Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 7, No. 2, p. 100-106, 2015
http://www.innspub.net

INNSPUB
RESEARCH PAPER
OPEN ACCESS

Assessment of physico-chemical quality of water discharges along the Mostaganemois coastline

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Article published on August 10, 2015

Key words: Mostaganem, Pollution, Wastewater, Coastline, Physico-Chemical Parameters.

Abstract

The city of Mostaganem is particularly affected by some problem of pollution caused by human activities (urban, industrial and agricultural discharges) due to its geographical location, its growing population and its continued industrial development. Consequently, the study focuses on the assessment of the environmental quality of water discharges evacuated along Mostaganem coastline by determining the physico-chemical parameters of wastewater in order to establish a diagnosis of the current area state. The results show an increase in level of suspended solids, biochemical oxygen demand and chemical oxygen demand and a decrease of dissolved oxygen level. Regarding nitrogen compounds, it notices that nitrogen is found mainly in the ammonium form. Furthermore, the pollution degree differs from site to site depending on the pollution source. The continuing deterioration of the quality of these waters certainly lead to the loss of this natural heritage if protective measures are not taken.

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Introduction

The coastline is generally defined as a contact area between the mainland and the sea (REEM, 1998) it represents a considerable challenge in terms of socio-economic development but this place is particularly fragile and sensitive (Bouras *et al.*, 2007) as it is very damaged and seriously threatened by human activities.

Indeed, population growth accompanied by rapid urbanization causes many disturbances to the natural environment (Mc Kinney, 2000). Industrialization, inefficient use of fertilizers and pesticides and the lack of awareness towards environmental protection, also lead to an imbalance of the ecosystem and generate pollutants that can affect the physico-chemical and biological quality of aquatic receptors (Mullis *et al.*, 1997).

The coastal pollution by chemicals and heavy metals such as cadmium, nickel, zinc, lead, copper, etc., are accelerated dramatically during the last few decades (Mashiatullah *et al.*, 2009; Qadri *et al.*, 2011; Nergis *et al.*, 2012; Seema, 2015).

The Mostaganem coastline pollution« is mainly due to industrial and domestic waste. These have serious repercussions since hurting marine biodiversity (Boukhelf, 2007), the situation is aggravated by transport of a large waste water during recent years (Daief *et al.*, 2012). These discharges cause - when the renewal of water bodies is low compared to the amounts released - significant damage to water quality and marine ecosystems (Remili *et al.*, 2013).

The objective of this work is to evaluate the degree of pollution of raw water discharged along the Mostaganem coast by physical-chemical parameters analysis.

Materials and methods

Description of study area

The city of Mostaganem is a Mediterranean port city. The majority of its units are concentrated in the industrial areas. The sampling sites (Sablettes, Salamandre, Port of Mostaganem and Oued Ain Safra) were selected based on the importance of pollution and the location of the main discharge points along the Mostaganem coastline which flows directly into the sea (Fig. 1).

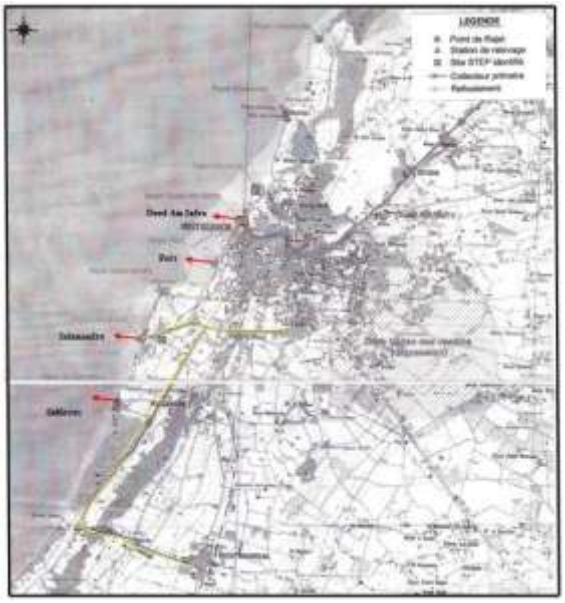

Fig. 1. Area study.

Sampling technique

The assessment of water quality requires analysis, including numerous dosage of physic-chemical parameters which led us to make several samples bimonthly from January to May 2014 along the Mostaganem coast sites. The water samples were collected between 8 am and noon, using sterile glass bottles with a capacity of 500 ml, according to the guidelines of international organizations (OMS, 2004) and the recommendations of Rodier (2010). The samples were stored in an insulated case in temperature between 0 and 4 °C until arrival at the laboratory in a time not exceeding 24 hours. The physicochemical analyzes were performed at the Laboratory of the National Agency for Water Resources (ANRH).

Results and discussion

Based on the information results obtained from water samples taken during the three sampling surveys and

analyzed for physic-chemical parameters in the different study sites, we present the following results (Fig. 2).

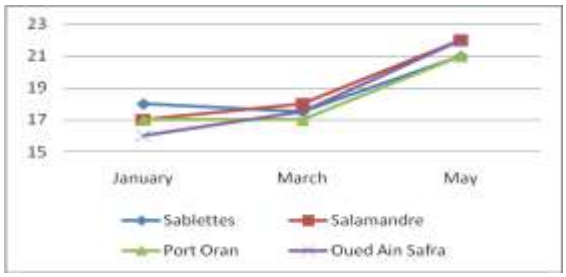

Fig. 2. Variation of temperature C°.

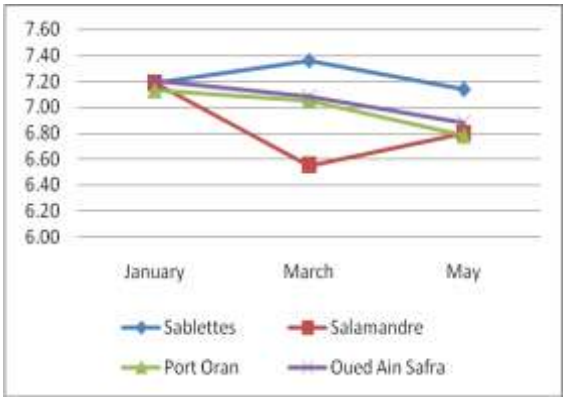

Fig. 2. Variation of pH.

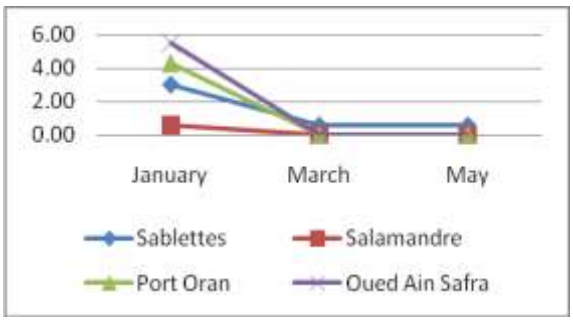

Fig. 2. Variation of dissolved oxygen mg/l.

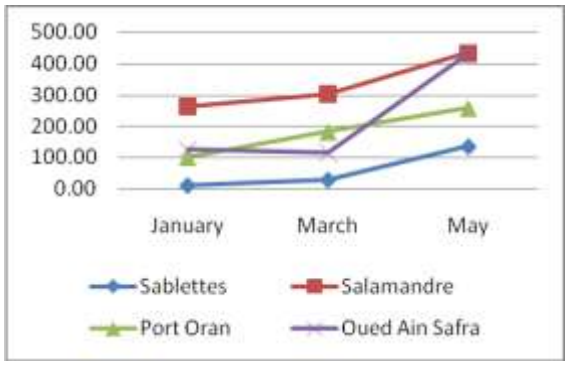

Fig. 2. Variation of suspended solids mg/l.

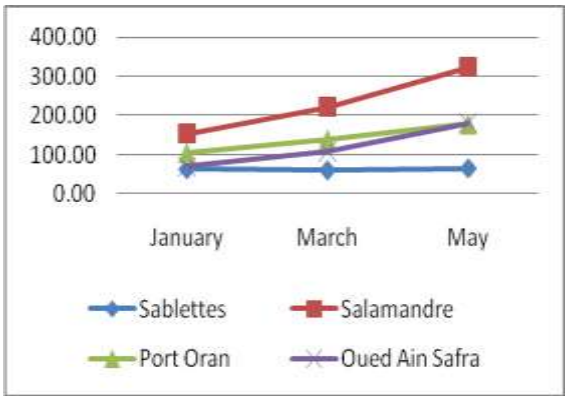

Fig. 2. Variation of biochemical oxygen demand mg/l.

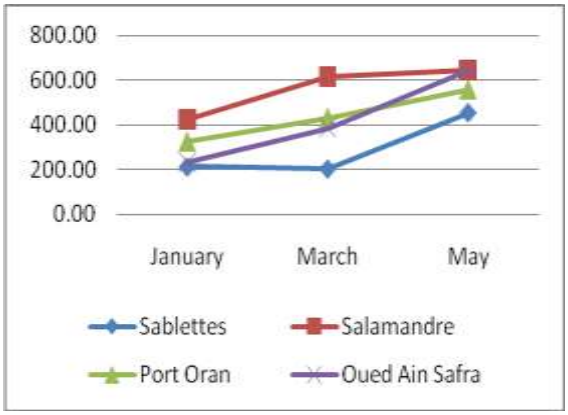

Fig. 2. Variation of chemical oxygen demand mg/l.

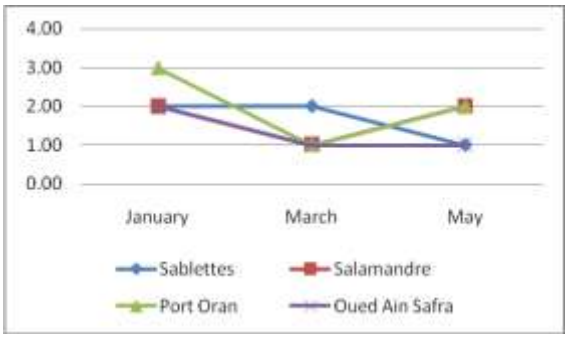

Fig. 2. Variation of nitrate mg/l.

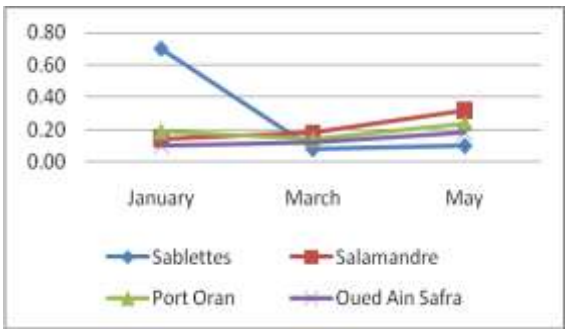

Fig. 2. Variation of nitrite mg/l.

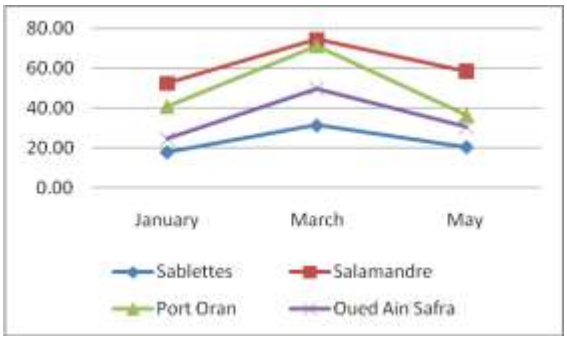

Fig. 2. Variation of ammonium mg/l.

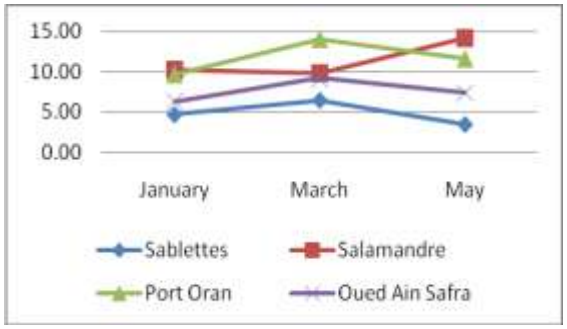

Fig. 2. Variation of phosphate mg/l.

Temperature

For most sets of samples, water temperature varies significantly from one site to another. Temperature values recorded oscillate between 16 and 22 °C. The warmer waters are those of Salamandre with an average of 19 °C. This high temperature of the Salamandre site can be explained by the fact that it receives more rejection than others. But these results remains in the standards (lower than 30 °C) which is considered the direct discharge limit value in the receiving environment (Jora, 2006).

The pH is an important element for the interpretation of corrosion in pipes of sewage facilities. The pH average values respectively oscillate between a maximum of 7.23 and a minimum of 6.85. The observed values indicate that the pH is neutral to slightly alkaline in all sites. Indeed, the recorded results indicate a receiving medium with a carbon dioxide system in equilibrium (CO_2) similar to that of the world ocean and whose potential hydrogen fluctuates around 6.88 and 8.89. The results are in global standards that promote pH of the discharged water which varies between 6.5 and 8.5.

Dissolved oxygen

In the study, the levels of dissolved oxygen analyzed in the Mostaganem coastline wastewater show significant variations from one site to another. These variations are between 0.20 mg/l minimum average recorded at Salamandre, and 1.83 mg/l average maximum recorded at Oued Ain Safra.

We note that the highest concentrations is recorded in January. This is mainly due to the decrease of the water temperature; because cold water contains more dissolved oxygen than warm water (Hebert *et al.*, 2000), and strong wind speeds that generate continuous mixing of the water body and therefore an enrichment of the dissolved oxygen phase during the winter season.

The high flow rate can also increase the exchange of oxygen with the atmosphere, thereby facilitating the flow of air and subsequently influence the concentration of dissolved oxygen. Concentrations of Oued Ain Safra and the Port are the closes to the considered normal conditions (5-6 mg/l).

A value of 0mg/l dissolved oxygen is recorded in March and May for all sites excepted Sablettes. The decrease in these levels may be due to bacterial metabolism, which uses this element to degrade organic matter abundant at those stations (Fekhaoui *et al.,* 1993).

Suspended Solids

National standards (06-141 Executive Decree of 19 April 2006/JORADP/ 23-04-2006) and international (OMS/PNUE, 1995) set as limit value for TSS, in liquid effluent a concentration of 35mg/l. Concentrations measured in our study in the effluent exceed the standard with a minimum average of 59.33 mg/l recorded at Sablettes and an maximum average of 334 mg/l at Salamandre. The comparison of our results with those obtained by Remili and Kerfouf (2013) show a significant increase in the concentrations of TSS.

Chemical oxygen demand (COD)

According to the results obtained the mean levels of chemical oxygen demand are between 289 mg/l recorded at Sablettes and 559.67mg/l at Salamandre .We class it in the third category with untreated water which can only be used after a specific and expensive treatment. According to Algerian standards (Jora 2006) requiring the COD content not exceeding 120mg/l, we see that the lowest content (289mg/l) recorded at Sablettes rejection far exceeds the standards. These levels show an excessive dissolved oxygen consumption to chemically oxidize organic loads discharged in the study area (Bonte *et al*., 2008).

Biochemical oxygen demand (BOD_5)

The results show that the highest content of BOD5 is recorded at Salamandre and it comes from an urban rejection with a mean value of 232.97mg/l. The minimum average value is recorded at Sablettes (63.37mg/l). All contents DBO5 rose to a peak during the month of May. Unless the rejection of Sablettes which have quite stable values with low fluctuations, this can be explained by the fact that discharges of this site are primarily from the summer activity that is substantially reduced during our sampling companion. This hypothesis can be confirmed by a levy performs during summer period. We note that the minimum content of BOD5 greatly exceeds the standard used for the estimation of water quality (35mg/l) (Jora, 2006).

Nitrate levels, shows a slight variation averages that range between 1.33mg/L at the discharge Oued Ain Safra and 2mg/l at the port of Mostaganem. The increase in nitrate levels during the winter months may be due to leaching of fertilizers used in agricultural soils situated on the coast. In conclusion we can say that nitrate levels recorded in waste water from Mostaganem are below the level suggested by the Algerian standards (Jora, 2000) and international (50mg/l). This indicates that the studied waters are not subject to risk of nitrate pollution.

Nitrite

The average nitrite concentrations at the Mostaganem coastline are cocated between 0.13 mg/l recorded at Oued Ain Safra rejection and 0.29mg/l recorded at Sablettes. The low concentrations of nitrites encountered in wastewater effluent studied, could be explained by the fact that nitrite ion (NO^{2-}) is an intermediate compound between ammonium and nitrates, and which is unstable in the presence of oxygen, whose concentration is typically much lower than that of the two forms that are related to, nitrates and ammonium ions (Thomas, 1985).

Ammonium

Analysis of ammonium profile shows that the highest average grade is recorded at Salamandre with a value of 61.83mg/l. The lowest average is 23.37mg/l recorded at the urban rejection of Sablettes. The ammonia nitrogen comes from livestock excretions and bacterial decomposition of organic nitrogen compounds. It is used by phytoplankton as nitrogen source and oxidized by nitrifying bacteria. The concentrations are highly variable depending on location and season. The ammonium found in wet period values are lower than those of the dry period, reflecting the effect of dilution. Relatively high levels can be explained by the enrichment in nitrogenous compound and by the bacterial degradation of this organic nitrogen compound, this mechanism is called bacterial ammonification (Lisec, 2004).

Phosphate

In the marine environment, phosphorus is represented by Orthophosphates ions. The results Analysis shows that the average concentrations of wastewater phosphates vary between 4.89mg/L and 11.75mg/l. Compared to the Algerian limits set at 10mg/l, the phosphate contents of Sablettes and Oued Ain Safra remained below the norm. The two other dejections exceed the standard with averages of 11.42mg/l at Salamandre and 11.75mg/l at the Port. This high concentration of phosphate may be explained by the fact that the sea was rough, causing an increase in suspended matter rich in various

minerals including phosphate and by the release of this element trapped in large quantities in the sediment.

Conclusion

This work forms part of the evaluation of the physic-chemical quality of water discharges flowing into the sea without any treatment along Mostaganem coastline. The space-time monitoring of several physical and chemical tracers gave us the image of a relatively intense pollution that results in significant organic and inorganic filler.

Salamandre area is distinguished by a worrying pollution that is highlighted by the high values of the different parameters recorded. This can be explained by the large chargebacks received from this site. The results show the need for pre-treatment of this waste water, biological treatment should be considered to improve their quality of the required standards and meet the expectations of the authorities for the protection of the environment and human health.

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