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Full Length Research Paper

Survey of the physico-chemical quality of the wastewaters of Biskra city rejected in Chabat Roba, Messdour and Wadi Z'ommor (Algeria)

Souiki Lynda[1], Rouabhi Rachid[2], Berrebbah Houria[3] and Djebar Mohammed-Reda[3]

[1]Biology Department, 8th May University 1945, Guelma, 24000, Algeria.
[2]Biology Department, Tebessa University Center, Tebessa, 12000, Algeria.
[3]Laboratory of cellular toxicology, Annaba University, Annaba, 23000, Algeria.

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The wastewaters of the agglomeration of Biskra (Southeast Algeria) are poured without treatment in three main dismissals that are Chabat Roba (1st site), Messdour (2nd site) and Wadi Z'ommor (3rd site). The pollution charge determined in the 1st site is the order of 157.76 ± 34.14 mg/L of O_2 for the BOD_5 (Biochemical Oxygen Demand in 5 days) of 457 ± 73.59 mg/L of O_2 for the COD (Chemical Oxygen Demand) and 1109 ± 110.56 mg/L for the TSS (Total suspended Solids). In the 2nd site, the polluting charge is in average of 156 ± 29.72 mg/L of 'O_2 for the BOD_5, 430.76 ± 29.81 mg/L of O_2 for the COD and 1157.92 ± 76 mg/L of O_2 for the TSS. The 3rd site, the polluting charge is represented by 152.92 ± 27.76 mg/L of O_2 of BOD_5, 381.69 ± 70.03 mg/L of O_2 of COD and by 1039 ±106.65 mg/L of O_2 of TSS. The follow-up of these parameters in the three sites puts in evidence instability of the organic charge during seasons. The COD/BOD_5 report equal 3 for the 1st site, this elevated value, watch that these waters are characterized by an inorganic pollution probably due to the industrial origin. With regard to the 2nd and 3rd sites, the COD/BOD_5 report is between 3 and 2.5 for the first and between 2 and 2.50 for the second. The results defined the urban nature of the rejection poured in these sites.

Key words: Wastewaters, Biskra, COD/BOD_5 report, pollution charge, TSS.

INTRODUCTION

The pollution is nowadays a curse that threatens life on earth; it covers very various meanings and qualifies a multitude of action that damages from way or other the natural habitat. Near the qualitative risks linked to the dangerous toxicity of some substances, it exists the quantitative reasons of pollution whose consequences can be catastrophic, in spite of the least harmfulness of the concerned pollutants, due to the enormity of the masses that is poured in the natural habitats (Ramade, 1999).

The problem of water pollution represents undoubtedly one of the most troubling aspects of the global crisis of the environment. Indeed, to the difference of various phe-nomenon of pollution that only constitutes a potential threat susceptible to affect the human activities in the future. The crisis of water already rages for a long time, and with an increased gravity, because of the urban and industrial rejects affecting the natural habitats while con-stituting a source of diffuse dispersed contamination on wide territories. Certainly, in the industrialized coun-tries, large programs of struggle against this last per-mitted to slow down the progression of the contamination of the superficial waters by the sewages dismissal of industrial domestic (Ramade, 2003) . Paradoxically to the countries of the third world, where this curse rages always in a chronic way, remain a serious morbidity reason. Algeria lives this crisis, and endure so many the illnesses bound to the re-use of the wastewaters in agriculture, added to

*Corresponding author. E-mail: r_rouabhi@yahoo.fr

this the mismanagement of this type of water and the few of functional stations of purification through the whole national territory (ANAT, 2003). However, the dismissals of the urban sewages added to those from the industries that thrown directly and without previous treatment in the natural habitat generate a pollution of more and more important physico- chemical and bacteriogical type. Therefore, the risks of contamination of the underground sources (nappes) are strongly probable.

We attend in our case a figure in the region of Biskra where the wastewaters are rejected in nature with their polluting charge of urban or industrial origin. The absence of a purification station of the wastewaters in this desert region increases the problem of the pollution more and more by the rejected wastewaters. Indeed, the geographical concentration of the dismissals put the problem of their restitution. Thus, the demographic growth in urban environment and the industrial development drives to an important increase of the dismissals volumes and the fluxes of the polluting organic matters that they generate. Before appreciating the impact of the dismissals of wastewaters on the environment receptors (Chabat roba, Messdour and Wadi Z'ommor), it is interesting to present the physico- chemical characteristics of the wastewaters of the urban township of Biskra. The use of the physico-chemical characterization para-meters of the urban sewages constitutes a good means to give the picture of the quality of these urban dismissals and their impacts on the receiving environment. The present survey consists in characterizing the urban dismissal of the township of Biskra, to make a spatio-temporal of physicochemical analysis then by the determination of some major and global parameters of the pollution of the wastewaters, and finally to clear the protective measures of the receiving environment of these dismissals (Chabat roba, Messdour and Wadi Z'ommor).

Survey area

Biskra is situated in the East of Algeria, more precisely to the south of the mounts of the Aurès, which constitutes the North limit; it spreads to the South until the zone of the Melrhir Chotts and to the Southwest until the begining of the big oriental Erg (Figure 1) . Its surface is of 21.671,20 Km^2 and it is limited by the wilaya of Batna in North, the wilaya of M'sila to the Northwest, the wilaya of Djelfa to the Southeast, the wilaya of Ouadi Souf to the South and the wilaya of khenchla to the North (ANAT, 2004) . Biskra is located in a semi-arid to semi-desert zone. According to the census of 2003, our zone of survey (township of Biskra) regroups a population of 205.162 inhabitants with a density of 33 inhabitants / km^2 (ANAT, 2003).

MATERIALS AND METHODS

Wastewaters sampling

The physico-chemical parameters are determined from withdrawal monthly done in three sites of dismissals: Chabat Roba (Site I), Messdour (Site II), and Wadi Z'ommor (Site III) during the period 2003 until 2004 (Table 1). The wastewaters appropriated to every site is kept in small bottles of glass with capacity of 250 ml. The small bottles are kept in low temperature. The samples of water intended for analyses the metallic ions are acidified to the concentrated nitric acid 65% (Rodier, 2005).

Wastewaters analyses methods

pH, temperature, and the electric conductivity have been measured in situ using a multiparameters probe of WTW model (Multiline P3 PH/LF-SET). A probe of WTW type (Oxi330/SET) determines the level of the dissolved oxygen. The turbidity is measured based on the Algerian normalization method: AN 746 (1994). The quantity of the TSS contained in water has been determined by the method of filtration on filterable disk fiber glasses (Whatman: 47mm of diameter) according to the Algerian normalization method AN 6345 - 1992. The NH^+_4 ion is measured by colorimeter following a catalysis in alkali environment by a solution of sodium nitroprussiate according to international normalization ISO 7150/1-1998, at wavelength of 655 nm. The nitrites are determined by spectrometric molecular absorption according to the method normalized NA 1657-1994. The dosage of the nitrates has been used by spectrometric method to the diméthl-2,6 phenol according to ISO 7890/1-1986. The nitrogen kjeldhal has been measured by catalytic mineralization after reduction with alloy of devarda according to the Norm ISO 10048-1991. The concentrations of the tertiary phosphates have been determined by spectrophotometric with molecular absorption at a wavelength of 700 nm according to the method of international normalization ISO 6878/1-1998. Finally, the COD and the BOD_5 have been determined respectively according to the methods of normalization French industrial standards authority (FN, T90-101) and French industrial standards authority (FN, T90-103).

RESULTS

The physicochemical characteristics of raw wastewaters of three sites of dismissals are grouped respectively in the Figures 2 to 12.

The temperature of the wastewaters in the three sites of dismissals is 19 to 32°C ± SD (26.03 ± 3.85°C) for the site I, 18 to 31.50°C ± SD (25.13 ± 3.99°C) for the site II and 18 to 30°C ± SD (24.98 ± 3.43°C) for the site III. These results put a similar seasonal evolution in the three sites of dismissals with hotter waters in summer and colder in winter. However, the light reduction of the temperature has been observed as over norms from site I to the site III. The monthly variation of the temperature is not meaningful from site to another (Figure 2). The secu-rities of the electric conductivity (Figure 3) vary from 2990 in 6330 µS/cm ± SD (4943.46 ± 947.46 µS/cm) from the site I, to 3250 in 6000 µS/cm (4692.23 ± 864.66 µS/cm) for the site II and 3980 in 5060 µS/cm (4653,15 ± 353,85

Table 1. Ratios of the pollution global parameters of wastewaters of Biskra.

Parameters/Sites	COD/BOD_5	Oxydable matter (OM)* (mg/L)
Site I	3	257.76
Site II	2.76	247.58
Site III	2.49	229.17

*OM = COD +2(BOD_5) / 3 (Boeglin, 1999).

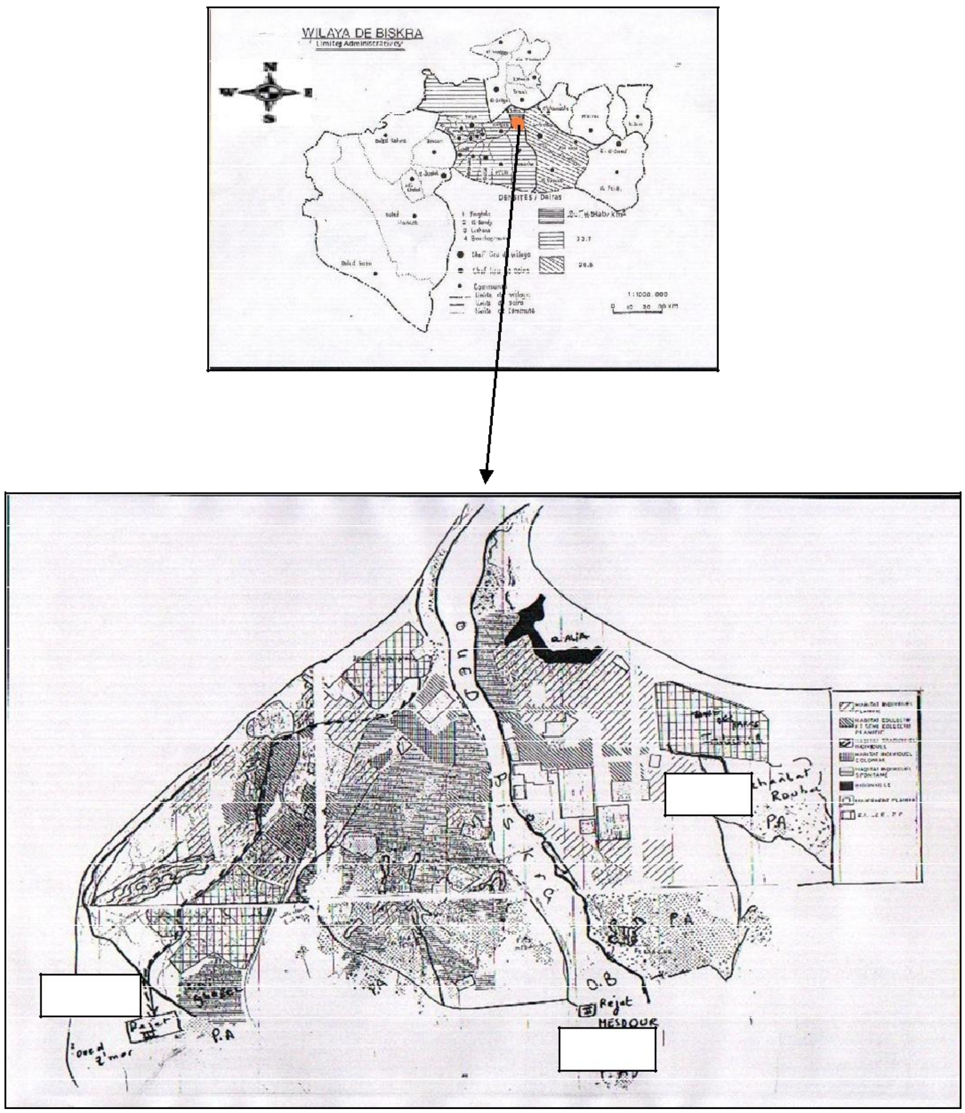

Figure 1. Localization of the main sites of dismissals in Biskra (ANAT, 2004).

µS/cm) for the site III. The securities of the conductivity recorded during our survey show a strong mineralization in the site I. However, the seasonal evolution of this parameter is felt weakly exception in the site I, where we record strong summery securities. However, the monthly variation of the gotten conductivity is very highly meaningful in the three sites. The concentrations of dissolved oxygen in the wastewaters of the three sites oscillate bet-

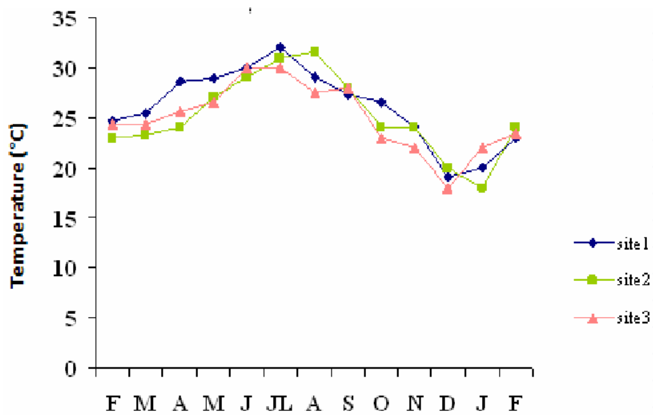

Figure 2. Spatiotemporal evolution of temperature according the time in months.

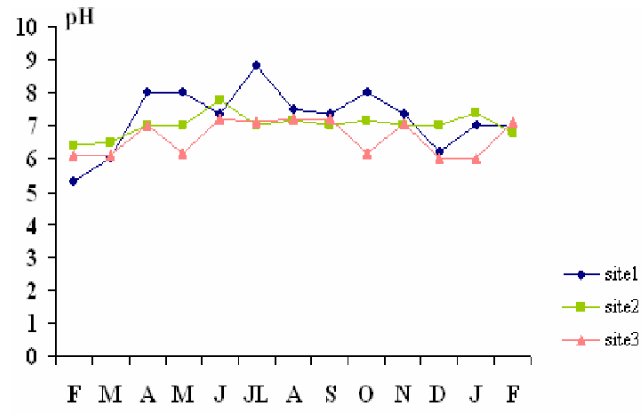

Figure 5. Spatiotemporal Evolution of pH according the time in months

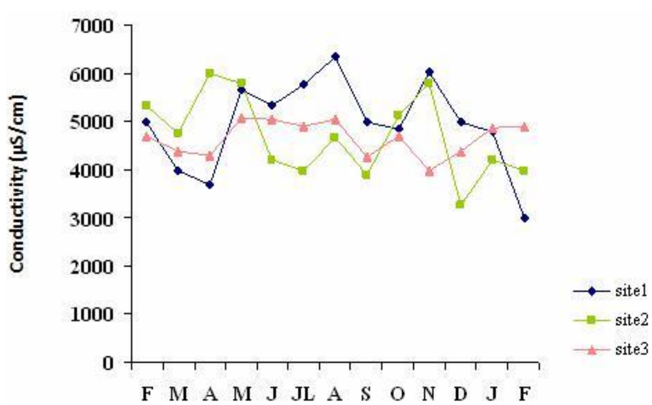

Figure 3. Spatiotemporal evolution of conductivity according the time in months.

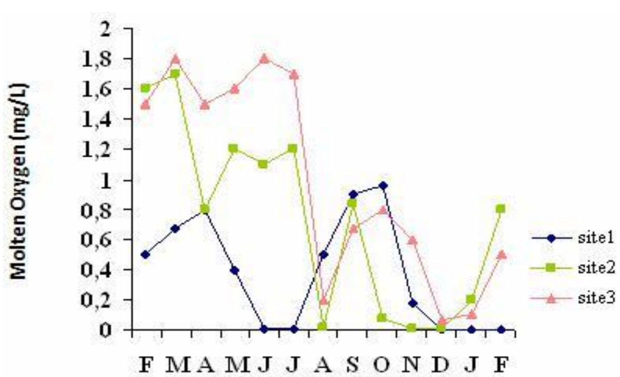

Figure 4. Spatiotemporal evolution of molten oxygen according the time in months.

of strong contents in oxygen recorded in site III, one in spring and the other in summer. The securities are weakest and sometimes quasi-hopeless for the site I in between 0.02 and 0.96 mg/L ± SD (0.37 ± 0.37mg/L) for the site I, between 0.006 and 1.7 ± SD (0.73 ± 0.61 mg/L) for the site II and between 0.007 and 1.80 mg/L ± SD (0.98 ± 0.67 mg/L). The follow-up of this parameter puts in evidence the presence of very marked two peaks summer and in winter. The difference of dissolved oxygen from site to another is meaningful (Figure 4). The Registered pH in the three sites vary from 5.33 to 8.80 ± SD (7.21 ± 0.94) for the site I, of 6.40 to 7.76 ± SD (7.01 ± 0.34) for the site II and 6.00 to 7.20 ± SD (6.64 ± 0.54) for the site III. This parameter presents a very marked seasonal evolution, from basic pH in summer to acidic pH in winter (Figure 5).

The concentrations of matters in suspension (TSS) measured in the three sites oscillate between 980 and 1280 mg/L ± SD (1108.46 ± 110.56) for the site I, 960 and 1280 mg/L (1157.92 ± 112.76) and between 750 and 1120 mg/L ± SD (1039 ± 106.68) for the site III. The follow-up of the concentrations in TSS shows a seasonal evolution marked by a reduction of the concentrations in winter and an elevation in safe summer for the site III where we record a minimum in September 2003 (Figure 6).

The values of gotten turbidity vary from 650 to 654 NTU ± SD (811 ± 133.34 NTU) in the site I, of 980 to 2830 NTU ± SD (1743.38 ± 695.14 NTU) in the site II, and of 318 to 501 NTU ± SD (427.46 ± 57.53 NTU) in the site III. It appears that the seasonal evolution of the turbidity is characterized in the site II with a maximum in winter and a minimum in summer. With regard to the sites I and III, the seasonal evolution of the turbidity is similar with a crossing in month of August.

The middle concentrations of the nitrites are quasi-hopeless during the whole follow-up. The nitrogen kjeldhal varies from 37.54 to 64.08 mg/L ± SD (49.982 ± 7.47 mg/L) in the site I, of 30.08 to 62.03 mg/L ± SD (42.37 ± 10.60 mg/L) in the site II and 29.85 to 55 mg/L (40.95 ±

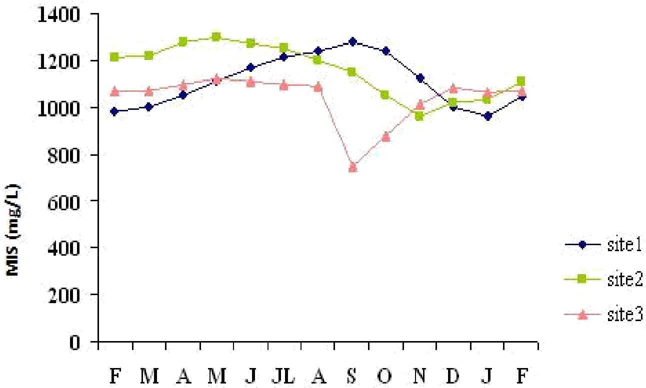

Figure 6. Spatiotemporal evolution of Matter in Suspension TSS according the time in months.

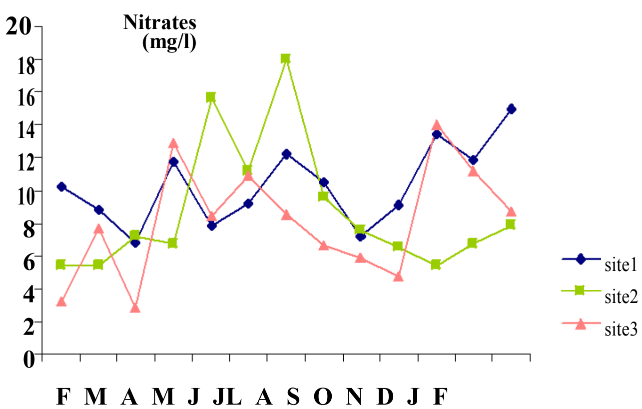

Figure 7. Spatiotemporal evolution of nitrates according the time in months.

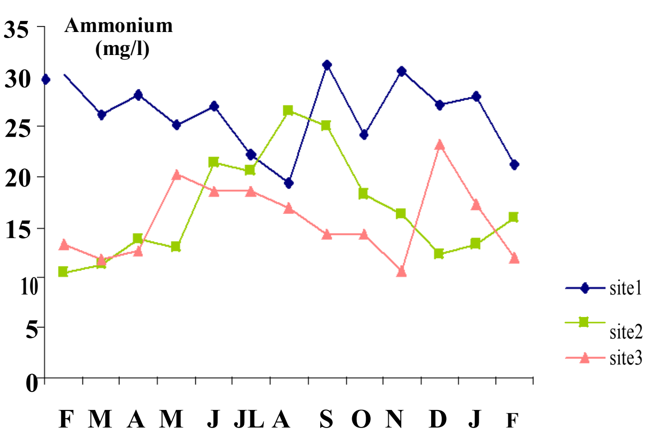

Figure 8. Spatiotemporal evolution of ammonium according the time in months.

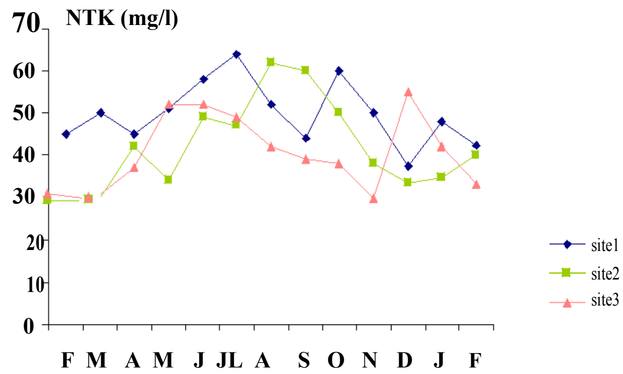

Figure 9. Spatiotemporal Evolution of NTK according the time in months.

8.68 mg/L) in the site III. The middle concentrations of the NH_4 ion fluctuate between 25.20 to 30.55 mg/L ± SD (26.21 ± 3.67 mg/L) in the site I, 10.54 to 21.33 mg/L ± SD (16.74 ± 5.23 mg/L) in the site II and 10.56 to 23.22 mg/L ± SD (15.64 ± 3.78 mg/L) in the site III. The gotten concentrations of the nitrates vary from 6.86 to 15mg/L ± SD (10.31 ± 2.46 mg/L) in the site I, of 5.40 to 18 mg/L ± SD (8.71 ± 3.97 mg/L) in the site II and 3.18 to 12.9 mg/L ± SD (8.11± 3.49 mg/L) in the site III (Figure 7). The seasonal evolution of the Ammoniacal nitrogen and nitrogen kjeldhal is similar. It is characterized by a light reduction of the concentrations in summer period in the sites I and III, whereas, we record an inverse evolution in the site II (Figure 8 and 9). The level of the tertiary phosphates recorded in the three sites of dismissal vary from 30.09 to 46.52 mg/L ± SD (38.03 ± 5.73 mg/L) for the site I, of 13.58 to 35.02 mg/L ± SD (20.50 ± 6,11mg/L) for the site II and 20.08 to 45.89 mg/L ± SD (32.50 ± 7.64 mg/L) for the site III. It seems that the seasonal evolution of the average concentrations of the tertiary phosphates is similar for the site I and the site II, whereas, for the site III, we record two marked peaks, one present a reduction in summer and the other an increase in winter (Figure 10).

The values of the BOD_5 are vary from 102 to 200 mg/L of O_2 ± SD (157.76 ± 34.14 mg/L of O_2) in the site I, of 102 to 189 mg/L of O_2 ± SD (156 ± 29.72 mg/L of O_2) in the site II and 105 to 185 mg/L of O_2 ± SD (152.92 ± 27.76 mg/L of O_2) in the site III. For COD it oscillates between 315 and 540 mg/L of O_2 ± SD (457.76 ± 73.59 mg/L of O_2) in the site I, between 399 and 486 mg/L of O_2 ± SD (430.76 ± 29.81 mg/L of O_2) in the site II and between 289 to 485 mg/L of O_2 ± SD (381.69 ± 70.03 mg/L of O_2) in the site III. These results put in evidence a very marked spatiotemporal evolution with instability of the organic charge of the first site to the last and the summer to the winter (Figure 11 and 12).

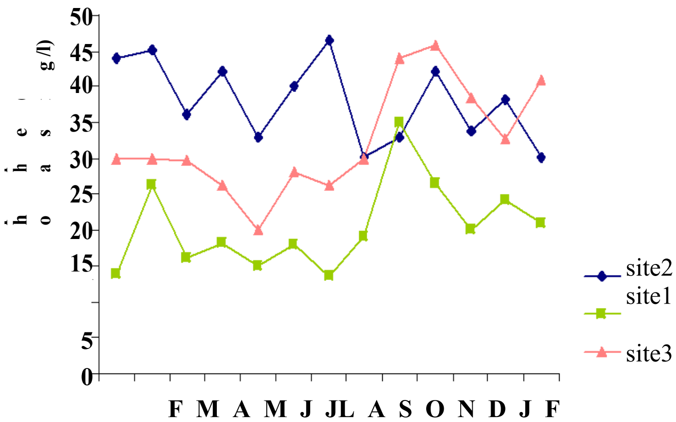

Figure 10. Spatiotemporal Evolution of Orthophosphates according the time in months.

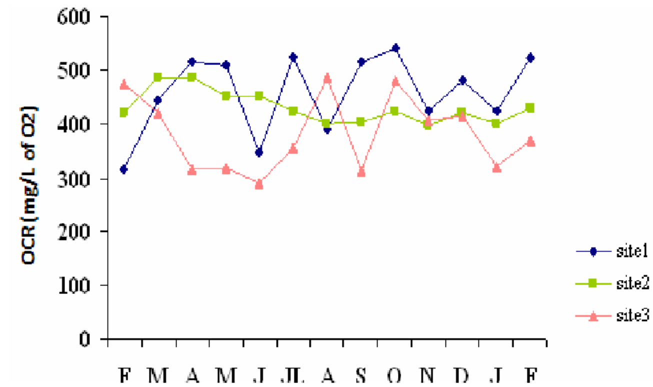

Figure 11. Spatiotemporal Evolution of COD according the time in months.

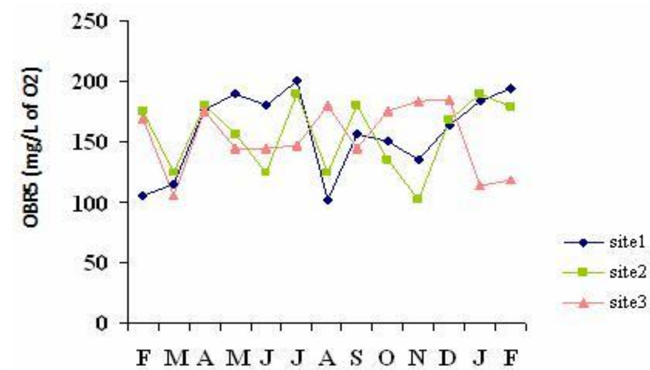

Figure 12. Spatiotemporal Evolution of BOD_5 according the time in months.

DISCUSSION

The temperature of water is an essential element in the working of the aquatic ecosystems, it depends on the sunshine and exchanges with the atmosphere. The average temperatures recorded in these sites are lower to 30°C, considered boundary value of the direct dismissals in the receiving environment (J.O.R.A, 2003). In the same way, the temperature is lower to 35°C, considered like indicative boundary value for the wastewaters (J.O.R.A, 1998). The value of the electric conductivity is probably one of the simplest and the most important for the control of the quality of the wastewaters. The results put respecttively in evidence a strong mineralization of the wastewaters of the three sites with averages of EC equal to 4943, 4692 and 4653,15 µS/cm. The conductivity values pass the Algerian norm (AN) that is equal to 2000 µS/cm (J.O.R.A, 1993) . In addition, these results are superior with those met in the wastewaters of valencia (Spain) (Bes-Pia et al., 2002) and by Sonnenberg and Holmes in Jacksonville (Sonnenberg and Holmes, 1998). On the other hand, they are comparable to those found by Yaoundé in Cameroon (Endamana et al., 2003).

The seasonal evolution of this parameter in the site I is characterized by strong value of EC in summer and weak enough in winter. This reduction in winter seems to be due to the phenomena of dilution under the effect of frequent rains during this period. The comparison of the average values of dissolved oxygen in the wastewaters, analyzed with the grid of surface quality (J.O.R.A, 2003) permits to deduct that these waters are of very bad quality in the descending order of the sites. The significance of this parameter is very fattening pond since the presence of dissolved oxygen conditions the reactions of deterioration (aerobe) of the organic matter and generally the biologic balance of the surroundings water. In the networks of wastewaters purification, its complete disappearance generally comes with the apparition of H_2S in air, coming from the reduction of the present Sulphured compounds in the sewages and correlatively of the phenomenon of acidic attack of the duct concrete (Thomas, 1995).

The seasonal evolution of this parameter due to the biological activity in the middle, it is characterized by maxima (0.96, 1.70 and 1.80 mg/L) that don't pass the 2 mg/L. These securities remain weak for a good oxygenation of the middle. The yearly average values of the wastewaters pH recorded in three sites are respectively: 7.21, 7.01; and 6.64. These wastewaters evacuated by the dismissals are therefore relatively neutral. These results are similar to those found by El Guamri and Belghyti (2006). The securities of pH measured are acceptable according to the Algerian norms of quality of the wastewaters destined to the irrigation, and also they are in the interval admitted (5.5 to 8.5) considered, as boundary value of the sewages liquid dismissals poured in the natural habitat (J.O.R.A, 2003). The seasonal evolution of the pH in the waters of the site 1, is determined by an acidic character in winter and an alkaline character in summer. This wintry acidic tendency of the waste-waters of this site, seem due on the one hand to the slowing of the photosynthesis activity consumer of H^+ proton and to the contribution of acidic pollutants. Nevertheless, the dismissal of the basic sewages is responsible for the increase of the pH lasting the sum-mer. Matters in suspension, represent the set of the mineral and organic particles contained in the waste-waters, their effect on the physicochemical characteristic of water is very ominous (modification of the turbidity of waters, reduction of the light penetration therefore of the photosynthesis). The analysis of the results shows that the wastewater of the three sites is characterized by elevated annual average concentrations, 1108.48, 1280, and 1039 mg/L. These results are often link to the important charge in organic and mineral matters generated by the urban population. In the same way, these securities are superior of those gotten in the Senegal (Kankou, 2004). According to the norms of the Official Journal of the Algerian Republic, the gotten results pass the concentration extensively limits the direct dismissal (50 mg/L) (J.O.R.A, 2003). The turbidity of the middle is in direct relation with the TSS. The measured variables of the yearly turbidity in the wastewaters of the site II are two times more elevated than those recorded in the site I, and four times more that those recorded in the site I. However, the seasonal evolution of this parameter is characterized by a fall of the securities in summer because of the crops of waters in this period of the year.

The nitrogenous diffusion is more respectively elevated in the wastewaters of the three sites with yearly average values of NTK of 49.98, 42.37 and 40.95 mg/L. These concentrations are more superior to the acceptable limits of direct dismissal in the receiving environment, NTK = 40 mg/L (J.O.R.A, 1993). The concentrations of annul nitrites is too weak; it is the reason for which we did not represent this spatiotemporal variations graphically. These weak concentrations are therefore the consequence of the fast transformation of this unsteady element by the bacteria of the middle in nitrates. The summery reduction of the concentrations in Ammoniacal nitrogen in the site I and III is bound presumably to an assimilation by algae, very present during this period, because algae absorb the NH_4 preferentially. However, the opposite evolution observed for the site II (elevated concentrations in summer), cannot be explained by the direct influence of the polluting charge poured in this site, and is very charged in Ammonium during the summer following the very advanced bacterial activity and that passes the summery assimilation by the phytoplankton. The spatiotemporal evolution of Ammonium ion shows a well reduction of the averages of a site according to the other because of mineralization of the Ammoniacal nitrogen in nitrates by bacterial action (*Nitrosomonas* and *Nitrobacter*) (Jones et al., 1983). The comparison of the seasonal evolution of the nitrates and Ammonium ion in the site I put in evidence an evolution of these two parameters, which indicates a denitrification.

The phosphor is among the most important nutriments for the algal growth (Lair, 1978). The annual averages concentrations gotten of tertiary phosphates are respectively 38.03 mg/L in the site I, 20.50 mg/L in the site II and 32.50 mg/L in the site III. These results pass the acceptable values of direct dismissal extensively in the receiving environment (2 mg/L) (J.O.R.A, 1993) and those found by Otokunefor and Obiukwu (2005). The seasonal evolution of the tertiary phosphates mainly in the site II, show that the progressive reduction of the concentrations (from January to February 2003), can be the result of the fast assimilation of this element by the bacteria and the algae of the middle (Legendre, 1984), and/or its complexation with the calcium as apatite (Alaoui et al., 1994). However, the progressive increase in tertiary phosphates in the same site observed in the month of July until the end of the year 2003, can translate a possible tipping of sewage rich in phosphate compounds. Important variations of the BOD_5 and the COD are recorded into the season. The yearly average values of the COD found are distinctly superior to those gotten (Otokunefor and Obiukiw, 2005) and to the Algerian norm (J.O.R.A, 1993) . On the contrary, they are perfectly in agreement with those found by Konkou (2004). For the yearly average values of the BOD_5, they are much raised according to those found in Cameroon (Endamana et al., 2003) and in Nigeria (Ekzeowor, 2001).

The yearly report BOD_5/COD (Tab.1) is the order of 0.34 for the site I, 0.36 for the site II, and 0.4 for the site III. This result permits to conclude that the wastewaters of the three sites are polluted by an organic pollution characterized by partially degradable sewages. Otherwise, the yearly report COD/BOD_5 is the order of 3 for the site I, elevated value, what indicates that the Oxidable Matter, valued in 257.76 mg/L in the wastewaters of this site is with difficulty degradable in relation to those of the site II and III whose COD/BOD_5 reports are respectively 2.76 and 2.49. This last report is in the interval (2.00 to 2.50), which according to Rodier characterizes the urban wastewaters (Rodier, 2005). However, the organic matter degradability is appreciated in the descending order of the sites.

Conclusion

The quality of the rejected wastewaters essentially depends on the quantity of consumed water (daily Endowment *per capita*), of the percentage of this quantity that meets at the sewer and that depends of the climatic conditions, of living standard of the population connected to the network of purification, the social habits and the type of habitat. To the term of this assessment of pollution physicochemical degree, we can note that the set of the studied parameters (in particular the BOD_5, COD and the TSS) situate the wastewaters of the dismissals of Chabat Roba, Messdours and Wadi Z'ommors in the weak concentration (Metcalf and Eddy, 1991). It is due to the weak dilution of the organic matter (soluble or in suspension) because of the consumption more at least limited *per capita* in comparison with the developed countries. The report determined COD/BOD_5 permitted to characterize the origin of waters poured in every dismissal; it is the order of 3 for the site I, elevated value, what indicates that the waters of this dismissal are under inorganic pollution (metallic) bound probably to the direct dismissal of the industrial sewages. Indeed, this report also explains the strong metallic tenures represented by 62% of Cadmium determined in the waters of this dismissal. For the site III, the COD/BOD_5 report is consisted between 2 and 2.50, which characterizes the wastewaters of domestic dominant urban origin. This counterpart content made of zinc (59%) determined in this let dismissal suggested that the source of this is close to the domestic origin (housekeeping products, detergent etc.). With regard to the type of the wastewaters of the site II, they are characterized by an urban origin since the COD/BOD_5 report is lower to 3 and superior to 2.50. The dismissal of the urban wastewaters (domestic and industrial) in the natural habitat without previous treatment can have a considerable environmental impact. These wastewaters dragging the contamination of the receiving rivers and by the way of consequence cause important pollution for the urban population, the users, and the faunastic resources. Therefore, a rational management of resources in water and the construction of a station of purification of the urban wastewaters of Biskra are going to minimize the environmental risks bound to the dismissal of these wastewaters in the raw state, in the sites of Chabat-Roba, Messdours and Wadi Z'ommors.

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