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Hydraulic, Energetic and Agricultural Profitability of the WWTP of Sidi Ali Lebhar-BEJAIA, Algeria

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ABSTRACT/RESUME

Abstract: *Wastewater treatment plants are the main cure to prevent environment from water pollution. Both water that originates from residences, industries and rainfall must be treated according to its composition before returning to nature or being reused in other fields such as agriculture which can really help preserving conventional resources for the next generations and avoiding hydric stress as much as we can. That is why water purification process must be both environmentally and economically beneficial. The main goal of our work part is to characterize the quality of purified water of the WWTP of Sidi Ali Lebhar in BEJAIA (Algerian coast) and then assess its performance and its energetic output. In order to accomplish this, a whole diagnosis based on laboratory analyses and other water and energy data must be elaborated. In the end, the possibility of the agricultural reuse of purified water and sludge is going to be assessed and some enhancements are going to be proposed.*

I. Introduction [1]

Water Resources Management is one of the main axes of preoccupation of Algeria to follow the path of Sustainable Prosperity. There are Many Acting institutions specialized in sanitation and treatment plants management that contribute to water resources depollution.

Besides, Algeria is paying more and more attention to the profitability of purified water and its reuse possibilities. In this project, we spotted the WWTP located in BEJAIA to make a complete diagnosis leading to detect process issues and coming up with enhancements recommendations.

After the characterization of the purified water and other by-products and the assessment of treatment performance, we are going to discuss the possibility of reuse in agriculture in order to take advantage of this plant both economically and environmentally.

II. Materials and methods

II.1. Work site

Our WWTP is located in BEJAIA. Since 2013, the plant receives and purifies wastewater by Activated sludge process and prolonged aeration in order to remove both the carbonaceous and Nitrogenous pollution. The region of is sanitized through a WWTP designed for 25000 inhabitants, with a nominal flow of 3000 cum/day.

II.2. Study Approach

First, the evolution of the laboratory results of wastewater and by-products parameters as well as the water and energy data in 2015 (functional period) have been statistically summarized and illustrated into the following graphics.

After this step, a calculus of performance ratios has been elaborated and illustrated into graphics.

The interpretation of the gathered data allows us to make a meticulous diagnosis of:

- The treatment performance and conventional tolerability assessment for release in nature.

- The usability of both the treated water and the by-products in agriculture,
- The energetic output of the plant.

III. Results and discussion

Here are some selected graphics showing the evolution of the main parameters and ratios from January to December 2015 (the functional period of the plant before the study period) and the main observations:

III.1. Hydraulic parameters [2], [3]

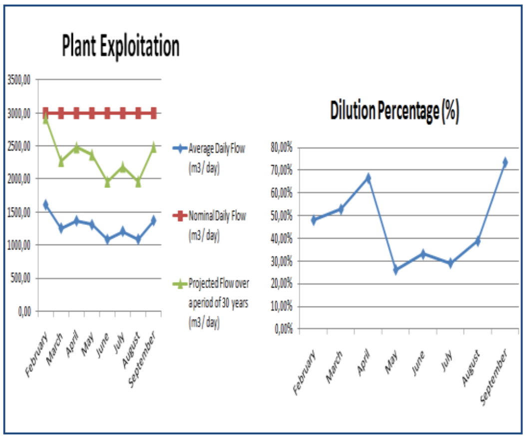

Figure 1. *Hydraulic Parameters Evolution in 2015*

The average Value for hydraulic load is 1286.90 m3/day, which represents only 42.90% of the rated capacity of the plant and this, indicates a low connection rate. Even with a projection over a period of 30 years, we will only be achieving 78 % of its rated capacity.

The average dilution percentage of the sewer system that leads to the plant is 46.10 %, which originates from 400.90 m3/day of clean water infiltration in average despite the separate type of the sewer system. This clearly shows its vulnerability and overuse.

III.2. Physico-chemical parameters [2], [3], [4]

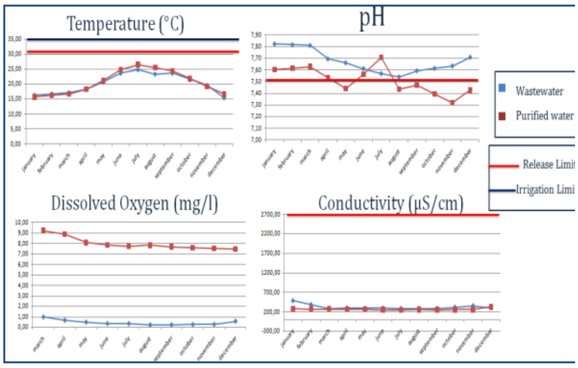

Figure 2. *Physicochemical Parameters Evolution in 2015*

The Physicochemical parameters remain relatively acceptable according to the regulations for irrigation and release:

The temperature and the conductivity are inferior to the Limits imposed by the WHO , the low values of conductivity indicate the low salinity of water

The pH is slightly superior to the ideal interval suggested by the WHO which is [6.5; 7.5] but the values remain all inferior to 8, which causes the presence of Ammonia NH3, a very toxic form of Nitrogen for the aquatic life.

The Dissolved Oxygen values of purified water are in the ideal interval for the aquatic life, which is [7; 11].

III.3. Organic and Suspended Pollutants [2], [3]

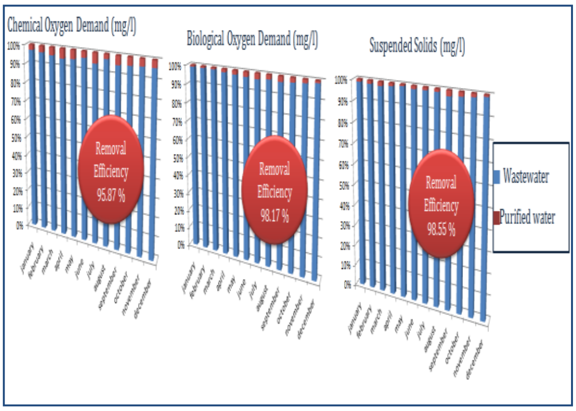

Figure 3. *Organic and Suspended Pollutants Evolution in 2015*

As we can observe in the three graphics, there is excellent removal efficiency for the three parameters and all the values are very far from the maximal limits imposed by the WHO.

III.4. Nitrogen and phosphorous pollutants [2], [3], [4], [5], [6]

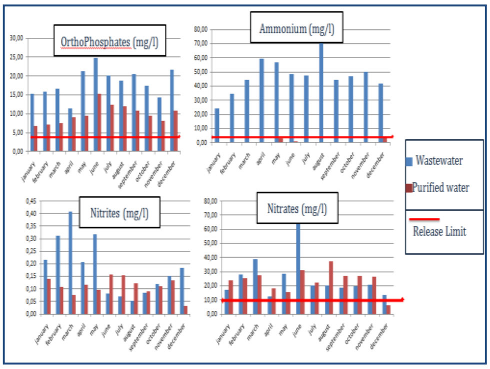

Figure 4. *Nitrogen and Phosphorus Pollutants Evolution in 2015*

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- The Ammonium values for purified water are all inferior to the limit imposed by the WHO, which is 5mg/l with great removal efficiency (98.33%), as well as Nitrites, which are inferior to 10 mg/l imposed by the WHO with low removal efficiency (40%). The average value of released nitrates is however superior to the maximal limit of release imposed by the WHO (10 mg/l).
- The average Orthophosphates value is also superior to the limit fixed by the WHO, which is 3 mg/l, and the low removal efficiency is explained by the absence of an anoxic zone for phosphorus elimination.

III.5. Water and Sludge Ratios [2], [3], [4],[5],[6]

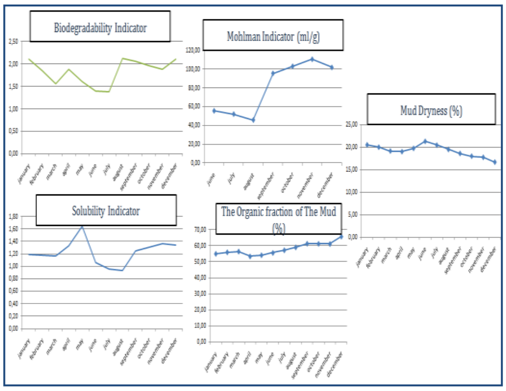

Figure 5.*Water and Sludge Ratios Evolution in 2015*

The effluent presents a great biodegradability explained by the ratio values that are all inferior to 3.

The solubility ratio (SS [1]/BOD [2]) explains that the pollution is slightly more suspended than dissolved.

The average Mohlman Indicator is inferior to 100 ml/g, which is the ideal interval for a good sedimentation.

The Organic fraction of sludge is mostly inferior to 65% which means the sludge is well mineralized

The stabilization of the sludge is acceptable However, to avoid temporary Nitrogen congestion, it is recommended to transport the sludge during agricultural growth.

III.6. Energy parameters and Ratios [2], [3]

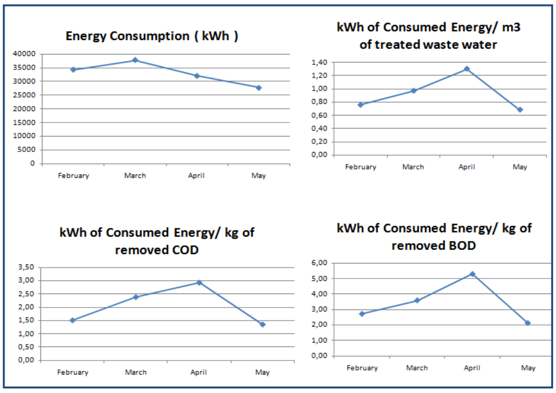

Figure 6. *Energy Parameters and Ratios Evolution in 2015*

The ratio of the consumed energy needed to remove a kilogram of COD[3] is supposed to be between 0.9 and 1.2 kWh/kg and we have an average value of 2.04 kWh/kg ; so, there is obviously an over-ventilation issue

The average value of the consumed energy needed to remove a kilogram of BOD [2] is 3.43 kWh/kg and it is supposed to be close to 2.5 kWh/kg, which still points out the problem of over ventilation.

The high Values in April are caused by the fixation of many mechanical dysfunctions during that period.

IV. Conclusion [1], [4], [5], [6]

The main goal of this diagnosis is to recover an environmental organ and contribute to Water resources valorization by reducing natural waste and recycling other available resources instead of the unreasonable abuse of the directly serviceable water. Based on all the deductions above, the plant can be economically, environmentally and agriculturally rewarding but still needs many enhancements to function as a Healthy organ of the environment such as:

- **Inspection of the sewer system**: in order to find out the origin of the clean water infiltration.

- **Laboratory Enhancements:** There are still many important parameters measurements that need to be provided, such as:
  - Mineral Salts that need to be measured and compared to regulations to calculate the SAR (Sodium Adsorption Ratio)
  - Regularity of Heavy metals quantification
  - An evaluation of water alkalinity using Carbonates and Bicarbonates measurements

- A wider biological quantification of pathogen microorganisms

➢ **Measuring the dissolved Oxygen amount in the aeration tank** in addition to the calculus of the exact needs in order to optimize the ventilation and the energy consumption.

➢ **Providing an anoxic treatment:** to optimize denitrification process and Phosphorus elimination.

➢ **Rehabilitation of the Chlorination Compartment**: to complete the denitrification and inhibit the activity of Filamentous bacteria.

➢ **Providing a better way to enhance the dryness of the sludge:** In order to improve the dryness rate of the sludge before reusing it in agriculture and consequently reduce the Nitrogen Congestion phenomenon, we need a better way to dry the sludge by sludge drying beds for example.

V. References

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Abreviations:

[1] Suspended Solids
[2] Biochemical Oxygen Demand
[3] Chemical Oxygen Demand

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