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# The physico-chemical study between upstream and downstream of the wastewater treatment plant (WWTP) Aïn Nokbi of Fes (Morroco)

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## Abstract

This work aims to make a comparative study of the bacteriological and physicochemical quality of the station for treating polluted water of the Ain Nokbi polluted water treatment plant in Fes.The physicochemical analyzes of wastewater treated by this treatment plant have high levels exceeding the direct discharge limit values for irrigation.

**Keywords:** Physic-chemistry, station for treating polluted water, purified water, upstream, downstream.

## Introduction

The city of Fez, spiritual capital of Morocco was established from the 9th century on the banks of Oued Fes. Located at the crossroads of several major road axes leading to the North, East or West of Morocco on the Saïs plain, it has experienced continuous development in view of the many advantages that its site offers to citizens (Baumontand*al* ., 2004).

The current population amounts to 1,100,000 inhabitants and should reach 1,500,000 inhabitants in 2030. The city represents the core of the economic activities of the Fès-Boulemane Region, the main ones of which are: Tourism, Handicrafts, the industry.

The city of Fez is one of the cities that has experienced strong demographic growth, massive urbanization and the development of industrial activities in recent times, which has resulted in an increase in the rate of consumption and use of water and consequently a remarkable increase in the volumes of wastewater discharged.

The purpose of this work is to study the bacteriological and physicochemical quality of treated wastewater by the PWTS (polluted water treatment station) of Ain Nokbi located in Fez to know if this treated water meets the standards of rejection in a natural source like OuedSebou of the city of Fes and to detect the dysfunctions if they will exist and to propose the suitable solutions thereafter.

This problem is not limited to the quantity of water resources, but also relates to their quality, which is needed now more than ever to be managed well (Baumont and *al*., 2004). Several regions in Morocco are suffering from the incessant increase in water needs, while the available resources remain limited and poorly distributed. This water deficit is currently accentuated with the development of the industrial sector which not only consumes high quantities of water, but also contributes to pollution and to the degradation of the quality of surface and groundwater (Darley, 2002).

Wastewater production in the city of Fez has been estimated at 118,000 m3⁄ d by the entire urban environment (1.2 million equivalent inhabitant) (Methri, 2012).The purification of wastewater by these various processes consists in producing water which can be reused in the agricultural sector or discharged into nature without harmful effect on the soil, plants and human beings, therefore on the environment. Purified wastewater has a very important environmental aspect, indeed this water protects the environments where it was discharged without treatment (Gillet and *al*., 2003). Apart from the high salinity and the microbiological load of the treated wastewater, it can be used without worry in the agricultural field and can give very encouraging results.

This study was carried out in collaboration with the Regional Laboratory for Epidemiology and Environmental Hygiene Fès-Meknès (LRDEHM) and the Department of Biology of the Faculty of Sciences Dhar el Mahraz.

## I- Materials and Methods

### I.1 Sampling

Taking a water sample is a delicate operation that must be taken with great care. It conditions the results and the interpretation of the data. The sample taken must be representative (Darley, 2002) and retain the physico-chemical characteristics of the water (gas (dissolved, suspended matter, etc.). The sample was taken at a depth of approximately 50 cm RODIER and *al.*, 2005; FROUK, 2002).

A total of 6 samples were taken from two different places, the first represents purified wastewater (downstream) and the other sample taken from upstream from the WWTP. The bottles containing the water samples to be analyzed were transported under isothermal conditions between 4 ° C and 6 ° C. The analyzes are carried out within the first three hours following the samples.

The water samples necessary for the physico-chemical analysis were taken according to the method described by Rodier and *al*. (2009), in disposable plastic bottles and stored at 4 ° C, for the sampling necessary for bacteriological analysis, we used sterile 500 ml glass bottles and in order to avoid the initial germ content there is no risk of water being altered in the bottle, all analyzes are carried out as quickly as possible.

### I.2 Presentation of the study region (AinBouali)

It is located at the foot of JbelZallagh. It is an area crossed by OuedSebou and bordered in the North, in the East as in the West by hills, constituting a kind of fence isolating the area close to the site from the rest of the surrounding territory (Figure 1). The altitude is variable, it starts at less than 300m and goes up naturally towards the mountain.

The resort covers a total area of 14 ha, in the Aïn Nokbi region located in the province of Moulayyakoub in the northwest of the city of Fez. The coordinates of the station are: 34.080701, -4.930264. The station collects domestic waste from the entire city of Fez (2nd largest city in Morocco in terms of population), i.e. around 5 million inhabitants living upstream from this station (Figure 2).

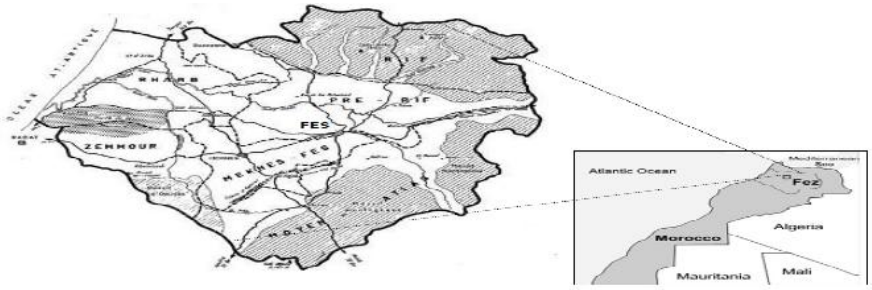


Figure 1:Map shows the city of Fes

The main objective of the construction of this station is to help reduce the pollution pressure on the Sebouwadi which constitutes the receiving environment for all the discharges from the area. Thus, the project is part of the sanitation and wastewater treatment program, which was launched by the Ministry of the Environment in 2005. The project to build the station was put on the responsibility of the autonomous water and electricity distribution authority of Fez (RADEEF).

### I.3 How the wastewater treatment plant(WWTP) works

The Fez wastewater treatment plant is a medium-load activated sludge plant, it uses biological processes to remove pollutant loads (Degremont, 2005). It was designed for 1.2 billion inhabitant equivalent (PE) with an average daily flow of 155,400 m3 / d. The BOD5 pollutant load is around 64 tonnes / d, which explains the size of the works that have been put in place at the station (Metcafet, 2003; Ouryachi, 1999).

This station treats three sectors which are: water, mud and biogas.

- The water sector first passes through the pumping station followed by a pretreatment (screening + desanding-oil removal), primary decantation, biological treatment with surface aeration and secondary decantation. This water which must be treated and discharged into the Sebou basin and can then be used in agriculture.
- The Mud stream, which is the result of the treatment of polluted water (PW). It begins with the measurement of the thickener of the primary sludge, the floats of the secondary sludge, a digestion of mixed sludge, dewatering with band filters and liming. This sludge undergoes anaerobic digestion in large bioreactors to produce biogas.
- The Biogas sector concerns the extraction of biogas from digesters, desulfurization, storage at the level of gasometers and cogeneration of biogas to obtain heat and electricity. This biogas is intended for the production of 50% of WWTP own needs in electrical energy. It is therefore clean and sustainable energy which is added to the positive impacts of this WWTP on the environment. The resulting mud after digestion is transported to the landfill of Fes. However, this mud can be used as compost.

Figure 2 : Aerial image of Ain Nokbi wastewater treatment plant

### I.4 Presentation of the sampling site

The wastewater treatment plant (WWTP) of the city of Fès is placed under the responsibility of the Autonomous Intercommunal Water and Electricity Distribution Authority of the city of Fès (RADEEF) and aims to improve the situation of the Sebouwadi downstream of the city's discharges, as well as the sanitary conditions of the population of the region.

OuedSebou located downstream of this station thus represents an important water resource whose deterioration in quality has handicapped the development of an entire region and will have disastrous consequences on the health of the population which uses it. domestic and agricultural purposes.

Two sampling sites were selected:

- Site S1 upstream of the WWTP with coordinates (34.081349, -4.927067) presents raw wastewater at the entrance to the WWTP.
- The S2 site located downstream of the treatment plant with coordinates (34.080327, -4.927294) and represents the treated wastewater at the outlet of the WWTP.

## II- Results and Discussion

The results of the physicochemical analyzes highlighted a spatio-temporal differentiation, between the entry and the exit of the WWTP, which results in a decreasing degree of the indicators indicators of the pollution (BOD5, COD, MES, NH4, NO3, etc.) .)going from upstream to downstream. The station located upstream is characterized by a high load of organic matter and significant mineralization due to domestic and industrial discharges. On the other hand, the station located downstream is characterized by a significant reduction in organic pollution but unfortunately this reduction remains not in conformity with the Moroccan standard relating to the quality of water intended for human consumption (03.07.001) and to the value of the organic parameters considered as the direct discharge limit value for treatment plants (Baumont, 2004).

At the end of this study, in a context of limited water resources, wastewater in Morocco presents not only a new limitation of the available resource but above all an attack on the health of the populations and the quality of the environment in general.

The use of purified wastewater makes it possible to reduce the abstraction in aquifers, and to mitigate the impacts on the environment by eliminating or reducing the elimination of wastewater, which makes it possible to preserve the quality of downstream water. However, this use poses biological and chemical risks. The former include the exposure of humans, animals or plants to viruses, bacteria, protozoa, and helminths.

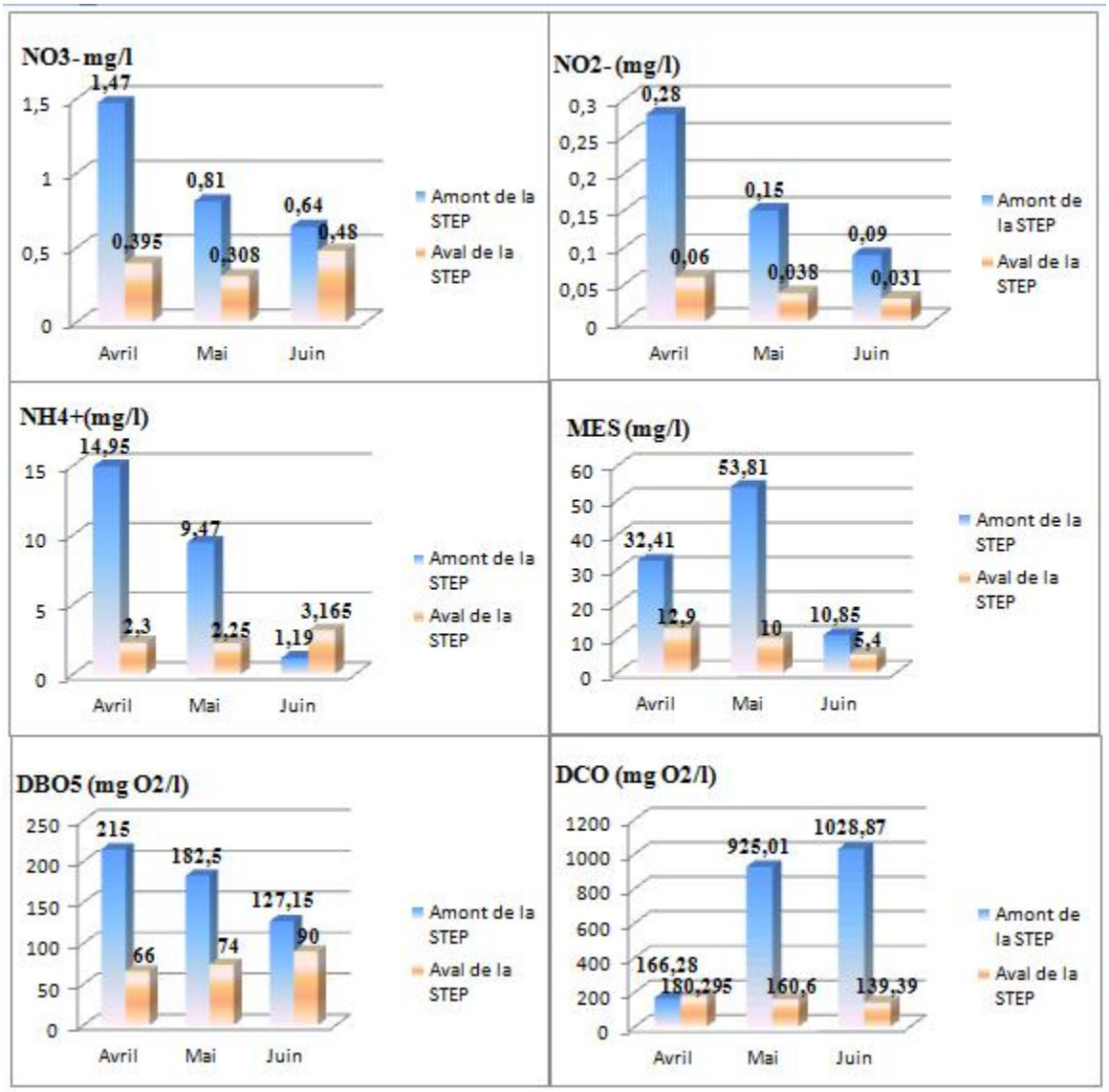


Figure 3 : Pollutant parameters (BOD5, COD, SS, NH4 +, NO2- and NO3-) from upstream to downstream.

## Conclusion

In the light of the results obtained from the physicochemical analyzes of the wastewater treated by the Ain Nokbi treatment plant, the recorded values of certain parameters studied (T ° C, pH, suspended matter (MES), nitrates, nitrites, orthophosphates and ammonium.) generally comply with international standards set by the FAO and the discharge limit values for treatment plants. However, for the other physicochemical parameters (conductivity, chlorides, BOD5, COD) these parameters have very high contents exceeding the limit values of direct discharge for treatment plants and the limit values intended for irrigation.

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