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ASSESSMENT OF THE POLLUTION LOAD BY RAW WASTEWATER FROM MECHRAA BELKSIRI (MOROCCO)

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[doi:10.48047/AFJBS.6.14.2024.12058-12066](https://doi.org/10.48047/AFJBS.6.14.2024.12058-12066)**Abstract.**

Population growth and the modernization of industrial production have generated considerable water needs. This consumption has led to a disproportionate discharge of untreated wastewater, directly into receiving environments (Oceans, Seas, Rivers, Lakes, etc.). These discharges lead to the contamination of surface and groundwater and thus promote the spread of water-borne diseases.

The main objective of this work is to describe the pollutant load of wastewater from the town of Mechrâa Belksiri (Kénitra-Morocco) and to classify them and identify their components and their intensity to seek an appropriate treatment allowing their subsequent reuse and reducing their harmfulness on their receiving environment Oued Sebou.

The analysis of temperature, pH, redox potential, electrical conductivity, dissolved oxygen and salinity are recorded "in situ" using a multi-parameter analyzer. The wastewater samples intended for physicochemical analysis in the laboratory were preserved according to the general guide for the conservation and handling of samples according to ISO 5667/3. Suspended Solids (TSS) are determined by filtration of a volume of waste water (100 ml) on a cellulose filter with a pore diameter of around 0.45 µm. The analysis of the BOD5 is determined by the breathing method using a BOD meter (OxiTop) and the COD, according to DIN 38409-H52 which is determined by oxidation by excess potassium dichromate at the temperature of 148°C, in an acidic medium and at boiling point.

Wastewater from Mechraa Belksiri town has a pH of 7.2 (6.8 to 7.4) and an average temperature of 20.5°C (17.5 to 26°C) and an electrical conductivity of 3145 µs/cm. The average concentration of dissolved oxygen is very low at 0.35 mg/L and varies from 0 to 0.9 mg/L. Wastewater is loaded with organic matter estimated by Suspended Solid matter (average 446 mg/L and range 320 to 520 mg/L), BOD5 (280 mg O₂/L) and COD (557 mg O₂/L).

The overall pollutant load of wastewater (BOD5/COD = 0.50; TSS/BOD5 = 1.59 and COD/BOD5 = 0.98) presents satisfactory biodegradability and is well prepared for suitable biological treatment with activated sludge.

Keywords: Wastewater, Analysis, Pollution, Purification, Reuse, Mechraa Belksiri, Morocco.

1 Introduction

Water consumption continues to grow under the pressure of modern civilization's considerable needs for raw materials. This leads to a massive discharge of untreated wastewater directly into receiving environments, thus promoting the spread of various water-borne diseases and the contamination of surface and groundwater [1].

Our study consists of evaluating the annual pollutant load of domestic wastewater generated by the urban population of the city of Mechraa Belksiri and aims to contribute to the establishment of a very useful technical reference in the management of the sanitation sector at city scale.

2 Milieu, Materials and Methods

The town of Mechraa Belksiri is located in the northwest of Morocco, at 34°34' North and 5°57' West, 47 km north of the town of Sidi Kacem and 80 km east of the town from Kenitra.

The Mechraa Belksiri region has surface (Sebou River) and underground (Gharb Tablecloth) water resources [2]. The population of the city is around 27,630 inhabitants [3]. The average daily consumption value of drinking water is around 3012 m³/day [4].

The town of Mechraa Belksiri has a separative type sanitation system. The network was built in the early 1980s. This network serves 65% of the urbanized perimeter of the center. Wastewater from the remaining population is treated by individual sanitation systems (septic tank) [5].

The wastewater network is structured around two watersheds draining the entire city center and P.A.M districts. and Massira and the discharges are made into Wadi Sebou.

Monthly wastewater sampling was carried out from June to May at the urban wastewater outlets of the city of Mechraa Belksiri [6].

The wastewater samples intended for physicochemical analysis were preserved according to the general guide for the conservation and handling of samples according to ISO 5667/3 [7] and Good practice guide [8].

The analysis of temperature, pH, redox potential, electrical conductivity, dissolved oxygen and salinity were determined “in situ” using a multi-parameter analyzer Model CONSORT 535.

The analysis of the BOD₅ was determined by the breathing method using a BODmeter (OxiTop) and the COD, according to DIN 38409-H52 [9] which is determined by the oxidation of the reducing materials contained in the water by excess potassium dichromate at a temperature of 148°C, in an acidic medium and boiling, in the presence of silver sulfate (catalyst) and mercury sulfate (complexing chloride ions).

Suspended Solids (MES) are determined by filtration of a volume of waste water (100ml) on a cellulose filter with a pore diameter of around 0.45 µm. The filter and its substrate are carefully

dried in the oven at 105°C for 24 hours. The difference in mass before and after drying gives the suspended solids content, expressed in mg/l of wastewater [10].

3 Results

3.1 Results of physicochemical analyzes of wastewater

The physicochemical characteristics of wastewater from the town of Mechraa Belksiri grouped in Table 1 show that:

The average and extreme values of temperatures recorded at the level of the effluents studied are less than 30°C which is a value considered as the limit for direct discharges into the receiving environment [11]. Likewise, these values are lower than 35°C which is a value considered as an indicative limit value for wastewater intended for crop irrigation [11].

The averages of the Hydrogen potential of wastewater are relatively neutral and fall within the range of Moroccan water quality standards for irrigation and within the range of direct discharge limits which is between 6.5 and 8.5 [11].

The electrical conductivity averages recorded are 3680 $\mu\text{S}/\text{cm}$ and 2816 $\mu\text{S}/\text{cm}$. Note that these averages are higher than the standards required for direct discharges of raw wastewater into the receiving environment and both for water intended for irrigation [11]. These high values are due to the increase in the electrical conductivity content of groundwater and drinking water in the region, which is around 1820 $\mu\text{S}/\text{cm}$ [6].

Salinity analysis revealed that there is a slight fluctuation in its content during the year with an average of around 1.67 g/l and a minimum content of 1.1 g/l. The average Salinity still remains lower due to dilution by rainwater.

The averages of the Redox Potential -0.10 mV and +0.04 mV are recorded. Wastewater with a negative potential has a reducing power favoring eutrophication of the environment, on the other hand there is an oxidizing power in the wastewater due to a significant contribution of O₂ by rainwater drained by the network of the pseudo-separative system [6].

At the collector level, the average value of the oxygen content is around 0.28 mg/l to 0.42 mg/l. The average values observed from the two collectors are close to each other and do not exceed

0.5 mg/l. This makes the wastewater of the town of Mechraa Belksiri undersaturated with oxygen which accentuates anaerobic fermentation and the release of bad odors.

The BOD₅ values recorded are between 230 and 330 mg of O₂/l and between 220 and 270 mg of O₂/l with an average value of 282.5 mg of O₂/l and 278.58 mg of O₂ /L

The average value of all the collectors in the city of Mechraa Belksiri is higher than that found in Marrakech (240 mg of O₂/l) [12], (137 mg of O₂/l) [13], and Souk Elarba du Gharb (162.08 mg O₂/l) [14]. On the other hand, it is lower than that found in Kenitra (335.5 mg of O₂/l) [15] and in Sanaa (Yemen) (1137 mg of O₂/l) [16].

The average value of all collectors in the town of Mechraa Belksiri is greater than 100 mg of O₂/l considered as the limit value for direct discharges [11]. This wastewater is classified as very poor according to surface water quality standards [11].

The COD values recorded are between 460 to 640 mg of O₂/l and 490 to 620 mg of O₂/l with an average value of 573 and 541.25 mg of O₂/l. The average value of all collectors in the town of Mechraa Belksiri is greater than 500 mg of O₂/l considered as the limit value for direct discharges [11]. Furthermore, this wastewater is of very poor quality (> 80 mg/l) according to surface water quality standards [11].

The average COD values recorded in wastewater from the two collectors studied in the town of Mechraa Belksiri show that these values are lower than those found in Sanaa (Yemen) (1888.53 mg O₂/l) [16]. and in Marrakech (2983 mg O₂/l) [12]. On the other hand, they are higher in Ouarzazate (571.3 mg of O₂/l) [17], and those found in Kenitra (500.7 mg of O₂/l) [15], and in Souk Elarba du Gharb (235.2 mg O₂/l) [14].

Analysis of the results shows that the average value of SSM recorded in wastewater is of the order of 419.17 mg/l and 474.17 mg/l. The values found are high at 50 mg/l considered as standards for wastewater intended for direct discharges [11].

Our results are lower than those found in Sanaa (Yemen) (813.5 mg/l) [16]; more or less similar to those found in Kenitra [15] and higher than those found in Marrakech (194.34 mg/l) [12], and in Souk Elarba du Gharb (224.25 mg/l) [14].

Table 1. Physico-chemical parameters of wastewater from the effluent of Mechraa Belksiri (Kenitra, Morocco).

	T° C	pH	EC (µS/cm)	Salt (mg/l)	Redox (mV)	O ₂ (mg/l)	BOD ₅ (mg/l)	COD (mg/l)	SSM (mg/l)
Minimum	18	7.1	3280	1.6	-0.5	0	220	460	320
Average	21.5	7.2	3480.83	1.67	-0.1	0.28	282.5	573.33	419.17
Maximum	26	7.3	3680	1.7	0.1	0.6	330	640	480
SD	3.27	0.08	123.84	0.05	0.16	0.2	35.45	63.15	57.91
Number	12	12	12	12	12	12	12	12	12
Minimum	17.3	6.88	2400	1.1	-0.1	0	250	490	430
Average	19.4	7.19	2816.67	1.27	0.04	0.42	278.58	541.25	474.17
Maximum	22	7.4	3400	1.5	0.2	0.9	310	600	520
SD	2.05	0.18	387.49	0.15	0.07	0.33	14.13	27.64	38.95
Number	12	12	12	12	12	12	12	12	12

4 Discussion

For a better appreciation of the origin of wastewater from different collectors studied, the calculation of the BOD₅/DCO, COD/DBO₅, MES/DBO₅ ratios and the estimation of oxidizable matter (OM) is of very important interest. The use of these wastewater characterization parameters therefore constitutes a good way to give an image of the degree of pollution of wastewater. The BOD₅/DCO ratio gives very interesting indications on the origin of pollution and its treatment possibilities.

For our present study, the calculation of these ratios and the estimation of the Oxidizable Matter for each wastewater collector studied reveals the following average values:

The COD/BOD₅ ratio makes it possible to deduce whether the wastewater discharged directly into the receiving environment has the characteristics of domestic wastewater (ratio less than 3) [18]. The results of this report constitute an indication of the importance of polluting materials with little or no biodegradability [19].

Wastewater has a COD/BOD5 ratio varying from 1.92 to 2.17 and 1.91 to 2.04 with an average of 2.03 and 1.94.

The COD/BOD5 ratio of the effluents is less than 3, therefore the wastewater from the town of Mechraa Belksiri is classified among wastewater with a medium organic load and is easily degradable [18]. These results agree with those found [20].

Wastewater has a BOD5/COD ratio which oscillates between 0.46 and 0.52 and 0.49 to 0.52 with an average of 0.49 and 0.51.

The ratio is around the average of 0.5, so wastewater is loaded with organic matter. This organic load makes this wastewater quite unstable, meaning that it will quickly evolve into “digested” forms with the risk of odors being released.

Wastewater has a TSS/BOD5 ratio varying from 1.10 to 2.18 and 1.39 to 2.08 with an average of 1.52 and 1.71. The oxidizable matter (OM) of wastewater has an average value of 379.44 and 366.14 mg/l.

These results confirm that the wastewater from the town of Mechraa Belksiri is loaded with organic matter and is easily biodegradable [21]. The values of oxidizable matter in wastewater are higher than those found in Kenitra [20].

Wastewater generates a polluting load of around 488.16 Kg/d and 433.25 Kg/d. Thus we estimate the overall pollutant load of the city of Mechraa Belksiri which oscillates around 921.41 Kg/d, i.e. a pollutant load of 336.32 T/year.

5 Conclusions

The physicochemical characteristics of wastewater from the town of Mechraa Belksiri exceed the general limit values for direct and indirect discharges into the receiving environment, Wadi Sebou [11].

Wastewater from the town of Mechraa Belksiri generates a significant pollutant load by flowing into receiving environments such as Oued Sebou, and especially during its stagnation can create a favorable environment for the proliferation of mosquitoes vectors of water-borne diseases.

Examination of the COD/BOD5 report clearly highlights the biodegradable nature of wastewater from the town of Mechraa Belksiri. It can be concluded that the wastewater from this discharge is easily ready for suitable biological treatment.

The overall pollutant load in the city of Mechraa Belksiri estimated at 921.41 Kg/d, i.e. a pollutant load of 336.32 T/year, can be useful for agriculture if it is well treated and valorized by a WWTP. We subsequently deduce that the Ratio of Inhabitant Equivalents in BOD5 of the city of Mechraa Belksiri has a value of 29.15 g/h/d.

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