# NEW TECHNOLOGIES FOR MUNICIPAL WASTEWATER TREATMENT

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**Abstract**

New technologies to treat and recycle water from municipal waste water treatment plants are of utmost urgency. This study is taking place on the Mondego River, lower basin and estuary, from Coimbra to Figueira da Foz and contribute for the environmental sustainability of this region.
In this work we developed a new treatment system using submerged membrane bioreactors for improved treatment and removal of pollution eliminating particles, bacterial and virus from the treated effluents. Use of microalgae photoreactors as an alternative tertiary treatment of urban wastewaters was also evaluated. Monitoring and long distance supervision are also possible with this system. The biotreatment process was monitored with an online sensor based on ultra violet spectra technology for continuous analysis of COD, $NO_3$ and TSS. This system eliminates the constant need for samples recollection to further analysis.
Supervision is ensured by last generation SCADA software (MOVICON), analyzing in real time all the occurrences and registering all the values in a data base. A new system of at distance supervision and control for urban wastewater treatment plants (WWTP's) was also tested and could allow for better technical performance and economy. Physico-chemical characterization of local WWTP's and Mondego River were performed, in order to test a kinetic model representative of the impact of WWTP's in the environment.

## Introduction

Water recycling is nowadays an important objective of residual water treatment. For this objective not only efficient secondary treatments are needed to remove most of the organic load but also sanitary and inorganic ions control are needed. Recycling of residual waters could in this way help fighting the quick depletion and contamination of underground water sources that is happening even in countries like Portugal, where lack of water is not yet a great problem, but can take place in densely populated zones or in the more arid zones of the south. This work will test and demonstrate the application of emerging technologies from the areas of Biotechnology to the Waste Water Treatment in order to evaluate its impact for Water recycling. The Zone of the Lower Mondego River Basin, in the CENTRO region of Portugal is a very sensitive zone from the environmental point with some natural reserves included on the Natura 2000 Network and also with an estuary of high environmental, social, economical and tourist importance. From Coimbra to Figueira da Foz the Mondego river it is the receptor of treated and untreated waters of a dense population zone and an important number of

Agricultural and Industrial activities carrying its pollution into the Municipal WWTP´s or at times directly to the river. Problems are normally worst during summer time when the river flow is small and tourist season is at its highest! Also Human, Agricultural and Industrial activities cause a number of pollution problems of the so called diffusion pollution consisting on inorganic pollution such as nitrates and heavy metals which can not be solved without appropriate tertiary treatments. The use of the membrane bioreactors (MBR) in the actual plants together with the demonstration of the use of microalgae photoreactors would alleviate or solve this problem.

## Methods

MBR and phtoreactor prototypes are installed at Urbana WWTP in Figueira da Foz and are running in real conditions, MBR is being fed from primary effluent and photoreactor from secondary effluent (after sedimentation tank) diverted from the main treatment system of Urbana WWTP. Photoreactor is inoculated with *Chlorella vulgaris*. For the real time data acquisition of UV-VIS spectra, a submersible spectrophotometer was installed and acquiring on-line data in MBR. All the data is saved and interpreted in an industrial controller that runs special software over a Windows NT operating system.
For photoreactor, analyses of chemical oxygen demand (COD) and total suspended solids (TSS), were carried out following the Standard Methods for the Examination of Water and Wastewater (1998). Phosphorous determination was performed using Phosver 3 (Ascorbic Acid) Method (HACH). Nitrate content was determined using the photometric, DMP method.

## Results and discussion

Physico-chemical characterization of local wastewater treatment plants (WWTP's) and Mondego River were performed, in order to test a kinetic model representative of the impact of WWTP's in the environment.
A monitorization system based on continuous ultra violet spectrum is developed and calibration studies are running for COD, $NO_3$ and TSS. This probe system can give results as quickly as 15 seconds and automatically generate a correlation for these parameters.

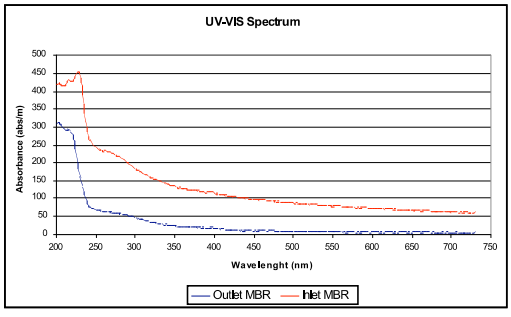

Fig. 1 – UV-VIS spectrum of the inlet when compared to the spectrum of the outlet

A last generation SCADA software (MOVICON) were developed, analyzing in real time all the occurrences and registering all the values in a data base. Considering that the supervision software MOVICON is prepared to integrate the OPC Technology (open connectivity) working as a web client it is possible to configure the control computer as a web server (workstation) and define several customers, that are bottom line the internet users to whom it was given a keyword on the process server. This characteristic allows supervising the process online.

A pilot membrane bioreactor (MBR) was also developed for biotreatment of wastewater and for removal of particles, bacteria and virus.

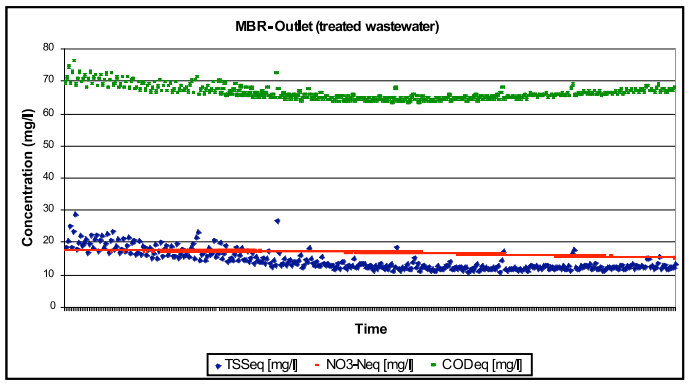


Figure 2. On line monitorization parameters (COD, $NO_3$ and TSS) in pilot membrane bioreactor (MBR)

Recycling water by doing a tertiary treatment using microalgae photoreactors (figure 3), it is possible to remove about 80% of nitrogen and phosphorus. for use in agriculture and other compatible applications.

Figure 3. Microalgae photoreactor

## Conclusions

Physico-chemical characterization of local wastewater treatment plants (WWTP's) and Mondego River were analysed in order to test a kinetic model representative of the impact of WWTP's in the environment.

A probe system based on continuous ultra violet spectrum is developed to monitor on line and continuously, COD, $NO_3$ and TSS. This system eliminates the constant need for samples collection to further analysis, substituting a process that can take several days for a reliable process.

Supervision is achieved by a last generation SCADA software (MOVICON), this software gathers the parameters (COD, $NO_3$, TSS) that are collected by the probe, analyse and register in real time all the occurrences in a data base. Monitoring and long distance supervision are also possible with this system.

With MBR, the water quality presented a high quality that remained constant with time and is in conformity with European regulation in conventional areas in regards with organic pollutant and suspended solids (COD< 125 mg/L and SS < 35 mg/L) whatever the concentration in influent was. On the other hand, microalgae photoreactor has high efficiency on N and P removal. These technologies will improve the efficiency of wastewater treatment plant and allow recycling the treated water. Its impact on decreasing the environmental pollution will contribute for the protection of the biotic of such a sensible and important environmental protected area, as the Lower Mondego Basin and estuary.

## References

Standard Methods for the Examination of Water and Wastewater (1998), 20th ed., American Public Health Association/American Water Works Association/Water Environment Federation, Washington DC, USA

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