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Evaluation of the Content of Heavy Metals and Organic Micropollutantsin the Effluents of the Wastewater Treatment Plant of the ErrachidiaCity –Morocco-

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ABSTRACT
The aim of this study is to assess the content of heavy metals and organic micropollutants in wastewater before and after their treatments in the resort of wastewater treatment (WWTP) of the Errachidiacity (Morocco) to achieve experiments on reuse in irrigation.
The analysis results showed that the content of heavy metals (Al, Ag, Cd, Cr, Fe, Hg, Pb, Ni, Mn, Cu, Zn and Ba) to the entry for the WWTP is relatively weak, due to low industrial and agricultural activity in the region. This clearly confirmsthenature ofdomesticsewageof the city. On leaving the station the concentrations of various metallictraces comply with discharge standards.
Moreover, the dosage of organic micropollutants reveals relatively high concentrations at the entrance of the station especially for chlorides (900 mg/L) and Kjeldahl nitrogen (92 mg/L). While the treated water have low levels, which confirms the good treatment efficiency of the WWTP of the Errachidia city.
Keywords: heavy metals, organic micropollutants, ErrachidiaWWTP.

I. INTRODUCTION

Wastewater discharges into the natural environment without treatment cause great risk to populations living near the release and a great nuisance for the receiving environment. The slums are areas for cities favorable to disease outbreaks related to water.

According to epidemiological surveys conducted by the Ministry of Health, the main factors promoting the development of waterborne diseases in Morocco are contamination of drinking water (more than 50% of registered cases), contamination of vegetables by waters waste and precarious hygiene dominant in rural areas and on the fringes of the peri-urban areas[1].This contributes to the fact that wastewater treatment is required prior to discharge or reuse in order to protect public health and the environment. It is in this context that several cities of the kingdom (Errachidia, Marrakech, Agadir, Ouarzazate, Nador ...) have featured the past few years of sewage wastewater[2]. In addition, and despite treatment wastewater treatment plants, they can still carry a large number of pathogenic microorganisms and micropollutants, of which heavy metals are the most dangerous [3]. Indeed, the reuse of treated wastewater is the first and main relay conventional resources; they represent a significant potential of about 500 million m^3. In Morocco, more than 7000 ha are irrigated with raw sewage near major urban centers where vegetables, cereal and industrial crops are practiced [4].

This practice is adopted by farmers haphazardly without considering the risks that may result from use of these waters for human health because they can transmit many pathogens including through the consumption of products derived from irrigation with wastewater or after direct contact with these waters.
Hence the importance of this study which will enable to assess the role of the purification station in Errachidia reducing heavy metals and organic micropollutants.

II. MATERIALS AND METHODS

II.1 STUDY ENVIRONMENT

The Errachidiacity is located south of eastern Morocco, 320 km south of Meknes, characterized by a dry climate. It has 76759 inhabitants in 2004 [5] and approximately 91 745 inhabitants in 2013 (with an average annual population growth of about 2% rate).

The new wastewater treatment plant in the Errachidia city is intended for collective wastewater

of the city. It is located three kilometers south-east of the city, its GPS coordinates are N 32 ° 1 '57 099" W 4 ° 2' 14 912", his averages are coordinated Lambert: X = 594000 m; Y = 147000 m.

The station is sized to receive a nominal flow rate of 7520 m^3/d at the horizon of 2020 and treat pollution load of about 3460 kg BOD_5/d.

It comprises a total of 10 ponds:

- 4 aeration ponds, three of which operate in the first floor, and the fourth in the second floor. The dimensions of these ponds are identical and 150 m long, 50 m wide and 4,5 m deep with a useful volume of 23 000 m^3 each. Apart from the second floor which has 5 aerators, all others are equipped with surface aerators 7 with a power of 11 KW. The mode of ventilation used in the station is 11 hours/24hours in the first floor basin and 7 hours/24 hours in the second stage;
- 6 maturation ponds consist of 3 floors, each consisting of two parallel basins; Maturation lagoons have the following characteristics: 150 m long, 50 m wide, 2 m deep with a useful volume of 11 325 m^3 each.

II.2 MATERIALS AND METHODS

According to Moroccan standards, sample collection (planned for analysis) to the input (raw water) and out of the station (purified water) will be performed every 3 months [6].

To date, two analyzes were performed the months of May and September.

The measurements are:

- Heavy metals involved in the analysis are: Aluminum (Al), silver (Ag), Cadmium (Cd), Chromium (Cr), iron (Fe), Mercury (Hg), total lead (Pb), Nickel (Ni), manganese (Mn), copper (Cu) , Zinc (Zn) and barium (Ba);
- Analysis of organic micropollutants namely: Chlorides, sulfates, total phosphorus, Kjeldahl nitrogen TKN, Oils and fats, free cyanides (CN) and phenol index.

The water was filtered through paper WATTMAN, 100 ml of the resulting solution is heated to dryness. The resulting residue is treated with hydrochloric acid until complete dissolution of all salts.

The solution obtained is transferred into a volumetric flask, with distilled water.

The methods used for the determination are:

- For the heavy metals, the assay is performed by atomic absorption[7], using a Perkin Elmer Type;
- For other organic micropollutants, the analysis was performed by UV-visible spectroscopy using a Varian spectrometer. By cons, for oils and fats, the Soxhlet method was preferred [7].

III. RESULTS AND DISCUSSION

Analyzes of heavy metals and organic micropollutants raw and clean the Errachidia citywastewater are carried out during the months of May and September 2013. The results found are presented in the tables below (Tables 1, 2, 3, 4).

III.1 Heavy Metals

The results of the analysis of heavy metals in the raw wastewater is treated and summarized in Tables 1 and 2.

***Table 1*: The contents of heavy metals in the entry for the station**

Parameters (mg/L)	May	September	Limits values (mg/L) [8]
Al	5,22	1,75	**10**
Ag	0,0025	0,0037	**0,1**
Cd	0,0003	0,0006	**0,2**
Cr	0,62	0,15	**2**
Fe	5,50	1,68	**3**
Hg	0,023	0,015	**0,05**
Pb	0,45	0,25	**0,5**
Ni	0,084	0,075	**0,5**
Mn	0,85	0,30	**1**
Cu	0,780	0,038	**0,5**
Zn	2,80	0,94	**5**
Ba	0,1900	0,085	**1**

The data in Table 1 show that the concentrations of heavy at the entrance to the station metals are very low, this confirms the nature of domestic sewage of the city. We also note that these values remain well within the range of Moroccan standards [8], except in the case of iron whose value was recorded the month of May a value slightly above the standard (3 mg/L) this can be explained by discharges from small industries as well as pipes corrosion of the sewerage network of the city. Moreover, this concentration is still less than that found in the cities of Oujda, BeniMellal and Marrakech [9] [10] [11] [12].

***Table 2*: The contents of heavy metals at the outlet of the station**

parameters (mg/L)	May	September	Limits values for irrigation (mg/L) [6]
Al	0,97	0,65	**5**
Ag	0,0011	0,0020	**0,1 [8]**
Cd	0,0001	0,0008	**0,01**
Cr	0,0700	0,0850	**0,1**
Fe	1,20	0,45	5
Hg	0,0017	0,0005	0,001
Pb	0,065	0,052	5
Ni	0,025	0,028	0,2
Mn	0,068	0,075	0,2
Cu	0,054	0,025	0,2
Zn	0,15	0,21	2
Ba	0,048	0,037	1 [8]

The analyzes carried out on samples of the two months of May and September, registered respective conductivity values 2860 µs/cm and 2920 µs/cm. Both values are within the range of Moroccan standards [6]. On the other hand, the contents of heavy exit station metals are negligible and do not exceed the discharge standards.
Regarding irrigation, the total content of heavy metals, and in particular of highly toxic elementsremain compliant [6].

III.2 ORGANIC MICROPOLLUTANTS

Tables 3 and 4 present the results of analysis of organic micropollutants.

***Table 3*: Values of organic micropollutants at the entrance to the station**

parameters (mg/L)	May	September	limits indirect discharges values (mg/L) [8]
chlorides	900	895	--
Sulfates	180	298	400
total phosphorus	18,5	8,5	10
TKN	92	61	--
Oils and fats	50,08	47,50	50
CN	0,054	0,050	1
Phénol index	2,50	2,75	5

***Tableau 4*: Values of organic micropollutants at the exit of the station**

parameters (mg/L)	May	September	limits direct discharges values (mg/L) [8]	Limits values for irrigation (mg/L) [6]
chlorides	1000	680	**--**	**--**
Sulfates	250	147	**400**	**250**
total phosphorus	9,00	4,15	**10**	**--**
TKN	6,0	6,4	**30**	**30**
Oils and fats	40,6	15,5	**30**	**--**
CN	0,041	0,045	**0,1**	**1**
Phénol index	0,1	0,05	**0,3**	**3**

- **chlorides**

The concentration of the chlorides of waste water presents important values which can achieve until 900 mg/L the entrance and 1000 mg/L to the exit of the station. Chloride concentration depends on urbanization [13] [14], and the nature of the crossed land [15].

- **sulfates**

The presence of sulfates in wastewater is linked to human activity such as agriculture and industrial discharges.

Sulfates have a maximum concentration of 298 mg/L at the entrance of the station, this value is included in the range limits of indirect discharges values [8].

At the exit of the station, there were concentrations of 250 mg/L and 147 mg/L with an average of 199 mg/L. This value remains below the limits of direct discharge values and fits perfectly in the quality of water for irrigation [6].

- **Total phosphorus**

Phosphorus is found in waste waters because of detergent builders added and the decomposition of organic matter. The content of total phosphorus entering the station of May (18,5 mg/L) slightly exceeds the value set for indirect discharges [8], while that of September (8,5 mg/L) remains within the range of standards [8].

In terms of irrigation, leaving the station, the recorded values are consistent with Moroccan standards of water for irrigation. [6]

- **Kjeldahl nitrogen TKN:**

The TKN from raw sewage at the entrance to the station is about 76,5 mg/L, this value is greater than that found in Oujda [9], and Kenitra [16]. In addition, the passage through the station allows a good reduction vis-à-visthis compound, in effect leaving the station,TKNhas an average value of 6,2 mg/L. This recorded value is less than 30 mg/L and considered limit value for direct discharges into receiving waters [8], and wastewater for irrigation [6].

- **Oils and fats**

The content of oils and fats in raw sewage from theErrachidiacity, is about 4,8 mg/L, this high (due to a lack of discharges pretreatment from restaurants, hotels and resorts services) remains slightly below the threshold. [8]

On the other hand and out of the station, the recorded value has an average of 28 mg/L remains within the limits of direct discharges values [8].
The presence of oils prevent the bringing around of oxygen and thus promote the development of anaerobic conditions [17].

- **Cyanide**

The presence of cyanide in high concentrations in wastewater makes harmful and sometimes highly toxic [18]. For our case, the analysis has led us to average grades at the entrance and exit of the order 0,052 mg/L, 0,043 mg/L which remain compliant discharges and water for irrigation [8] [6].

- **Phénol index**

The presence of phenols in wastewater even at low concentrations causing a toxicity to fish and crustaceans [19]. In addition, wastewater from the Errachidiacity have a inlet concentration of 2,6 mg/L less than 5 mg/L (limit indirect discharges [8]).
The reduction of organic matter has to be at the exit of the station, a value phenols 0,075 mg/L complies with direct discharges and those of agricultural reuse [8] [6].

IV. CONCLUSION

This work aims to evaluate metal pollution and organic micropollutants in wastewater from the Errachidia city. To this end, we have made a series of analyzes which showed us that the sewage of the Errachidia city have low concentrations of heavy metals at the entrance, which justifies the domestic nature of the sewage of the city. After treatment in the station, the content of the treated water complies with agricultural reuse. It is the same for organic micropollutants which also showed a good abatement result.

In the end, we can conclude that the chain used in the aerated lagoon wastewater treatment plant of the Errachidia city achieves a good performance vis-à-vis the heavy metals and organic micropollutants, which helped to enhance the water clean the city for use in agricultural irrigation and contributed to the preservation of the environment and economy of water resources in this region characterized bySaharan climate.

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