Prediction of biodegradability ratios in wastewater treatment plant of Skhirat Morocco

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Abstract— *In this note, our study was carried out by physico-chemical monitoring in terms of organic matter. The mean objective is to evaluate the performance of the Skhirat wastewater treatment plant based on the ratios COD/BOD and BOD/COD in order to know the degree of biodegradability and to make the decision about the treatment model to choose. In fact, the performances acquired in terms of COD and BOD are respectively of the order of 87.26% and 88.35%; what is significant downstream of this station that we take advantage of to irrigate several green spaces by saving all conventional water resources. In addition, the organic material is easily biodegradable with ratios of COD/BOD and BOD/COD respectively of about 2.05 and 0.49. This allows us to adopt an appropriate biological treatment by design and sizing suitable structures.*

Keywords— *Wastewaters, Organic matter, biodegradability, performance, Skhirat, Morocco.*

I. INTRODUCTION

At these last decades, Morocco has experienced a very significant development in the installation of the stations of purifications in several communes of the country. Because of development of the populations socio-economically the polluting load by equivalent-inhabitant has increased as rejection of domestic and industrial wastewaters to the network of collective cleansing arriving at the sewage treatment plant of the town of Skhirat located in the area Rabat-Sale-Kenitra.

Obviously, the composition of wastewaters reflects the life styles [1]. Pollution is an artificial phenomen on resulting either from the natural substance concentration or of the no natural synthetic compounds (xenobiotic) rejected into the environment [2].

The organic and inorganic substances rejected into the environment following domestic, agricultural and industrial activities of water lead to an organic and inorganic pollution [3,4]. At the horizon, these effluents pose a future problem because of the increase in the population which will generate very large quantities of pollutants what requires an appropriate treatment by correcting any specific anomaly. The objective of this study is of knowing the degree of biodegradability for the decision making of which type of treatment to follow, while being based on the ratios of COD/BOD and BOD/COD.

II. ZONE OF STUDY

The zone of study is spread out over a surface of approximately 600 ha and fact part of the urban district of Skhirat which is located at about twenty kilometer in the southwest of the town of Rabat. It is bounded by the communes of Harhoura and Ain Atiq to north and by the communes Essabah and Charrat to the south. The study area is part of the urban plan development of the city of Skhirat. In the North, there is a significant extension of the industrial zone which exceeds the surface delimited by the installation plan.
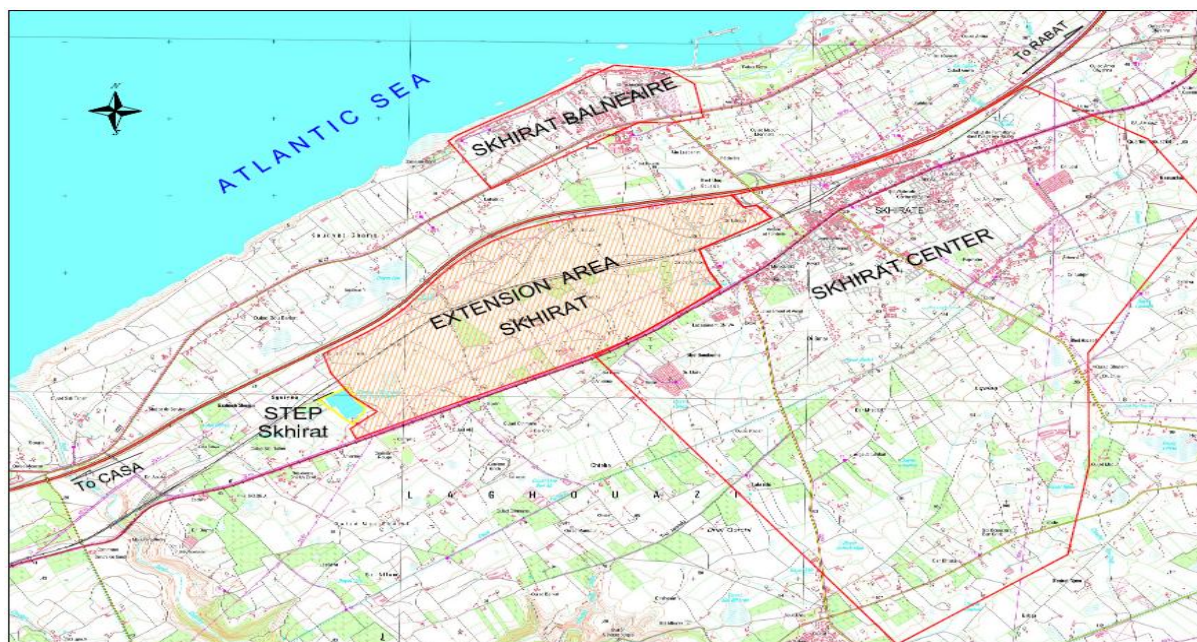
FIG.1: GEOGRAPHICAL LOCATION OF THE WASTEWATER TREATMENT PLANT (STEP) OF THE MUNICIPALITY OF SKHIRAT

The population of the urban district of Skhirat, according to the last censuses of 1994, 2004 and 2014, respectively counted 29599, 43025 and 59598 inhabitants with an inter annual average rate of increase in 3,8 %. The climate of the geographic area is of the subhumid mediteranean type with an annual average temperature of the area close to 18 °C and an annual rainfall average which is about 500 mm while varying from one year to another.

III.   MATERIAL AND METHODS

Sampling was carried out by monthly taking away during one year with four taking away for each month as well as the sites of study were carefully selected at the entry and the exit of the wastewaters treatment plant of the city Skhirat (Area of Rabat-Sale-Kenitra)

After the conservation of the samples of wastewaters was made according to the general guide for the conservation and the handling of the samples according to[5]. The measurement of suspended matter (SM) was carried out by a cellulose membrane filter of diameter of 0.45 μm [6]. Moreover the BOD was measured by an oxytop DBOmeter at temperature 20°C during five days of incubation as well as the COD by a spectrophotometer.

IV.   RESULTS AND DISCUSSION

4.1   Report COD / BOD

This report COD/BOD, informs us about the nature of pollution and it indicates the importance of the polluting matters more or little or no biodegradable [7].

The index of biodegradability (COB/BOD) proves also very useful for the fellow-up of the effectiveness of biological treatment; the report is increasing more especially as the biological treatment is more difficult. According to always the same reference, for an effluent with domestic predominance, this report generally is understood between 1.5 and 2.5. For industrial effluents, which may contain a significant fraction of non-biodegradable compound, it may be envisaged according to this ratio COD / BOD whose aptitude for degradation is more or less favorable to a biological treatment, according to the rules being generally adopted:

* COD/BOD< 3   : Easily biodegradable effluent

* 3 < COD/BOD<5   : Fairly biodegradable effluent

* COD/BOD > 5   : Not easily biodegradable effluent, even no biodegradable

Our report COD/BOD is of the order 2.92 for wastewaters of the sewage treatment plant of the Skhirat city. Thus this ratio is lower than 3 what indicates than these effluents need a biological treatment.

4.2   Report BOD / COD

The report BOD/COD, is an indicator of the biodegradability of the organic matter [8], and this ratio provides important indications on the origin of the pollution of wastewaters and the suitable treatment to realize [9].

In our obtained results, we watch that the average of report BOD/COD is about 0.48 is noted higher than ratio 0.47 [10] with a minimal value of 0.15 and one value maximum of 1.
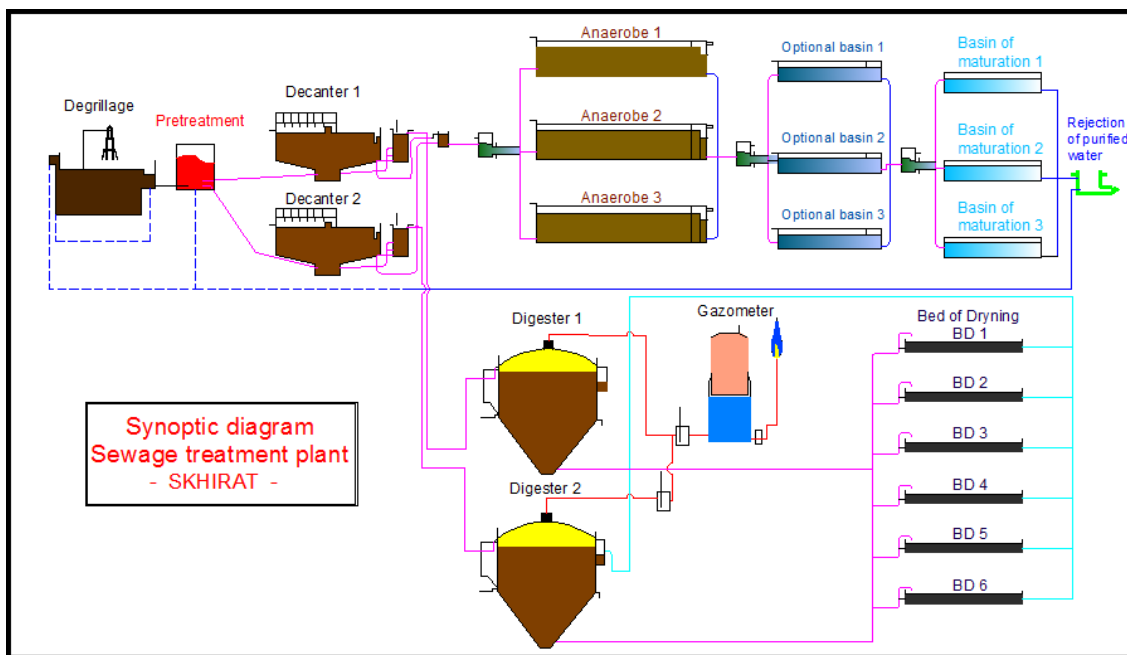

FIG.2: PRESENTATION OF THE SYNOPTIC DIAGRAM OF THE STEP OF SKHIRAT

Figure 2 represents really the stages of operation of sewage treatment plant of the town of Skhirat and the levels of treatment conveyed as of the entry of the effluents to their exit of this STEP. So we tracked and decompensated his decision-making allowance if there was a malfunction in one of the current phases or in the whole, correcting any anomaly that subsequently occurred.

TABLE 2
COD AND BOD RATIOS OF WASTEWATERS ENTERING AND LEAVING THE STEP SKHIRAT

Statistical	COD Entrance	BOD Entrance	COD purified	BOD purified
Nb. observation	12.00	12.00	12.00	12.00
Minimum	187.00	112.00	19.20	1.60
Maximum	1030.00	614.00	107.52	42.00
First Quartile	588.50	146.75	40.30	7.33
Median	783.50	245.00	53.76	10.00
Third Quartile	941.00	525.00	65.84	17.00
Average	722.67	326.75	56.86	14.67
Variance	70936.39	39390.52	753.87	160.36
Standard Deviation SD	266.34	198.47	27.46	12.66
Coefficient of variation	0.37	0.61	0.48	0.86
Standard deviation of average	80.30	59.84	8.28	3.82
Limit inf. of average (95%)	545.92	195.04	38.64	6.26
Limit sup. Of average (95%)	899.42	458.46	75.08	23.07

This station is characterzed by degriller/sand trap, as degriller, two decanters, 3 basin of anaerobes, 3 basin optional, 3 basins of maturation, 2 digesters and a gasometer which produces methane while finishing by beds for waste sludge drying. Finally the purified wastewaters are rejected into the Charrat river
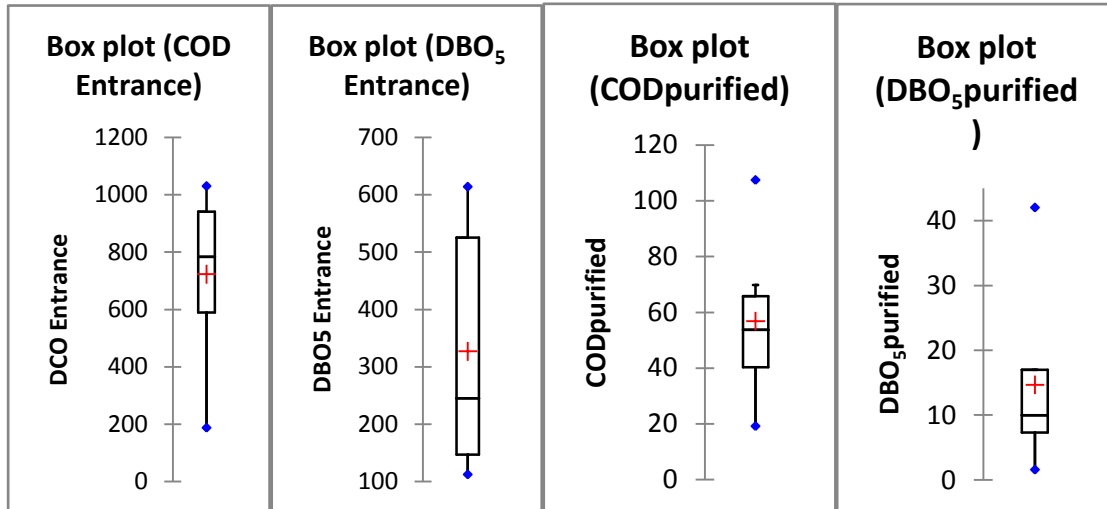

FIG.3: PRESENTATION OF THE BOXPLOTS OF COD AND BOD₅ AT THE ENTRY AND EXIT OF STEP

According to the figure 3 above us a difference between rough wastewaters and those purified within the STEP of the town of Skhirat being characterized by of Boxplots which present averages different of COD and BOD respectively at the entrance of the order of 722.67 and 326.75 mg of O_2/L. At the exit those index are of about 56.86 and 14.67 mg of O_2/L. These boxplots presents 1st, 3rd quartiles, Minimas, Maximas, Medians and Averages which are very different depending on wastewaters states brut or purified according to these graphs.

So they got results are in conformity with the standards of rejection in terms of COD limited to less than 250 mgO_2/L and BOD with 120 mg of O_2/L what makes it possible to re-use these purified wastewaters at several agricultural purposes such as forestry, irrigation of urban green spaces, lawn watering golf courses…etc.

With regard to the mean value of the COD is regarded as higher than that recorded at the sewage treatment plant of the center emplissor of the company Salam Gaz at the town of Skhirat (698 mg of O_2/l) on the other hand the mean value of the BOD is noted lower than this STEP of the company as [11].
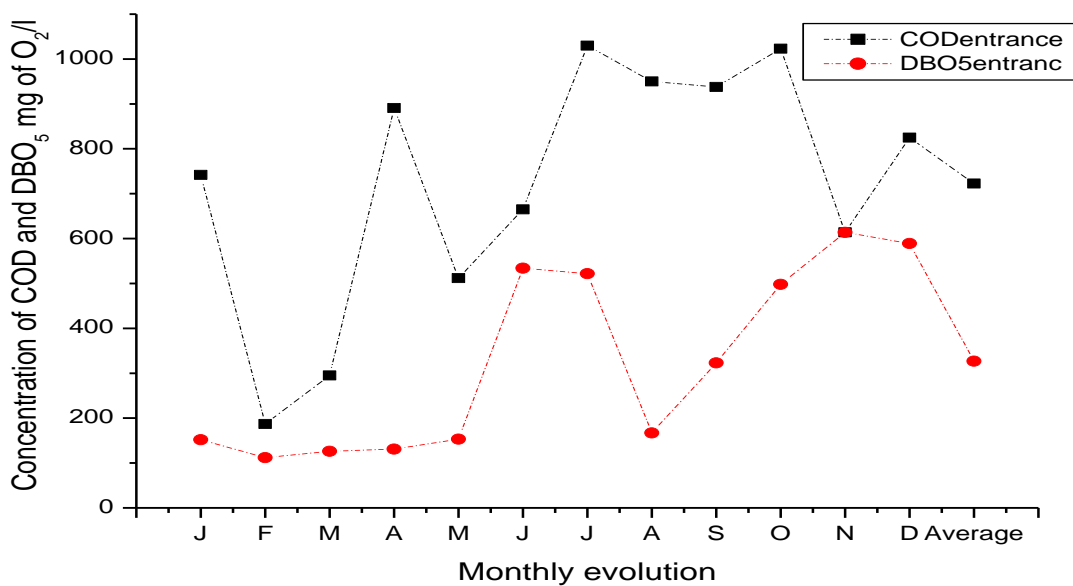

FIG.4: MONTHLY EVOLUTION OF THE CONCENTRATIONS OF COD AND BOD AT STEP entrance

The monthly mean value of the chemical demand for oxygen (COD) is about 722.67 mg of O_2/L what is lower than that recorded with the STEP of the town of Nouakchott (1806.76 mg of O_2/L) in the same way for [12-13]. Moreover, the biological oxygen demand (BOD_5) has a monthly mean value of about 326.75 mg of O_2/L which is also lower than that of the STEP of the town of Naoukchott (538.31 mg of O_2/L) at its entry [14] and those in [12-13].
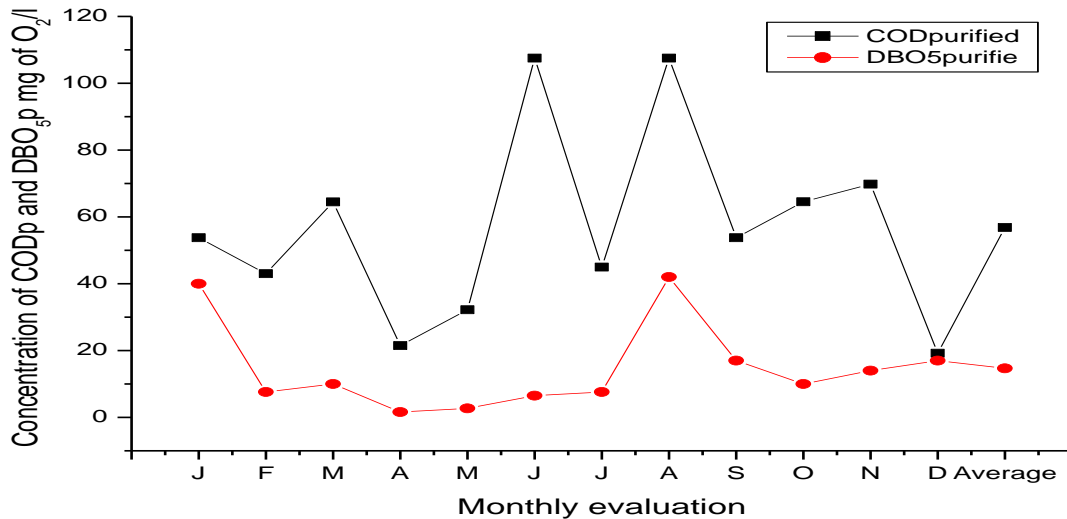
FIG.5: MONTHLY EVOLUTION OF THE CONCENTRATIONS OF COD AND BOD OF PURIFIED WASTEWATERS
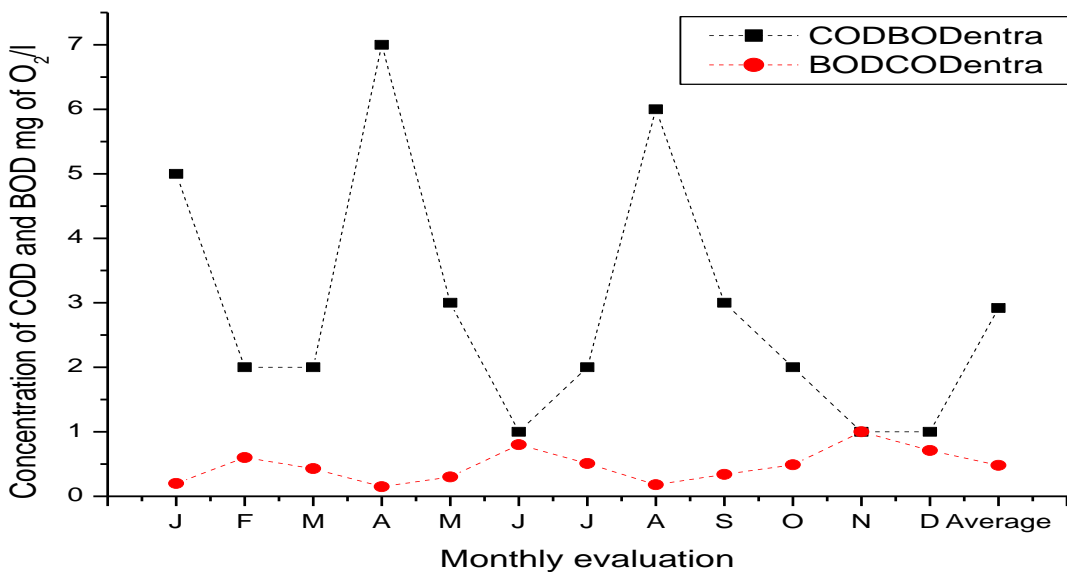
FIG.6: MONTHLY EVOLUTION OF RATIO OF COD/BOD AND BOD/COD OF ROUGH WASTEWATERS

However at rates of BOD/COD higher than 0.30, the biological processes are more effective than the physico-chemical processes [15]. In the case of the STEP of Skhirat, this ratio is about 0.48 and it is superior to the precedent report while implying to follow the advantage of a biological process of treatment.

➢ DCO/DBO_5 < 2: the effluent is easily biodegradable. = Effluents of food industry
➢ 2 < DCO/DBO_5 < 3: the effluent is biodegradable with selected stocks. = Domestic Effluents dominant.
➢ DCO/DBO_5 > 3: the effluent is not biodegradable. = Effluents industrials

V. CONCLUSION

According to the hall above results, we can deduct a ratio from COD/BOD of monthly mean value of about 2.92 which is greater than 2 but less than 3 what mean that these effluents are of domestic predominance with easily biodegradable organic matters.

This result is confirmed by the report of BOD/COD which is about 0.48. So these ratios help us to make a good decision to carry out a biological treatment what is in conformity with the actual sewage treatment plant of biological lagoon type at the of the town of Skhirat.

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