Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

PHYSICO-CHEMICAL CHARACTERIZATION OF THE WASTEWATER FROM THE TREATMENT PLANT (KHENIFRA, MOROCCO) TYPE OF BACTERIAL BEDS

Lakhal A F[1], Ait Said N[2], Belala A[2], Sadek S[2], El Markhi M[2], Salhi R[3], Bricha M.R[4], Lrhorfi L A[5], LmoudnN[5] and Chaouch A[1].

[1]Laboratory of Agro-Physiology, Biotechnology, Environment and Quality, Faculty of Sciences, Kenitra, Morocco.
[2]Laboratory of Biotechnology, Quality and Environment, Faculty of Sciences, Kenitra,Morocco.
[3]Laboratory of Marine Geosciences and Soil Sciences, Faculty of Sciences El Jadida, Morocco.
[4]Department of Radiopharmaceuticals Production, National Centre for Nuclear Energy, Sciences and Technologies (CNESTEN) Rabat, Morocco.
[5]Laboratory of Natural Resources and Sustainable development, Faculty of Sciences, Kenitra, Morocco.

Abstract

Background: Good water quality is crucial to human health, social and economic development as well as the functioning of ecosystems. Economic activities, unabated population growth and unsustainable farming practices further increase pressures on water bodies.

Objective: The present study relates to the evaluation of the efficiency of the treatment of waste water from the Khenifra sewage treatment plant of the bacterial bed type during the period of 2019.

Methods: In our work we studied the physico-chemical parameters of the raw and purified waste water from the station. For this, we have carried out a set of measurements such as: temperature, pH, electrical conductivity, biochemical oxygen demand BOD_5,chemical oxygen demand COD, suspended matter MES.

Results: The COD/BOD_5 ratio determines the possibility of degradation that can be hoped for by a biological oxidation treatment. The values obtained are an average of 1.09.And the average MES/BOD_5 ratio of 0.9 to 2013 and 1.04 to2014.

Conclusion: This allows us to deduce that the load of organic matter in wastewater within the ship repair units is easily biodegradable.

Key Words: pollution, wastewater, khenifra, water treatment, Morocco**.**

ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

Introduction:

The city of Khenifra has a sewage treatment plant (STEP) type bacterial beds with an odor treatment system, produced by the National Office for Drinking Water (ONEP), for an overall cost estimated at 110.5 million dirhams. This project consists in the realization of a mechanical pretreatment system, combined works of primary decantation and stabilization of the covered sludge, bacterial beds for biological treatment, a clarifier (secondary decantation), a sludge dewatering system by beds of drying and an odor treatment system using biological filters.

It is the most widely used immobilized cell system. In this type of reactor, the biomass is fixed on a circular solid support surmounted by a rotary distributor. The effluent to be treated is introduced from the top and flows by gravity onto the bacterial bed. The support materials were first of all made up of large pieces of stone with a relatively limited relative surface. Now low density plastic supports (polystyrene) are commonly used and offer significant relative surfaces. Air injection for nitrification is done at the bottom of the bed[1].

The objective of this study is to contribute to the development of a process for treating domestic wastewater from small communities using an anaerobic bacterial bed reactor. It is an innovative process with technology adapted to the socio-economic and climatic conditions of Morocco.

The Khenifra wastewater treatment plant has a capacity of 153,200 equivalent inhabitants. The proposed biological treatment is bacterial beds.

This station includes:

• Water treatment by: Pretreatment, primary decantation, biological treatment with bacterial beds, secondary decantation.

• Sludge treatment by: digestion in Imhoff pits, dewatering on drying beds.

• Odor treatment: by biofilters.

Characteristics of the effluents to be treated

-Number of equivalents inhabiting 153,200;

- Daily wastewater volume 12,000 m^3/d ;

- Average dry weather flow 500 m^3 / h;

- Peak flow in dry weather 971 m^3/ h;

- Peak flow in rainy weather 1,827 m^3/h.

Study method

The sampling points used to monitor treatment performance are:

• Entrance to the station with a composite sampling mode

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

• Leaving the station with a composite sampling mode.

The monthly sampling frequency was carried out at the intervention points selected between January 2019 and December 2019.

The physicochemical parameters studied are: temperature, pH, electrical conductivity, dissolved oxygen, chemical oxygen demand (COD), biochemical oxygen demand for 5 days (BOD5), suspended matter (MES).

The pH and temperature, conductivity and dissolved oxygen are determined by a multi-parameter type CONSORT C831.

The biochemical oxygen demand (BOD_5) for 5 days was determined by the OxiTop method (International Standard ISO 5815-2 (1/4/2003). For COD and MES measurements, they are carried out respectively by the colorimetric method (Center of expertise in environmental analysis of Quebec, 1999) and the gravimetry method (Moroccan Standard, 1996) with a BAXTRANE type balance of precision 5 µg.

Result and discussions

Temperature

Figure 1 shows the seasonal temperature trend in raw and purified water using a bacterial bed treatment from the city of Khenifra.

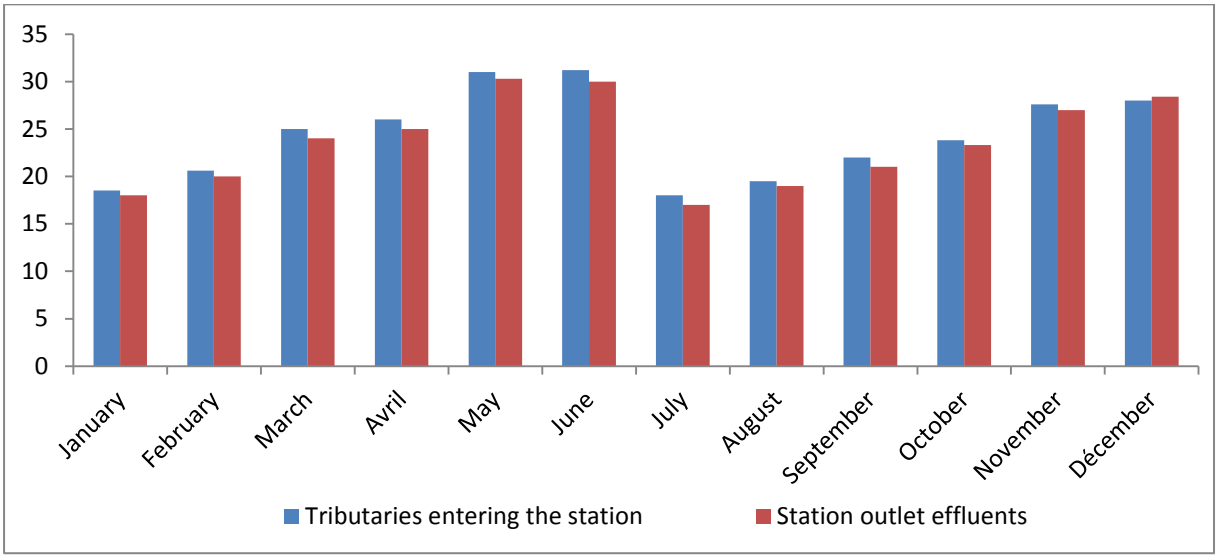

Figure 1: Seasonal temperature evolution in raw water and water purified by bacterial bed type STEP

The annual variation in the temperature of raw and treated wastewater is remarkable: the lowest (17°C) are recorded during the wet season, the highest with 27°C are observed during the dry season (Figure 1).

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

This difference in temperature clearly shows that the water temperature is intimately linked to the air temperature, they are higher during the dry season and decrease during the wet season.

The values obtained are comparable to those found elsewhere for wastewater from slaughterhouses which generally have a neutral to slightly basic pH [2-3-4].

Hydrogen potential

Figure 2 shows the temperature evolution in raw water and water purified by a bacterial bed treatment from the city of Khenifra.

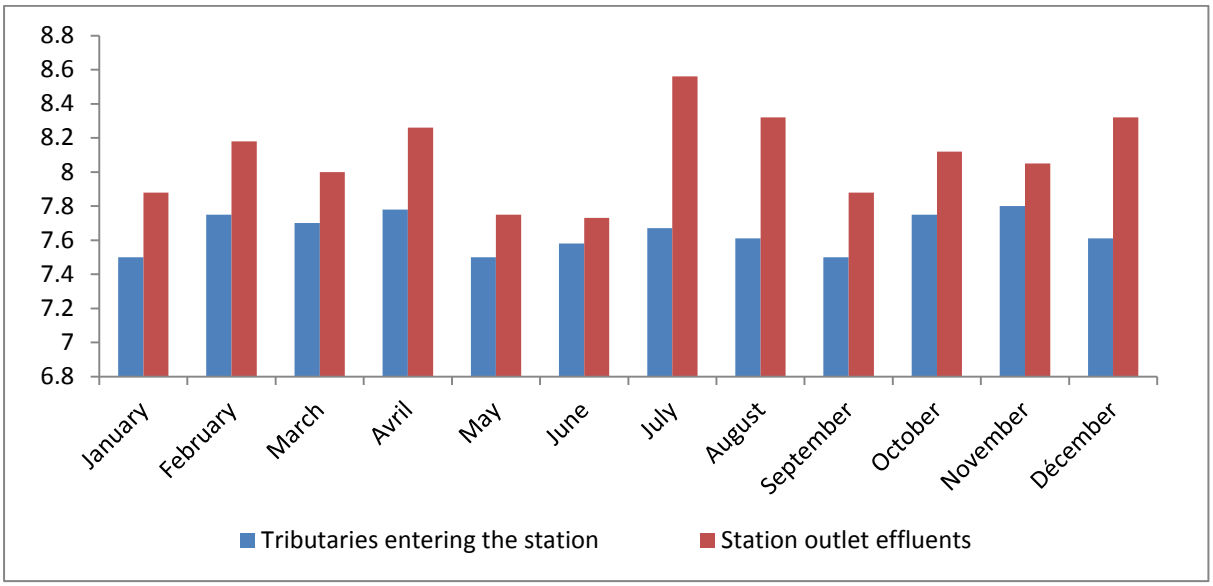

Figure 2: Seasonal evolution of the Hydrogen Potential in raw water and water purified by STEP type bacterial bed

The analysis of the seasonal evolution of pH at the level of the Khenifra station (Figure 2) shows that the average values of the pH of the inlet and the outlet show a variation respectively 7.64 and 8.08 as mean values pH. In addition, there is a variation in the pH of raw and treated water independent of the seasons, which agrees with the results obtained by Ben abdellouahad, 2006[5]. These authors underlined the absence of any seasonal effect on the pH of the courses studied. The pH value always remains within the limit value of direct and indirect discharges from Morocco [6].

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

Electrical conductivity

Figure 3 shows the evolution of electrical conductivity in raw water and water purified by a bacterial bed treatment from the city of Khenifra.

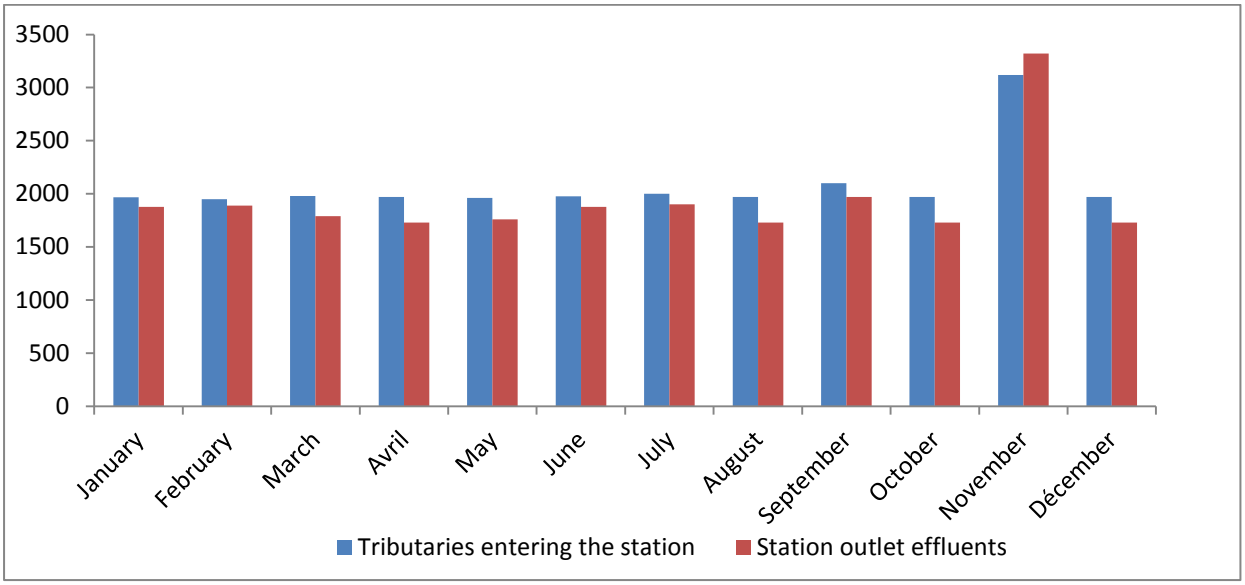

Figure 3: Seasonal evolution of electrical conductivity in raw water and water purified by bacterial bed type STEP

Analysis of the seasonal evolution of electrical conductivity at the Khenifra station (Figure 3) shows that the average pH values of the input are identical to the output, which are 1941.75µS/cm and 2077 respectively, 75 µS/cm as average pH values. In addition to the variation in the pH of the raw and treated water depending on the season.

Dissolved Oxygen

Figure 4 shows the evolution of Dissolved Oxygen in raw water and water purified by a bacterial bed treatment from the city of Khenifra.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

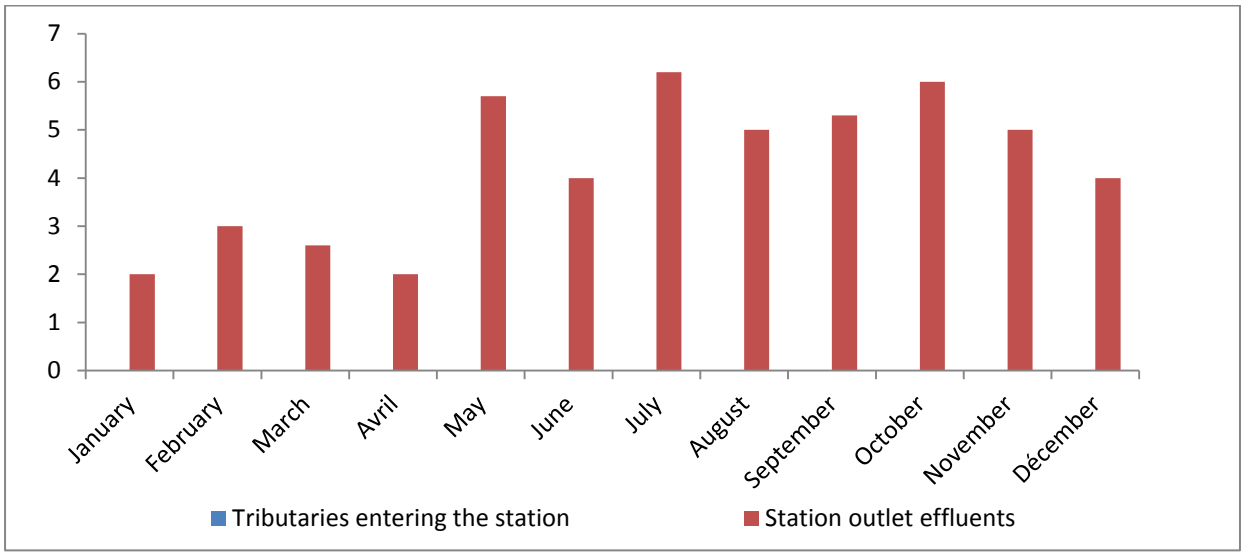

Figure 4: Seasonal evolution of Dissolved Oxygen in raw water and water purified by WWTP type bacterial bed

These results are comparable to those found at a treatment plant that operates on the same principle (bensergao station). The value of dissolved oxygen is increased during treatment, ranging from 0 mg /L in raw wastewater to 6.2 mg/l of treated wastewater, this comes down to the complementarity of processing steps. The value of dissolved oxygen measured in treated water is greater than the limit value (0.2 mg/l) set by joint order of the minister of the interior, the ,minister of regional planning, the water and the environment and the minister of industry, trade and upgrading of the economy No.1607-06 of 29 Joumada II 1427 (July 25, 2006).

Biological Oxygen Demand

Figure 5 shows the evolution of Biological Oxygen Demand levels in raw water and water purified by a bacterial bed treatment from the city of Khenifra.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

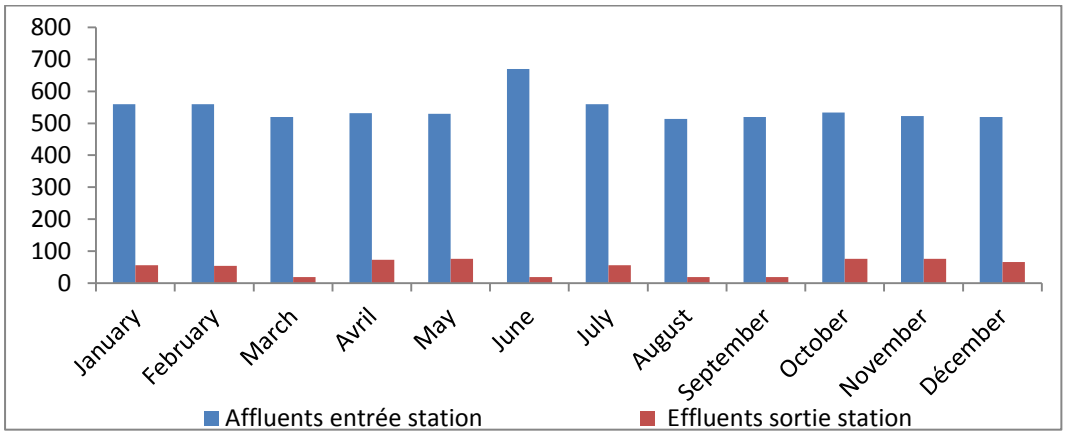

Figure 5: Seasonal evolution of the levels of Biological Oxygen Demand in raw water and water purified by WWTP type trickling filter

These encouraging results are comparable to those found at a treatment plant which operates on the same principle (M'zar and Bensergao treatment plants), with an average of 50.75 mg /l d 'O_2 at the outlet of the treatment plant.

The average value higher than that found in Marrakech (240 mgO_2/l)[7], (137mg O_2 /l), Souk Elarba du Gharb (162.08 mgO_2/ l)[8] and in Kenitra (335.5 mg O_2 /l) [9]. On the other hand, it is lower than that found in Sanaa (Yemen) (1137 mg O_2/l)[10].

IV-6- Chemical Oxygen Demand

Figure 6 shows the evolution of the levels of Chemical Oxygen Demand in raw water and water purified by a bacterial bed treatment from the city of Khenifra.

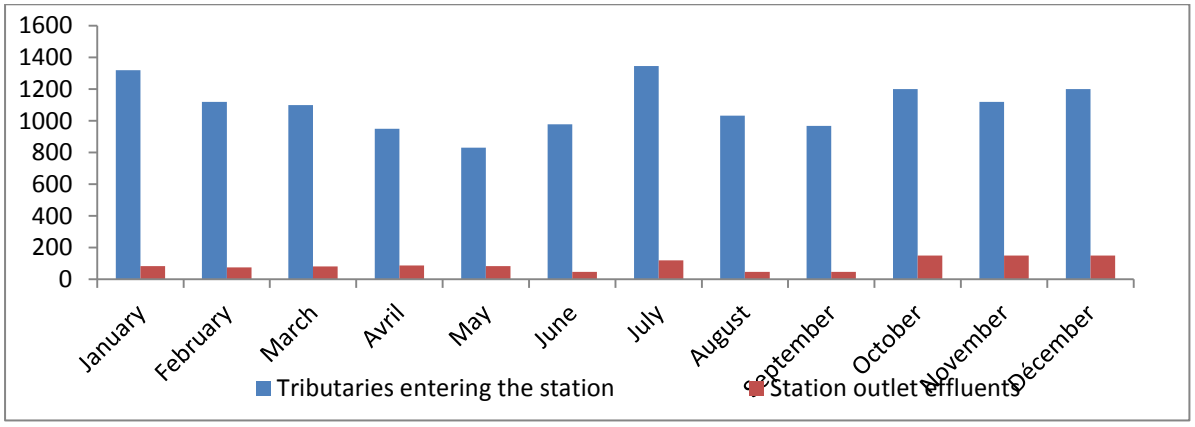

Figure 6: Seasonal evolution of the Chemical Oxygen Demand contents in raw water and water purified by STEP type bacterial bed

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

These results are comparable to those found at a treatment plant that operates on the same principle (bensergao station). The value of the COD is in decrease contained during treatment, going from 1096 mg /L in the raw waste water up to 93 mg / L of the treated waste water, this comes back to the complementarity of the stages of treatment. The COD value measured in the treated water is lower than the limit value (250 mg/l) fixed by joint decree of the Minister of the Interior, the minister of spatial planning, Water and environment and the Minister of Industry, Trade and Upgrading of the Economy No. 1607-06 of 29 Joumada II 1427 (July 25, 2006).

Suspended Matter (MES)

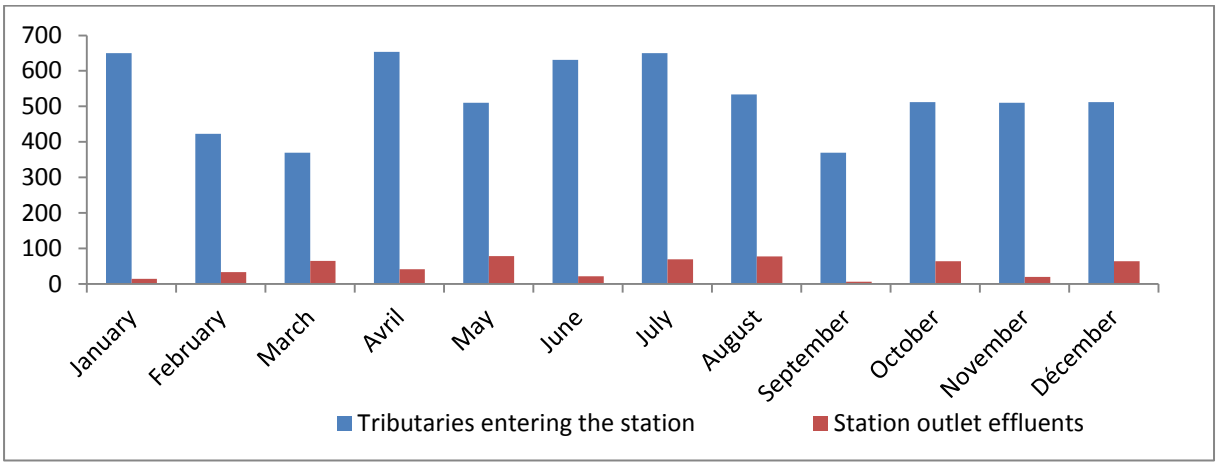

Figure 7: Seasonal evolution of the contents of suspended matter in raw water and water purified by STEP type bacterial bed

Figure 7 shows the evolution of suspended matter contents in raw water and water purified by a bacterial bed treatment from the city of Khenifra.

According to the calculation of the average of raw and purified waste water at the entrance and exit of the station we find the following results: the minimum value is 370 mg /l and maximum of 654 mg/l at entering the station, and leaving the station an average of 46.66 mg/l.

Biodegradability (K): COD / BOD_5 ratio

The COD/BOD_5 ratio determines the possibility of degradation that can be hoped for by a biological oxidation treatment. The values obtained are an average of 1.09.

ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

In this case, the water arriving at the WWTP is not mixed with water of industrial origin which is not connected to the same sewerage network (unitary network). For the values throughout this study, they are less than 2.5, which means that the effluent has good biodegradability. These results agree with those reported by Gnagne and Brissaud (2003) [11]and Zerhouni (2003) [12].

MES / BOD_5 report

The average MES / BOD_5 ratio of 0.9 to 2013 and 1.04 to 2014. This makes it possible to deduce that the load of organic matter in wastewater within ship repair units is easily biodegradable according to Henze[13].

A large amount of water is used in the Upstream, Downstream, Petroleum and Automobile industrial processes and a huge fraction of it comes out as waste after getting polluted by oil and other toxic substances. Liquid wastes from the Petroleum Industries are relatively less toxic in nature and can be easily treated by conventional processes. However, solid wastes, especially oily Waste still remains as major environmental hazards, demanding safer disposal practices[14].

Great importance must be given to keeping a good quality of treatment because

Water is one of the five (Earth, Air, water, fire and space) essential elements of life. The safe potable water is absolutely essential for healthy living [15].

Conclusion

According to the assessment of the qualitative and quantitative monitoring of the khenifra station between January 2019 and December 2019, the following main conclusions can be drawn: Quantitatively: the treatment plant operates below its daily water volume capacity used 12,000 m^3 / d.

Qualitatively:

• The characteristics of the wastewater at the entrance to the station reflect Moroccan urban wastewater.

• The minimum purifying performance required, according to the European Directive considered as a reference, is not achieved at the STEP level.

• The comparison of the quality of the effluent from the WWTP to the Moroccan standard for the reuse of treated wastewater in irrigation (Official Bulletin n°5448, 2006), shows that the wastewater treated by the WWTP cannot be reused only for restrictive irrigation (categories B and C) and cannot be reused for the irrigation of crops that can be eaten raw or on land where the public is likely to be in direct contact.

ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

Acknowledgment

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references to this manuscript. The authors are also grateful to authors / editors/ publishers of all those articles, journals, and books from which the literature for this article has been reviewed and discussed.

Conflict of interest

Conflict of Interest: Nil

Funding: This studies as no fund from any authorities and there is no conflict of interest.

References

1Andersson S., Hamrin F., Johansson L., 1994. Predator regulation and primary production along eutrophication gradient of temperate lake ecosystems, In: Complex interactions in lake communities (Carpenter. SR, ed.), 45-65.

2 Massé D.I. and Masse L. "Characterization of wastewater from hog slaughterhouses in Eastern Canada and evaluation of their in-plant wastewater treatment systems".2000b. Canadian Agricultural Engineering.Flight.42, No. 3.139-146.

3 Miranda L.A.S., HenriquesJ.A.P. and MonteggiaL.O..“A full-scale uasb reactor for treatment of pig and cattle slaughterhouse wastewater with a high oil and grease content”.Brazilian Journal of Chemical Engineering.Flight. 22, No 04, pp. 601-610.

4 V. Reginatto, R.M. Teixeira, F. Pereira, W. Schmidell, A. Furigo, R. Menes, C. EtchebechereandH.M. Soqres.Anaerobic ammonium oxidation in a bioreactor treating slaughterhouse wastewater.Brazilian Journal of Chemical Engineering.Flight. 22, No 04, pp. 593-600, October-December 2003.

5 Benabdellouahad S. Thesis, Mohammed V- Agdal University. Rabat, (2006) 252

6 Limit values for direct and indirect releases from Morocco.

7 Gebrati L, and Nejmedine A, “Photocatalytic treatment and biodegradability of textile effluents from the city of Marrakech,“ Proceedings of the International Symposium on Water in the Mediterranean Basin: Resources and Sustainable Development, Monastir (Tunisia), pp.330-334 , 2002.

8 Kbibch A, Belghyti D, Elkharrim KH, and El Khokh K, “Analysis of the pollution of the Mdawadi by domestic wastewater from the city of Souk Elarba in Gharb Morocco,“ Science Lib Editions Mersenne, Vol. 3, no. 110203, February 2011.

9 Oulkheir S, “Physico-chemical and microbiological characteristics of wastewater from the city of Kenitra,“ Postgraduate thesis, Faculty of Sciences, Kenitra, pp. 79, 2002.

10 Raweh S, Belghyti D, AL Zaemey A, EL Guamri Y and El kharrim K “Physico-chemical quality of wastewater from the treatment plant in the town of S'Anaa (Yemen), “International Journal of Biological and Chemical Sciences, Vol. 5, no. 1, 2011.

11 GnagneT and Brissaud F “Study of the potential for the purification of slaughterhouse effluents by infiltration on sand in tropical environments,“Sud Sciences & Technologies, n° 11, December 2003.

12 Zerhouni, R : Algal flora of wastewater from the city of Fez and study of the capacity of certain species to remove nitrogen, phosphates and some heavy metals (Chromium and Cadmium),“Doctoral thesis, Faculty des Science, Dhar El Mahraz, Fez, Morocco, pp. 146, 2003.

ISSN:1673-064X
E-Publication: Online Open Access
Vol: 65 Issue 01 | 2022
DOI 10.17605/OSF.IO/QJNMB

13 Henze M, Harremoes P, Jansen J. L. C and Avrin, E. :Wastewater treatment," 2nd Ed, springerverlag, Berlin, 1999

14 PriyankaKhanna, NidhiRai : Assessment of ground water quality of peesangan block of ajmer district ; International Journal of Current Research and Review IJCRR ,Int J Cur Res Rev | Vol 8 • Issue 4 • February 2016.

15 ChintanPathak, V. K. Srivastava :OIL-WATER SEPARATION USING FLY ASH ZEOLITETreatment International Journal of Current Research and Review www.ijcrr.com Vol. 04 issue 08 April 2012.