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# Comparative Study on Water Treatment Technologies: Photocatalysis and Nanofiltration with Pollution Assessment using Principal Component Analysis

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## ABSTRACT

Lake Réghaïa is a site of international ecological importance, but it is threatened by the discharge of organic and inorganic waste from the Rouïba-Reghaïa industrial zone via the two Oued El-Biar and Oued Réghaïa wadis. The first part of the study is focused on monitoring pollution parameters by means of a statistical study using the principal component analysis (PCA) method. The aim is to characterize water chemistry for an observation period, and to give a preliminary idea of the elements and sites of pollution at the various points of the lake. In the second part, two treatment processes were studied: photocatalysis and nanofiltration. The application of PCA to our results, using IBM SPSS Statistics 26 software, was carried out on a matrix of dimensions (13x7) where the rows represent the physical-chemical pollution parameters and the columns are the sampling points. The study shows that treatment by photocatalysis is the most effective way of continuing the treatment of lake water, since it allows mineralization of our organic pollution, followed by measurement of the chemical oxygen demand (COD), with faster degradation kinetics of pollutants in the presence of electron acceptors (H<sub>2</sub>O<sub>2</sub>, S<sub>2</sub>O<sub>8</sub><sup>2-</sup> and O<sub>2</sub>). Whereas results for membrane filtration show better COD removal at a pH of equal to 10 and 5.

**Keywords:** Lac de Reghaïa, Wastewater, Principal Component Analysis (PCA), photocatalysis, Nanofiltration

## 1 Introduction

The development of effective methods for the treatment and supply of water and sanitation services has been the subject of a considerable amount of study and research. Conventional water treatment techniques have proved inadequate, and are limited in their ability to completely eliminate organic molecules that are difficult to biodegrade. Many of the dyes present in industrial effluents are made up of polycycles substituted by chlorinated, sulfonated and nitrated groups, and are therefore recalcitrant to conventional treatment methods. Lake of Réghaïa is a coastal wetland, the last remnant of the ancient Mitidja marshland, classified by the international RAMSAR convention in 2003 and considered a rare example, as it remains the only wetland in the region. The lake covers a water surface area of between 75 and 150 ha, with the oued de Réghaïa estuary flowing into the Mediterranean Sea. The photocatalysis process uses a solid nanoparticule as catalyst to be activated under UV or Visible radiation to form OH<sup>-</sup> hydroxyl radicals capable of partially or fully mineralizing organic compounds. The membrane processes are proving to be viable methods that can remove a wide range of pollutants from water. The Nanofiltration is a variant of reverse osmosis, which can operate at low pressures and it have a pore diameter of around one nanometre and a cut-off of 600 Daltons. They are characterized by excellent retention of multivalent ions and organic micropollutants. In this context, this work is based firstly on the use of two heterojunctions, Fe<sub>x</sub>O<sub>y</sub>-TiO<sub>2</sub> and ZnO-CuO to treat surface water by photocatalysis after an pollution assesement of lake of Reghaïa with a study of material characterization and comparaisn between water treatment process.

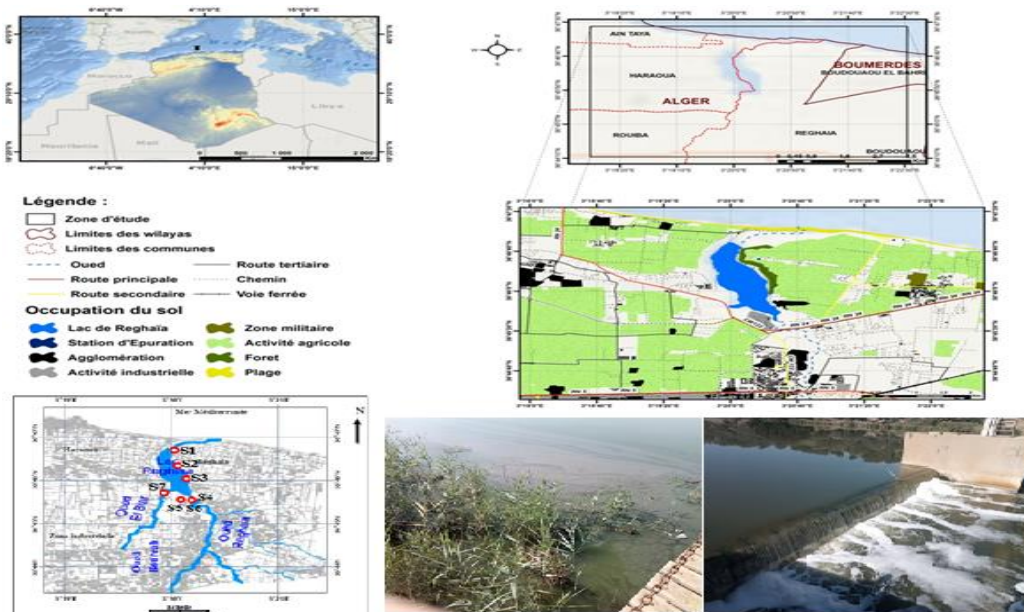


## 2 Material and method

### 2.1 Choice of sampling sites

In order to characterize the pollution inputs from the various discharges, and to estimate the contribution of the inputs from each tributary into Lake Reghaïa, water samples were taken at various points to show the impact of these discharges on the quality of the watercourses (**Figure 1**). Water samples are taken monthly, from October 2020 to January 2021, in polyethylene bottles. Samples are transported under isothermal conditions at 4°C.

- sampling points (S1, S2, S3, S4, S7) was carried out using a rod at a depth of 30cm
- sampling points (S5 and S6) inside the Réghaïa WWTP.



**Figure 1:** Location of sampling stations in the study area

## 3 Conclusion

To conclude our study, the results obtained allow us to conclude that treatment by photocatalysis could be an interesting alternative for treating the waters of Lake Reghaïa, by choosing the right semiconductor and optimizing the parameters. However, the study of the degradation products of most organic compounds requires a detailed study of the degradation mechanism. The use of a visible light source can be important and sustainable by using a solar energy source (photovoltaic system). However, photocatalysis must be coupled with nanofiltration to solve the problem of increased turbidity, as it involves a separation step for suspended solids present in solution.

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