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WASTEWATER TREATMENT EFFICIENCY CASE OF OXYLAG WASTEWATER TREATMENT PLANT, MHAYA (MOROCCO)

Bouhlal A.[1, 2], Chahlaoui A.[1], Bouzid J.[1], Farhaoui M.[2]
[1]Team of Natural Resources Management and Development, Laboratory of Environment and Health, Department of Biology, Faculty of Sciences, Moulay Ismail University, Meknès Maroc
[2]National Office of Electricity and Drinking Water

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Abstract

The wastewater from the urban commune of Mhaya (Morocco) was rejected directly into Ben Kazza river without treatment. This situation caused a widespread, massive, varied and insidious pollution of the environment. A wastewater treatment plant (WWTP) has been constructed in 2010 in order to preserve the nature surrounding the center. Called Oxylag, the plant has a nominal capacity of 6000 Equivalent Inhabitants. It is based on intensive treatment and it is considered as pilot and unique in Morocco. The treatment is consisting on three basins ventilated by insufflation of artificial air and a basin of finishing.
The present study aim is the assessment of the purification performance of this plant during 2012, through the analysis of the pollution parameters (COD, BOD5 and TSS), which is the subject of the Moroccan standards on the quality of domestic wastewater defined by the decree Number 1607-06 of 25 July 2006.
The results show a high purification performance in terms of carbon pollution removal (93% for BOD5, 79% for COD and 64% for TSS).

Keywords: WWTP; Oxylag; Rural Area; Efficiency; Environment; Purifying Performances.

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1. Introduction

The Mhaya center is the capital of the urban commune of the same name and belongs to the circle of Meknes suburbs and the prefecture of Meknes El Menzeh, part of the economic Fes-Meknes region (Figure 1). Geographically, it is crossed by the national road N ° 6, connecting the city of Meknès (Morocco) about 38 km to the North-East and about 22 km to the South-West of the city of Fez (Figure 2). It currently has a total population of 3960 inhabitants with a growth

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rate ranging from 0.5% in 2005 to 2.4% in 2020. The resources are mainly based on agricultural activities and livestock, which create job creators. The study was conducted in oxylag WWTP located about 1 km in the north of Mhaya urban commune. The WWTP area is about 4 hectares.

The subsoil of the station contains, at a depth of 10 m, the underground water of Fes-Meknes. The sandy to silty limestone cover this water table. The geotechnical study carried out revealed the presence of clay sands having a high permeability (from 1.40 10^{-2} to 8.80 10^{-3} cm / s).

Before the WWTP construction, the domestic waste water from the Mhaya center was evacuated without any treatment in the Ben Kazza River. This situation has constituted a real and potential threat to the environment and has inflicted the Moroccan decision-makers in identifying actions in order to manage wastewater. For this purpose, an intensive wastewater treatment plant (Oxylag), with a nominal capacity of 6000 equivalent inhabitants, has been constructed since 2010 at the Mhaya center [2].

Figure 1: Map of the Fes-Meknes region

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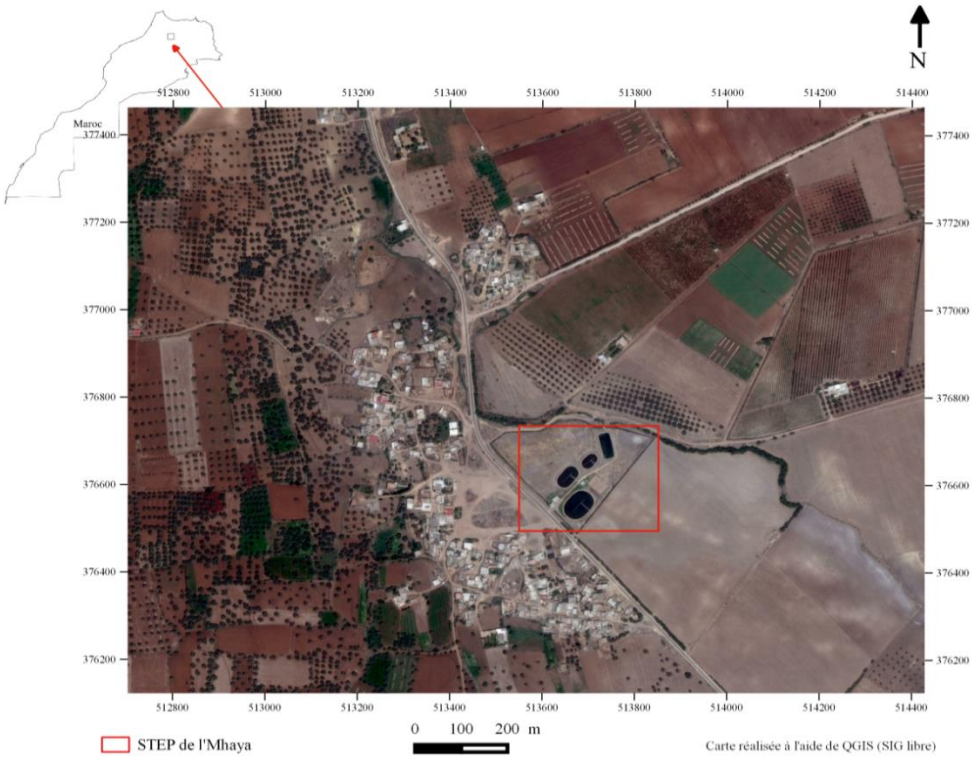

Figure 2: Situation of the Mhaya WWTP (Morocco)

The purification process includes a pretreatment step consisting of the screening, sandblasting and oil disposal, then the water passes through a counting equipment called venturi to measure the flow of wastewater entering into the WWTP. After the pretreatment, the wastewater is carried successively to three aerated basins B1, B2 and B3 (Table 1) where the oxygen transfer is provided by artificial air diffusers to activate the degradation process of the organic matter. Finally, the effluent passes through a finishing basin, which play a role in separating between the biological sludge and the treated water.

Table 1: Size of the different basins

Dimensions	**Basins**				
	Unit	**B1**	**B2**	**B3**	**Finishing**
Useful volume	m3	2342	1012	517	812
Water Depth	m	1,50	1,50	1,50	1,20
Complementary height	m	0,50	0,50	0,50	0,50
Length of crest	m	60	46	34	50,2
Width of crest	m	42	27	22	22,2
Ditch slope	m/m	3,0	3,0	3,0	3,0
Reserve volume	m3	1009	498	288	481

Thus, the aim of this work is to study the purification performance of this WWTP, pioneer in Morocco [2]; through analyzes of pollution indicators (BOD5, COD, TSS and volatile suspended solids VSS) at the WWTP intake and outlet. The results permit to evaluate the polluting potential of the treated water and the possible reuse [3-4-5] of this purified water in agricultural activities.

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2. Equipment's and Methods

2.1.Sampling

Wastewater samples for analysis are collected monthly at the intake WWTP using a 24-hour composite sampling method and at the WWTP outlet on a point-by-point basis. To ensure the samples representativeness, the samples were taken, packaged and stored in the refrigerator at 4°C until they were analyzed [6].

2.2.Analytical methods

The parameters used in this study for raw wastewater in the WWTP intake and outlet are Total Suspended Solid (TSS), Volatile Suspended Solid (VSS), Biochemical Oxygen Demand (BOD), Chemical Demand in Oxygen (COD) [7].

The suspended material is determined by a filtering technique through a previously weighed borosilicate glass fiber filter, the residue is dried at 105 ° C. and then weighed again. The weight of the suspended solids is obtained by the difference between the weight before and after drying. The VSS is obtained by the difference between the weight of the calcined residue at 550 °C and the dried material at 105 °C. The COD was measured using the 5220D method with a standard curve (0-1000 mg L-1) established using a UV spectrophotometer Varian. The BOD5 or biochemical oxygen demand after 5 days is the amount of oxygen necessary for the destruction or degradation of the organic matter of a water by the micro-organisms. It is measured by immersing a probe, a cell formed by a selective membrane and containing the electrolyte and two metal electrodes. The oxygen passing through the membrane is reduced to the cathode, while the metal ions pass into solution at the anode. Thus, the generated current is proportional to the partial pressure of the oxygen in the sample; the WTW Oximeter measures the dissolved oxygen. A series of analytical quality controls was performed by analyzing samples of liquid reference materials.

3. Results and Discussions

3.1.Characterization of Wastewater at the Entrance to the STEP M'Haya

The table 2 gives the characterization of the raw wastewater [8-9-10-11] of the Mhaya center as well as the comparison with the Moroccan urban wastewater ranges.

Table 2: Characterization of raw wastewater from the M'HAYA center in relation to the Urban Wastewater ranges in Morocco

Parameters	STEP M'Haya Input Range (2012)	*Average	** Moroccan Urban Wastewater ranges
COD (mg O_2/L)	[777 - 939]	858	[500 – 800]
BOD5 (mg O_2/L)	[420 – 520]	470	[200 – 400]
TSS (mg/L)	[222 – 571]	397	[250 – 500]

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VSS (mg/L)	[150 – 360]	255	-
DISSOLVED OXYGEN	0	0	-
COD/BOD_5 raw	[1,85 - 1,80]	1,83	[2 – 2,5]
VSS/TSS	[0,63 – 0,67]	0,65	-
TSS/BOD_5 raw	[0,5 3 – 1,10]	0,81	[1,2 – 1,5]

*Average of measurements 2012
** ONEP / GTZ, National Liquid Sanitation Management Scheme (SDNAL), May 1998

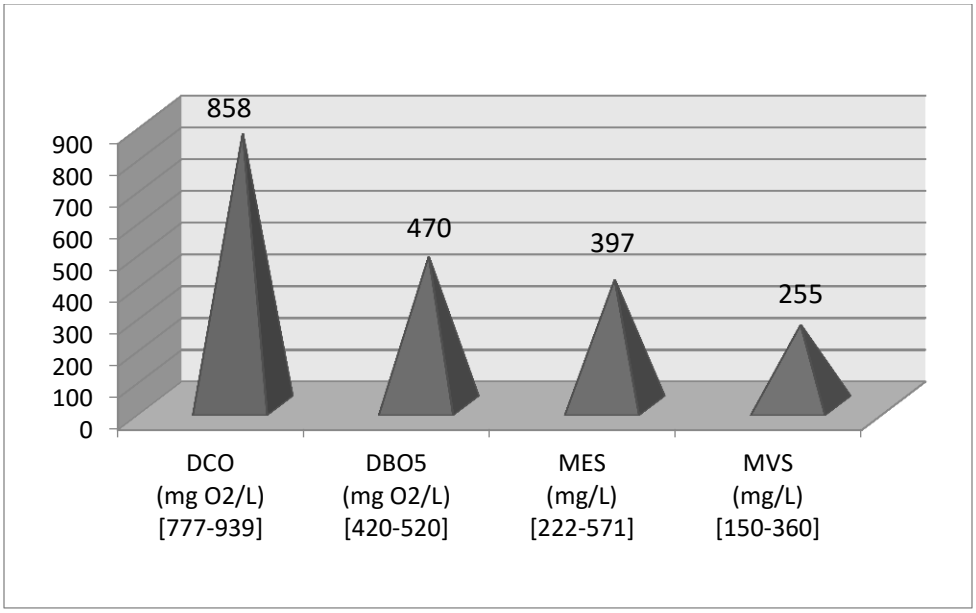

Figure 1: Physico-chemical characterization of wastewater at the WWTP intake

First, the raw wastewater introduced to the WWTP is relatively polluted in terms of BOD5 and COD compared to the usual range of domestic wastewater [12]. Also, the measured dissolved oxygen is zero showing the large amount of carbon pollution that resulted in the consumption of oxygen during self-purification processes. Second, the calculated COD / BOD5 ratio is about 1.83 on average and gives information about the wastewater biodegradability.

The calculated average TSS / BOD5 ratio (Table 2) shows an average value of 0.81 which remains below the limits of the usual range of Moroccan urban wastewater. This would generally have been due to the effects of the natural settling that would take place in the sewerage network. The calculated mean VSS/TSS ratio (Table 2) indicate an average value of 0.65 which belongs to the strict urban effluent and which could directly affect the excess production of biological sludge in the basins.

3.2.Purification Performance of MhayaWWTP.

Table 3 gives the Mhaya WWTP efficiency during 2012.

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Table 3: Efficiency of Mhaya WWTP during 2012

Parameters	WWTP Mhaya Intake Ranges	WWTP Mhaya Outlet Ranges	Efficiency (%)	Efficiency Average (%)	Moroccan domestic wastewater standards
COD (mg O_2/l)	777 - 939	154 – 211	78 - 80	79	250
BOD5 (mg O_2/l)	420 – 520	25 – 46	91 - 94	93	250
Dissolved Oxygen (mg/l)	0	2,19 – 9,48	100	100	_
TSS (mg/l)	222 – 571	115 – 120	48 - 79	64	150
VSS (mg/l)	150 – 360	22 - 98	73 - 85	79	-

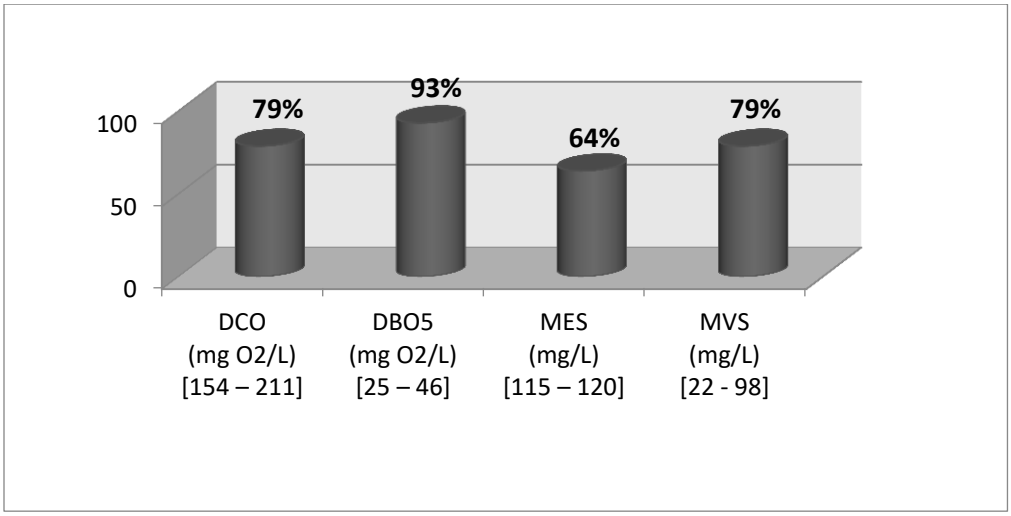

Figure 2: Purification efficiency of Mhaya WWTP

The dissolved oxygen is increasing after the wastewater treatment from zero to 9,48 mg/l. however, the BOD5 and COD are decreasing after the treatment respectively from 520 to 25 mg/l and 939 to 211 mg/l. the efficiency of the WWTP is 79% for COD and 93% for BOD5. Moreover, a high settling performance is observed, the TSS removal can reach 79% and the VSS removal is about 85%.

4. Conclusion

The Oxylag WWTP of Mhaya center shows better purification performance in terms of carbon removal (93% for BOD5, 79% for COD, 64% for TSS and 79% for the VSS) which meet the Moroccan domestic wastewater standards defined in the decree Number 1607-06 of 25 July 2006.

Therefore, the bacteriological and physicochemical characterizations of the wastewater are required in order to reuse the treated water in agricultural activities [13]. Finally, according to the treatment performance, this domestic wastewater treatment technology can be generalized in small and medium-sized centers in Morocco and all over the world.

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*Corresponding author.
E-mail address: bouhlal.abdelaziz.gie@gmail.com