mg / L (S3) to 4.11 mg / L (S1) in September and ranges from 3.36 mg / l (S3) to a maximum of 4 , 54 mg / L (S1) in November which testifies to an average quality of dissolved oxygen. The low values recorded at stations 2 and 3 are probably due to the significant fermentation of organic matter from domestic or agricultural discharges.

Sulphates

The natural origins of sulphates are rainwater and the solution of evaporates sedimentary rocks including gypsum ($CaSO_4$). They also come from the oxidation of the organic matter of the soils and the sulphides present in the substrates. The anthropogenic origins are the burning of coal and oil which results in significant sulphide production and the use of chemical fertilizers and laundry. The values of this parameter in the studied waters (fig. 6) are very variable in September: 122.4 mg / L (S1), 165 mg / L (S2) and 140 mg / L (S3). There was a significant increase in these stations in November: 792 mg / L (S1), 482 mg / L (S2) and 640 mg / L (s3). These high levels of sulphates in the study area can be generated by agricultural activities, industrial discharges such as tannery effluents, pulp and paper mills. But the main source of sulphates in the waters of Sebou remains the presence of secondary formations, mainly gypsum. The comparison of the sulphate values measured in the waters of the Sebou estuary with those of the surface water quality grid places these waters in the good class in September and very poor in November.

Chlorides

The chloride ion content of natural waters is essentially associated with that of sodium. In Sebou waters, this level reaches values between 3195mg / L (S1) and 2130 mg / L (S2) and 2670 mg / L (S3) in September (Fig. 7) is probably due either to the leaching of rocks and sedimentary soils, disinfection of domestic waters and industrial

processes using chlorine as a bleaching agent, domestic cleaning agents, and a sharp decrease in November due mainly to the nature of the lands traversed and by dilution of water. The high concentration in station S1 is probably related to the richness of marine waters in chlorine. Moreover, these values found in the studied waters are higher than the norm: 750 mg / L which makes it possible to classify these waters in the class bad or very bad.

Ammonium

This is the product of the final reduction of organic nitrogen and inorganic matter in water and soil. It also comes from the excretion of living organisms and the reduction and biodegradation of waste, without neglecting the contributions of domestic, agricultural and industrial origin. The ammonium ion concentrations at the stations studied are very high (values?) (Fig. 8), they can be mainly due to the leaching of agricultural origin and discharges of wastewater from the city of Kenitra which are rich in organic matter. Moreover, the comparison of the ammonium concentrations obtained with those of the surface water quality grid attributes the poor middle class to the waters of the Sebou estuary.

Nitrates

Nitrates penetrate into soil and groundwater and discharge into streams. However, they are also made synthetically by fertilizers and are one of the factors in the degradation of water quality. Nitrates usually originate from the decomposition of organic matter by bacterial oxidation of nitrites. They can also come from domestic and sometimes industrial wastewater [8]. The results obtained for this study (Fig. 9) show that the nitrate contents are between the minimum value of 32 mg / L recorded at the station (S1) and the maximum value found at the station (S2) with 45 mg / L in September and the decrease in these values in November. Nitrate contamination appears to be related to the input of groundwater contaminated by the infiltration of these compounds from agricultural land and also to soil leaching for station 2 and to domestic discharges for station 3. The comparison of nitrate concentrations in the waters of the Sebou estuary with the quality grid of surface waters, places the waters of the estuary in the middle class.

Nitrites

Nitrites are considered as intermediate ions between nitrates and ammoniacal nitrogen, which explains the small quantities encountered in aquatic environments. The results of our study reveal that the nitrite contents are very large (fig. 10), and are classified in the middle class in relation to the grid of surface water quality.

Total hardness

From Figure 11, the total hardness of the waters of the Sebou estuary increases from upstream to downstream. The lowest water hardness (230 mg / L) is recorded in September in the upstream S2 station and the highest (420 mg / L) is recorded in September in station S1 at the mouth of the river which may be related to the influence of marine waters rich in calcium and magnesium, and the increase in these values at S3 level, is probably caused by the influence of Kenitra's domestic discharges.

Alkalinity

Alkalinity is the measure of the ability of water to neutralize acids. This involves measuring the presence of carbon dioxide, bicarbonate, carbonate and hydroxide ions that are present in the water in the natural state. At the normal pH level of water, bicarbonate and carbonate are the most important contributors to alkalinity. The spatial and temporal variation of the alkalinity TAC shows that the values found (fig12) oscillate between 10 ° F recorded in the station S1 and 15 ° F recorded in the station S2 in September. The low TAC values recorded in November are often related to the lower temperature that affects the solubility of CO_2 and the biological activity of the aquatic system.

Suspended matter

The suspended matter can be considered as a form of pollution at high levels. The content of suspended matter in surface water should not exceed 200 mg / l. Increases in SM can be attributed to stormy rains followed by erosion of the estuarine soils adjacent to the estuary. Our findings (Fig. 13) show that the large solid load observed during the November companion (95mg /l for S1, 160mg / l for S2, 130mg / l for S3) generally results from the input of waste generated by domestic and industrial discharges.

Turbidity

Turbidity is inversely proportional to the transparency of the water, due to its finely divided suspended matter (SM) content: Clay, silica grains, organic matter. Turbidity has a complex ecological role (decrease in temperature, adsorbent capacity of pollutants, sedimentation ...). It has a maximum at station 2 for a value of 192 NTU (Fig. 14) and this is probably due to organic particles such as decomposed animal or plant matter or living organisms or to human activities for station 3.

Lead

Lead is naturally present in the environment. Previous work [9] has shown that the origin of metallic contamination by this element could be anthropogenic and natural. In our study, the lead content reached its maximum at station S2 (fig15), the high content at this station comes from industrial activities or solid waste. Generally, lead concentrations at sampling stations are low; this can often be related to the high content of sulphates and carbonates that allow precipitation of lead in the estuary water. The comparison of the values obtained from lead in the waters of the Sebou estuary with the quality grid of the surface waters makes it possible to place the waters of the estuary in the middle class to very bad.

Chromium

Chromium is present in small quantities in nature, it is more important in rocks of basic type than in those of siliceous types. The main sources of pollution of surface waters by chromium are surface treatment workshops, tanneries and the textile industries [10]. Chromium concentrations range from 0.01 mg / l as a minimum value at station 1 to 0.034 mg / l as the maximum value at station 3 (Fig. 16). In general, high chromium values denounce the presence of tanneries. Comparison of the values obtained from chromium in the waters of the Sebou estuary with the surface water quality grid makes it possible to place the estuary waters in the middle class.

Iron

 Surface water may contain varying concentrations of iron. It may be caused by the leaching of the lands traversed or industrial pollution. The spatial evolution of the iron concentration at the sampling stations in the Sebou estuary shows high levels recorded in S2 compared to that of station S3 (Fig. 17). These results reflect the progressive loading of the waters of the Sebou estuary caused by the discharging of industrial waste from the town of Kenitra. The comparison of the values obtained from iron in the waters of the Sebou estuary with the quality grid of the surface waters makes it possible to place the waters of the estuary in the good to middle class.
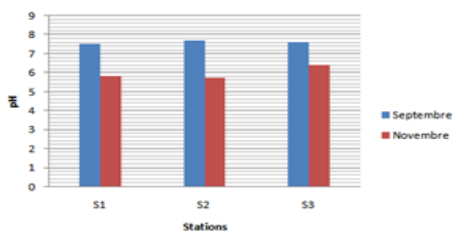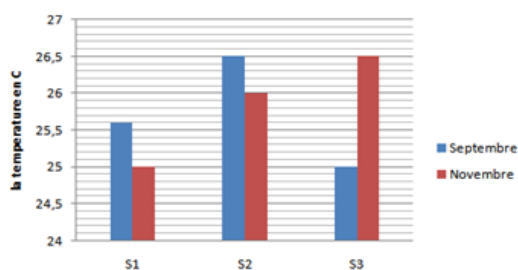

Figure 2: Spatio-temporal variation of pH

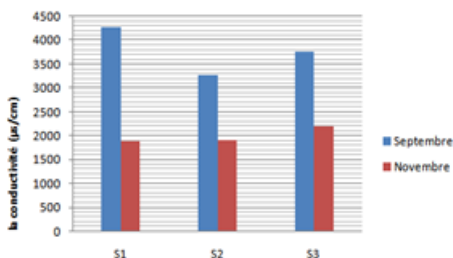*Figure 3: Spatio-temporal variation of the temperature*

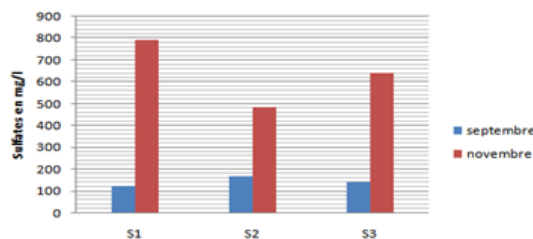*Figure 4: Spatio-temporal variation of conductivity*

Figure 5: Spatio-temporal variation of sulphate contents
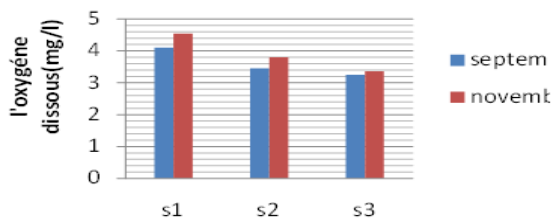
Figure 6 : Spatio-temporal variation of dissolved oxygen values
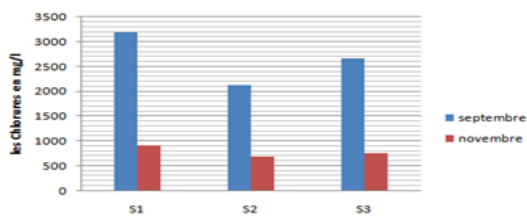

Figure 7: Spatio-temporal variation of chloride content
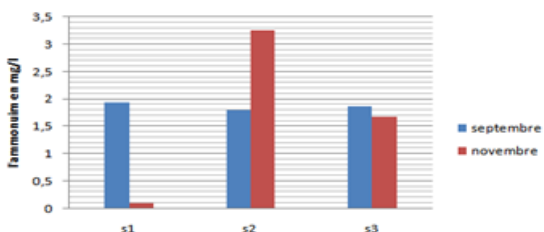

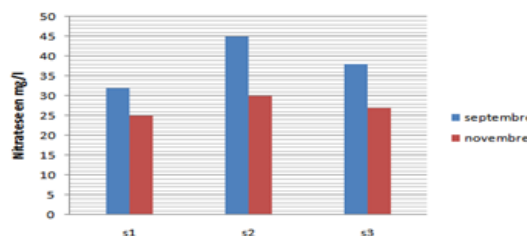*Figure 8: Spatio-temporal variation of ammonium content*

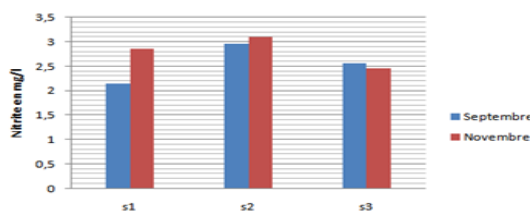*Figure 9: Spatio-temporal variation of the nitrate content*

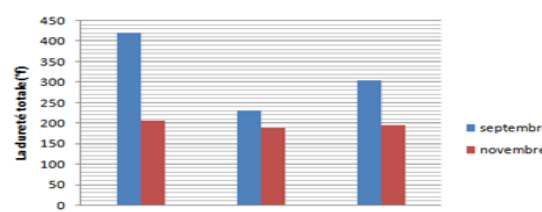*Figure 10: Spatio-temporal variation of the nitrite*

Figure 11: Spatio-temporal variation of the Total hardness
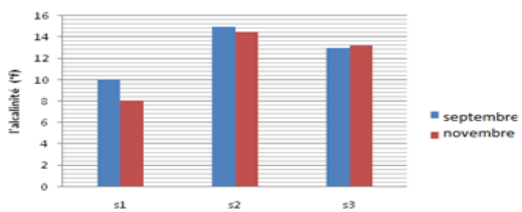

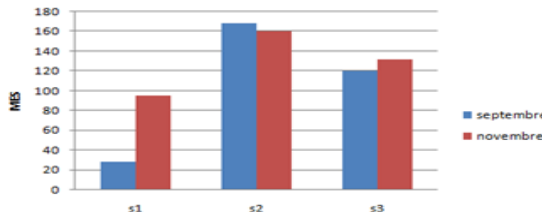*Figure 12: Spatio-temporal variation of the alkalinity*

Figure 13: Spatio-temporal variation of the SM
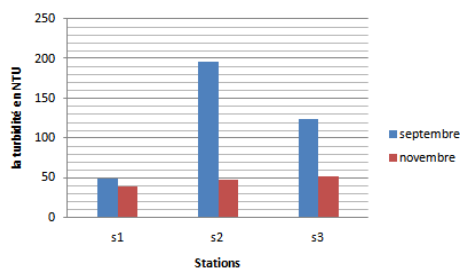

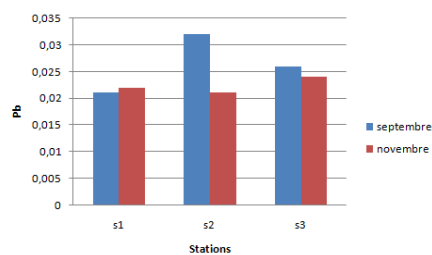*Figure 14 : Spatio-temporal variation of the turbidity*

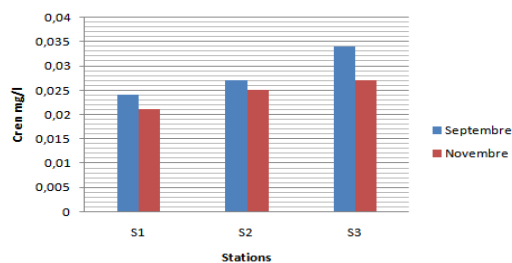*Figure 15: Spatio-temporal variation of the lead*
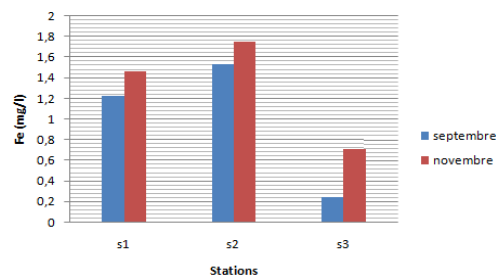
Figure 16: Spatio-temporal variation of chromium

Figure 17: Spatio-temporal variation of iron

Conclusion

This work is part of the evaluation of the physicochemical quality of Sebou River. It is interesting to note that the high concentration of the electrical conductivity observed at the station1 can be linked to the increase in salinity at the estuary level under the influence of marine waters, thus the high levels of sulphates obtained in November can be caused by agricultural activities and industrial discharges and ammonium ion concentrations at the stations studied are very high, can be mainly due to leaching of agricultural origin and discharges of the waste water of the town of Kenitra which are rich in organic matter. Moreover, the values measured in SSM show that the high solid charge observed during the November companion generally results from the input of the waste generated by domestic and industrial discharges.

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