ELSEVIER

Desalination 222 (2008) 302–306

DESALINATION

www.elsevier.com/locate/desal

Evaluation and biologic treatment of an urban effluent

H. Ghoualem*, A. Khouider

Laboratoire d'Électrochimie — Corrosion, Métallurgie et Chimie Minérale, Faculté de Chimie, U.S.T.H.B., B.P. 32, El Alia-Bab-Ezzouar, 16111 Alger, Algeria
Tel. +213 21 24 79 50–64; Fax +213 21 247311; email: haghoualem@yahoo.fr

Received 27 December 2006; accepted 7 January 2007

Abstract

The water consumption increases at high speed under the effect of the demographic growth and the agricultural and industrial development. This water consumption involves a significant and increasing quantity of wastewater. These untreated rejections generally are poured in receiving environment (lake, river, sea, etc.), causing harmful effects on the environment. This study aims to evaluate quantitatively and qualitatively urban water of the commune of Zeralda situated at the west (30 km) of Algiers. This water is rejected without treatment in the sea.

This study has been to investigate in a first time to the parameters of pollution which influence the biological treatment of water.

Among these parameters, we have determinate, pH, water–air temperature, MES, COD, BOD_5, turbidity, conductivity, etc. The results of the analysis of physical and chemical parameters of pollution showed that their content exceed widely the standards of rejection [1–2].

In a second time, we have tested a biological treatment by language. This study is based on the analysis of organic matter and nutritive substances in the aqueous phase. The obtained results showed an important increase of the dissolved oxygen and 97, 94.5 and 79.2% for turbidity, NH_4^+ and PO_4^{3-} respectively. After the obtained results this effluent can be treated, recycled and developed what constitutes an adequate solution to cure the problems of pollution, it will be able thus to safeguard the quality of the natural environment.

Keywords: Wastewater; Pollution; Biological treatment

1. Introduction

The urban and industrial activities generate an important quantity of residuary waters which is poured in the sea, lakes, wadis and rivers. The majority of these wastewaters does not undergo any previous treatment before their tipping in the receiving environment which leads inevitably to the deterioration of the receiving and constitute of this fact a considerable factor of pollution. This latter could be of chemical, organic and/or physical origin. In the past

*Corresponding author.

Presented at the conference on Desalination and the Environment. Sponsored by the European Desalination Society and Center for Research and Technology Hellas (CERTH), Sani Resort, Halkidiki, Greece, April 22–25, 2007.

0011-9164/06/$– See front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.desal.0000.00.000

several decades, many techniques have been developed to find an economic and efficient way to reclaim the wastewater, including physical, chemical and biological treatment such as active sludge, lagoon, sedimentation ozone oxidation and other technologies (Overcash and Pal, 1979; Gao, 1986; Jin, 1993; Raisin and Mitchell, 1994). These technologies are usually highly efficient for wastewater containing special pollutants [3]. The residuary water treatment before their dismissal in the nature proves to be necessary and constitute a means of struggle against the pollution [4]. These residuary waters are poured in the sea without previous treatment. In this work, we have examined a biological treatment of a poured urban residuary water in the sea [5–7].

The objective is to decrease this pollution, to protect and to maintain the quality of the receiving environment [8].

2. Material and methods

The origin of the poured residuary water in the sea comes from the domestic and industrial waters (95 and 5%). The withdrawals have been done on site. The analysis of different physical and chemical parameters (pH, temperature, MES, MVS, COD, BOD_5, NH_4^+, NO_3^-, NO_2^-, PO_4^{3-}) have been achieved according to the AFNOR standards [2]. Methods are for BOD_5 dilution –20°C incubation method, COD K_2CrO_4-boiling method, NH_4^+-N Nessler method, NO_2^--N Zambelli method, NO_3^--N sodium salicylate method, PO_4^{3-}-P ascorbic acid method. The experimental device used in the laboratory for the treatment of this urban water is composed of a tank being used for the food of the pilot of capacity 70 L is composed of three basins constituting the basins of ventilation and decantation of volume 49, 62, 35, 8 and 18 L with a useful height of water 0.28, 0.31 and 0.2 m respectively. The water flow is of 6.89 L/day [9].

3. Results and discussions

3.1. Preliminary analyses

The measure of temperature, pH and dissolved oxygen have been achieved in situ. The wastewater was brown in colour. The wastewater was characterized by considerable pollutant of suspended matter and volatile matters and high concentrations of BOD and COD. The values of ratio COD/BOD are between 1.42 and 2.48 with an average of 2.21.

The concentrations of the COD and BOD are higher than the dismissal standards (120 and 40 mg d'O_2/L).

The characteristics of the wastewater are presented in Table 1.

The pH varied from 6.5 to 8.4 (Fig. 1).

These values are in the good range of activity of the micro-organisms and are favourable for a biological treatment [7]. The temperature varied between 22 and 28°C (Fig. 2).

Table 1
Characteristics of effluent

Parameters	Average	Maximum	Minimum
BOD_5 (mg d'O_2/L)	147.75	162	132
Conductivity (µS/cm)	1879	2100	1512
Turbidity (NTU)	368.75	366	111
Ammonium-N (mg/L)	13.32	18.1	8.9
Nitrates-N (mg/L)	11.69	14.26	6.75
Nitrites-N (mg/L)	3.28	7.2	0.82
Phosphorus-P (mg/L)	12.21	16.4	7.65

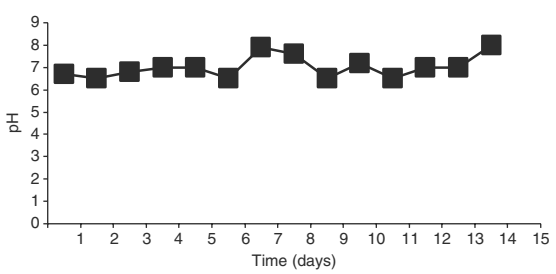

Fig. 1. Evolution of the pH according to the time.

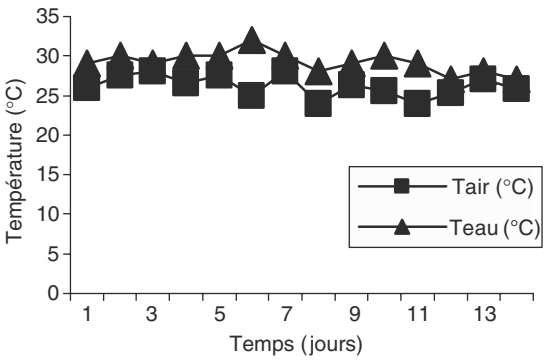

Fig. 2. Evolution of the air–water temperature according to the time.

This interval of temperature supports the development of the micro-organisms which take part in the treatment biological of wastewater.

The MES varied from 120 to 420 mg/L, the MVS varied from 80 to 320 mg/L (Fig. 3).

The concentrations of the MES are higher than the dismissal standards (30 mg/L). The dismissal of MES have tendency to limit photosynthetic phenomena of the rivers by reduction of the dissolved oxygen. The analysis of these waters permitted us to value quantitatively and qualitatively the polluting load rejected by the town. The analysis of these waters showed that the physicochemical content passed the standards of dismissal extensively. The load permitted to establish a balance of pollution. This latter explains the choice of biologic treatment [6]. We determine the good bacterial adaptation phase and calculate the debit of the experimental pilot. The experimental pilot used for the biological treatment is composed of three lagoons at microphytes [10].

3.2. Treatment

We tested on the scale laboratory a biological treatment. Before its introduction in the pilot the effluent was analyzed. The effluent was rich in biodegradable organic matters, and is constituted of nutritive substances. We have studied the physical and chemical parameters which influence on the biological treatment experimentally as: pH, temperature, turbidity, conductivity, nitrates, nitrites, orthophosphates, etc. In the follow-up of the pollution parameters according to the time, we notice that the conductivity and turbidity (enter and exit) present an important reduction. The conductivity decreases, this reduction is explained by the degradation of the organic matter and the elimination of the mineral matters by the micro-organisms. The conductivity (exit) is lower than 1500 μS/cm, this water can be used in the irrigated zones [11] (Fig. 4).

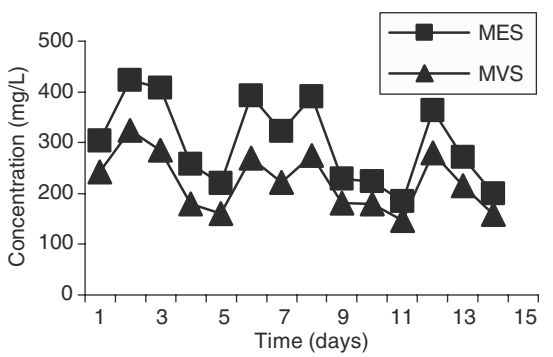

Fig. 3. Evolution of the MES and MVS according to the time.

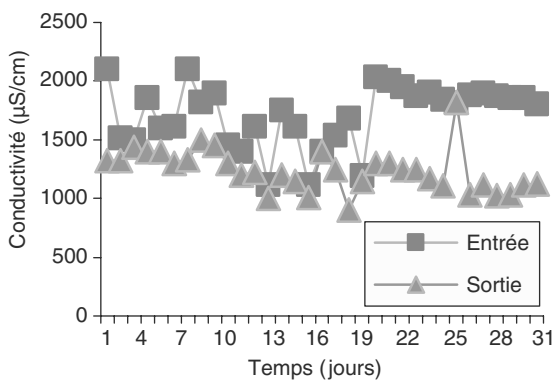

Fig. 4. Evolution of the conductivity according to the time.

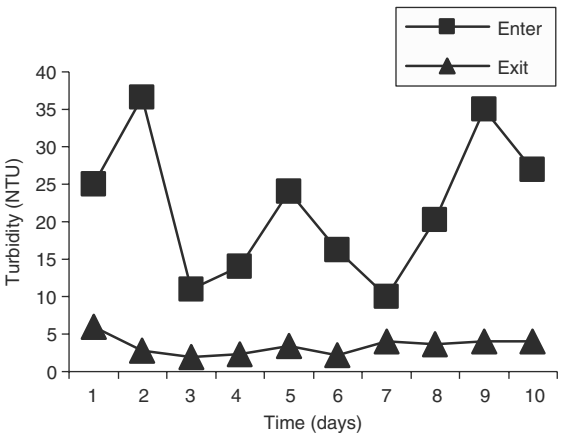

Fig. 5. Evolution of the turbidity according to the time.

We notice that before treatment water is turbid after treatment the colour of water gradually becomes limpid. We also notice that, there was a correlation between turbidity and concentrations of MES. When concentrations of MES decreased, the turbidity decreased (Fig. 5).

We notice a significant elimination as of MES which reaches sometimes 100%, what shows the treatment is well adapted (Fig. 6).

We notice a reduction in orthophosphates at the exit of the pilot. At the exit the concentrations becomes weaker with an important increase of PO_4^{3-} yields of elimination (Fig. 7).

At the exit, the concentration is definitely weaker, this reduction must probably with a progressive development of the total colony count

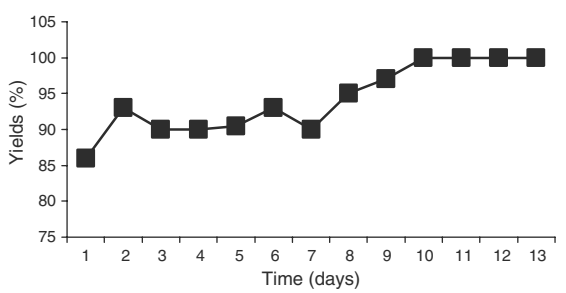

Fig. 6. MES yields according to the time.

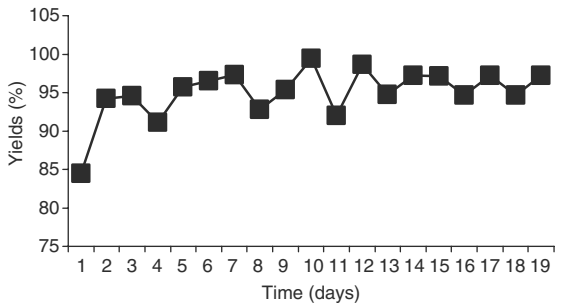

Fig. 7. Phosphorus yields according to the time.

which uses this element PO_4^{3-} like a nutritional source for its growth in a ratio DBO/N/P = 100/5/1 or DCO/N/P = 150/5/1, as it can be used in the formation of the biomass and will be fixed by the cations such as calcium and magnesium to settle in the sediments creating an orthophosphate reserve able to be given in circulation [9].

The availability of orthophosphates will depend on the needs for the species present in the medium.

The evolution of ammonium nitrogen is represented by Fig. 8. The dissolved nitrogen in wastewater is in several forms NH_4^+, NO_3^-, NO_2^- the evolution of these nutritive ions and the passage from one form to another depends on the metabolisms which take place within the treating medium.

The contents are high at the entry, this could be explained partly by the biological breakdown of the organic matter nitrogenized in NH_4^+.

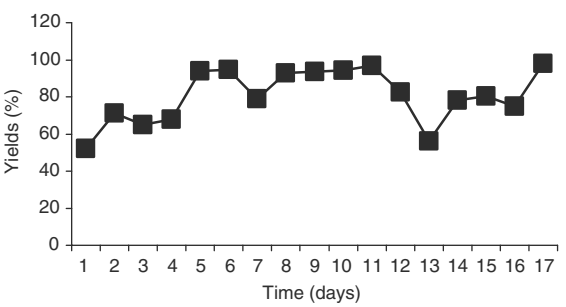

Fig. 8. NH_4^+ yields according to the time.

We notice an important elimination of NH_4^+ (94.54%). The ammonium is used by the bacteria for the cellular synthesis and the transformation with other forms of nitrogen (NO_2^- and NO_3^-). The obtained results showed an important reduction of the organic matter.

4. Conclusions

During this study we have tested a biologic treatment for an urban wastewater.

The evaluation of the polluting load has lead to determinate the physical and chemical parameters which influence the biological treatment. The results of the analyses of the chemical parameters of pollution permitted us to note that these urban waters passed the permissible standards.

The treatment applied to this effluent decreased the load of the pollution parameters extensively. The biologic treatment applied to these waters permitted to decrease the polluting load of which the retention of elimination of the pollution parameters reached 100% for the MES and 97% for the turbidity.

The obtained results suggest us that the effluent is suitable to this type of treatment.

This technique can be used and recommended in the urban wastewater treatment and exploited in the urban zones.

The biologic treatment applied to this effluent can be used because of its composition is essentially organic and biodegradable. This process of treatment will be able to decrease the pollution thus, to protect the environment and to maintain the quality of the receiving environment (sea).

References

[1] J. Rodier, l 'analyse de l'eau, eau naturelle, eau résiduaire, Ed Dunod, Paris, 1984.
[2] Dégremont mémento technique de l'eau Ed Tech et Doc, Paris, 1978.
[3] Tieheng, Sun and all treatment of domestic wastewater by an underground capillary seepage system, Ecol. Eng., 11 (1999) 111–119.
[4] P.E. Victor, protégeons l'eau, Ed Nathan, 1978.
[5] A. Gaid, Épuration biologique des eaux urbaines, Tome OPU, Alger, 1984.
[6] F. Edeline, Epuration biologique des eaux résiduaires, Ed Cebedoc, 1985.
[7] Cyril Gomella et Henri Guerée, Le traitement des eaux publiques industrielles et privées, Ed Eyrolles, 1978.
[8] R. Bremont and R. Vuichard, Paramètres de la qualité de l'eau, Ministère de l'environnement, SPEPE, Paris, 1973.
[9] H. Ghoualem and A. Khouider, Biological treatment of an urban sewage and analyses of sediments, Desalination, 206 (2007) 507–512.
[10] H.E. Maynard, S.K. Ouki and S.C. Williams, Tertiary lagoons: a review of removal mechanisms and performance, Water Res., 33 (1) (1999) 11–13.
[11] H. Ghulam and A.J. Al–Saadi, Wastewater quality and its reuse in agriculture in Saudi Arabia, Desalination, 123 (1999) 241–251.