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Performance of a wastewater treatment plant in south-eastern Algeria

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Abstract – *The experimental study was carried out on an urban wastewater purification station located in the region of El Oued -Kounine- in south-eastern Algeria. During 6 months, samples were taken every month to study the Physico-chemical parameters of this station. Monthly monitoring of SS, COD, BOD5 was made from September 2017 to February 2018 and the results obtained show that the average elimination rates were 77.76, 74.10 and 80% respectively for BOD5, DCO and SS. The average of the ratio COD/BOD5 during the 6 months of follow-up is equal to 2.9.*

Keywords: *SS, COD, BOD5, purification station, pollution, Physico-chemical parameters.*

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I. Introduction

Wastewater discharges are increasing due to industrialization and the rise in the standard of living of the population, the self-purification capacities are considered to be exceeded, which prompts researchers to develop several techniques to purify these effluents. Solar energy is free and environmental energy that can be used for water treatment such as solar distillation but unfortunately, this technique suffers from its low efficiency [1-4]. Researchers in the field of water treatment preferred neat large-quantity wastewater. The installation of purification systems downstream of sewerage networks is one of the solutions, if not the only one capable of preserving water resources. In addition to the decontamination of effluents, these installations allow the mobilization of a large volume of water suitable for reuse in several areas. Wastewater is all water from domestic, agricultural and industrial activities loaded with toxic substances that enters sewage pipes. They also include rainwater and its pollutant loads; they generate all kinds of pollution and nuisance in the receiving environment [5]. Biodegradable organics, hazardous, toxic, pollutant, bacteria, and hundreds of chemical compounds that float and settle in wastewater.

Considering the reactions between water, oxygen, bacteria, temperatures and many other factors, grandiose environmental problems have arisen in many regions of the globe such as the depletion of the quality of water in rivers, the appearance of diseases. waterborne and biodiversity extinction [6-8]. Municipal wastewater treatment plants (WWTPs) are public interest processes focused not on economic gains, but on the environment. the operation of a wastewater treatment plant leads to environmental impacts such as direct greenhouse gas (GHG) emissions from biological processes [9, 10]. Various physical, chemical and biological solutions and even by solar energy are under development [11, 12].
The objective of our work is to follow up for 6 months of a treatment plant in our region to find out whether the treated wastewater is by international standards and to determine the physicochemical and biological purifying power of the waters of the city of El-Oued by the Kouinine purification station.

II. Method and Experience

II.1. Theoretical Geographic position

With a diameter area of 54573 square kilometers, the region of El Oued is located in south-eastern Algeria. The geographical coordinates of El Oued are as follows: latitude 33.3683 ° and longitude 6.8674 ° with a mean altitude of 60 m as shown in Figure 1 [13].

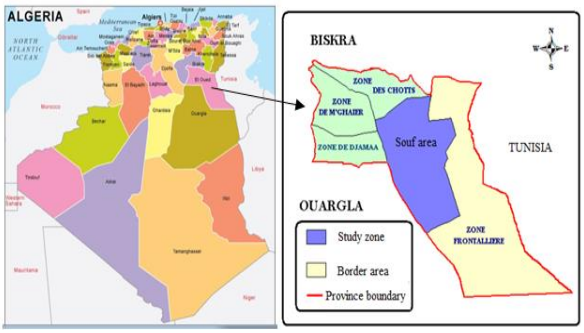

Figure 1. Location of El Oued area

II.2. The operating principle of purification Station

In general, the wastewater treatment plant is made up of six aerated lagoons divided into two treatment stages and three finishing lagoons (3rd stage), a pretreatment structure (screening, sand trap), 14 drying beds for sewage sludge and operating building, as well as the assembly of hydromechanical and electrical equipment. Figure 2 shows the stage principles of a wastewater treatment plant.

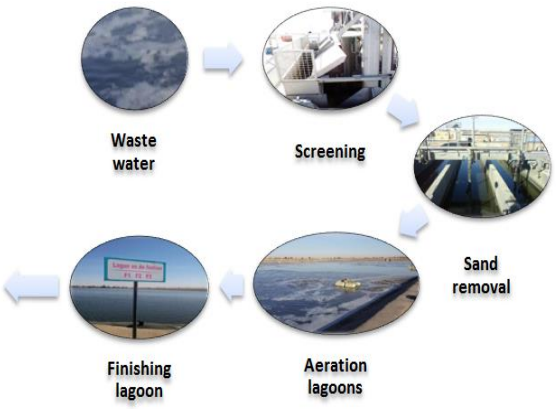

Figure 2. Operating principle of purification Station

III. Results and Discussion

III.1. Performance of a station

In this paper, we will study the operation of the Kouinine South-East Algeria treatment plant, on the one hand, and on the other hand, to examine the purification power and to follow the elimination efficiency of various pollution parameters. (organic load, dissolved oxygen, conductivity, etc.) at the exit of the station. In order to properly control the quality of the purified water (WWTP outlet), we will group all the results of the physicochemical parameters analyzed in tables or the form of curves and histograms to better examine the efficiency of the purification process. Within the framework of this study, the parameters retained are as follows: SS, COD, BOD5. The period taken for the analysis is from September 2017 to February 2018.

III.1.1. Suspended solids (SS)

The suspended solids (SS) are, for the most part, biodegradable by nature. The values reported in Figure 3 show a substantial reduction in suspended solids between raw and treated water. They are distinguished by an average concentration of 194.65 mg/l for raw influents and 31.03 mg/l for treated effluents and lower than the specific limit value for direct discharge to the Algerian receiving setting (40 mg/l). The monthly evolution of the suspended solid content (SS) of the gross influent at Kouinine station shows that the highest load was registered during the time (Sept- Feb); this high content may be the product of the intake of water loaded with mineral matter, i.e. sand, silt, etc. since these withdrawals coincided with sandstorms. The content and the mineral and organic composition of the materials in suspension in the raw wastewater are very variable depending on the watercourse (sand, sludge, organic particles, plankton, etc.); they depend on the nature of the land crossed, the season, the rainfall, the works, the discharges, etc.

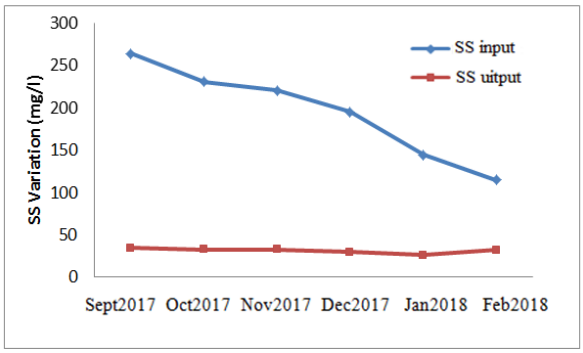

Figure 3. SS Evolution

III.1.2. Chemical Oxygen Demand (COD)

Figure 4 shows that the monthly average COD concentrations of raw water of the order of 403.11 mg/l and for treated effluent, the observed COD values are much lower than that of raw water on average of 102.83 mg/l, these values showed a high reduction of aerated basins in relation to carbon pollution. Besides, the comparison of the COD content at Kouinine station complies with the Algerian standard for direct discharges to the receiving environment (120 mg/l). In wastewater from the station, the COD is evolving in the same direction as the mineralization gradient (upstream-downstream). However, the effect of certain mineral elements, in particular, chlorides on the determination of this parameter results in an overestimation of the COD, the measurement of which remains negligible at the level of discharge. In addition, COD develops in the opposite direction with dissolved oxygen, indicating the likely use of oxygen for the degradation of carbonaceous material. Kouinine station guarantees a satisfactory removal of COD and achieves maximum productivity of 75.10 %.

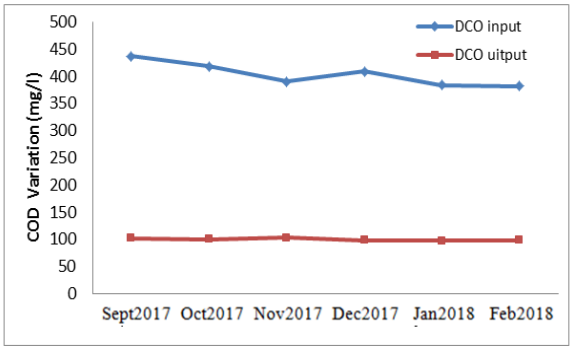

Figure 4. COD Evolution

III.1.3. Biological Oxygen Demand (BOD5)

Monthly variations in BOD5 content, during our monitoring, between upstream and downstream of treatment, are shown in Figure 5. The average value of the pollutant load collected at the station is 303.55 mg/l. The concentration of BOD5 in raw water can be explained by the existence of wastewater from urban agglomerations. However, we note that the maximum biodegradable organic pollution is eliminated by the station, the treated effluents are exhausted, with an average content of 33,55 mg/l. This output value tells us about the correct reduction of aerated basins with regard to carbon pollution. On the other hand, this reported BOD5 value at the outlet matches the basic limit value for direct discharge to the Algerian receiving environment (35 mg/l).

Figure 5 shows also an increase in BOD5 in the waters of the station, especially during the (Des-Feb) time. The station receives raw water, rich in biodegradable organic matter and nutrients from the urban agglomerations of El-Oued, Bayadah, Rabbah and Kouinine. This triggers a large increase in the organic load of surface water in a small area.

The increase in BOD5 contents during the winter period can be explained by the effect of the large quantity of oils arriving at the purification station which forms a thick layer on the surface at low temperature, this layer is an obstacle to oxygen penetration during aeration, knowing that it is not equipped with an oil separator. This rise is correlated with the highest growth of bacterial abundance, and the decline in dissolved oxygen levels follows the absorption of the latter by micro-organisms.

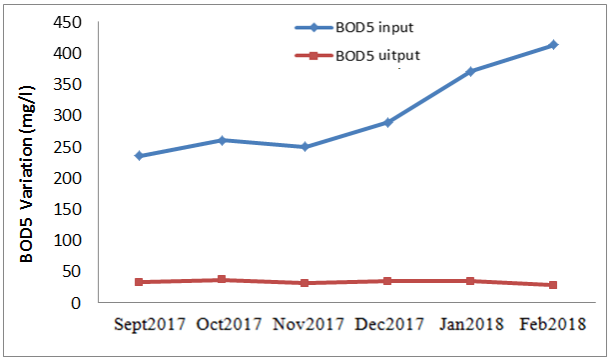

Figure 5. BOD5 Evolution

It is well known that the COD / BOD5 ratio makes it possible to deduce whether the wastewater discharged directly into the receiving environment has the characteristics of domestic wastewater (COD / BOD5 ratio less than 3), and the results of this work constitute an indication of the importance of pollutants that are little or not biodegradable. The average of this ratio DCO/DBO5 during the 6 months of follow-up is equal to 2.9. range if it is lowered or increased, namely 70, 80, 90, 100, 110, 120, and 130%. Based on Figure 5, the 130% selling price variant shows the fastest payback period or PBP while the 70% selling price shows the longest PBP. The payback period (PBP) is faster if the selling price increases, and longer if the selling price is lowered. The profit obtained with the same production time, which is 14 years, shows that the higher the selling price, the greater the profit, and if the selling price decreases, the profits will be smaller.

III.2. SS, DCO and BOD efficiencies

The analysis of the physicochemical parameters of the raw and purified wastewater from the Kouinine treatment plant gives us an idea of the purification yields, with rates of 77.76, 74.10 and 80% respectively for BOD5, COD and SS. These three yields show a fairly good elimination of organic pollution and they interpret the correct operation of the station. Interpret the correct operation of the station. Figures 6, 7 and 8 show and prove these results. Note that the efficiency of the purification of the organic load varies from one station to another depending on factors such as time, season, type of waste (urban and/or industrial).

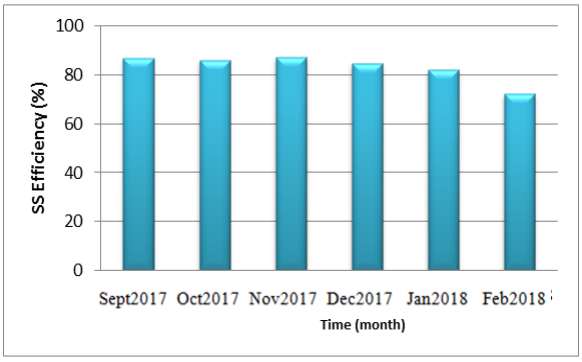

Figure 6. Evolution of SS in treated water over time

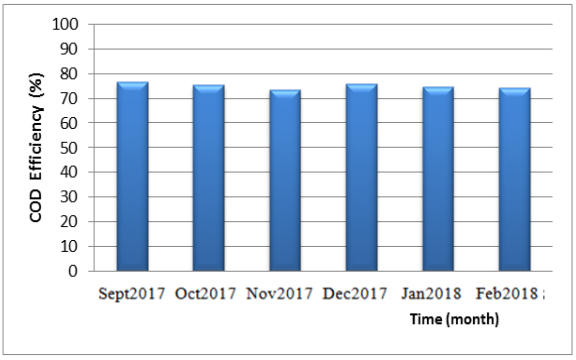

Figure 7. Evolution of DCO in treated water over time

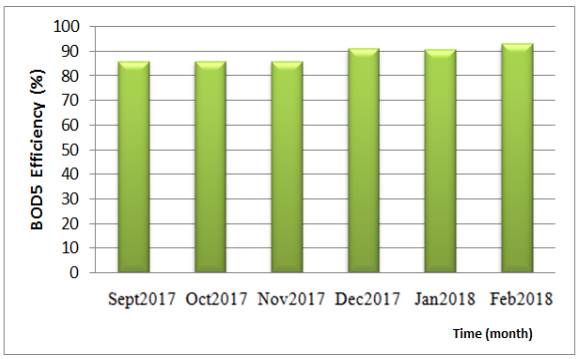

Figure 8. Evolution of DBO5 in treated water over time

IV. Conclusion

Monitoring the physicochemical parameters of raw and purified wastewater from the Kouinine treatment plant allowed us to deduce that:

- The purification yields reach values of 77.76, 74.10 and 80% respectively for BOD5, COD and SS;
- The average of this ratio COD/BOD5 during the 6 months of follow-up is equal to 2.9.

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