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# ASSESMENT OF A LAB SCALE PHOTOCATALYTIC MEMBRANE REACTOR PERFORMANCE ON REMOVAL OF ORGANIC COMPOUNDS FROM REAL MUNICIPAL WASTEWATER

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## *Introduction*

Membrane processes can be used as tertiary treatment in order to generate high quality treated water further used for various purposes. Main drawbacks of membrane processes hindering large-scale adoption are membrane fouling and relatively high costs for replacement. Coupling heterogeneous photocatalysis with membrane processes (photocatalytic membrane reactor – PMR) proved to be a solution to the issue related to membrane fouling and there are some available studies supporting its performance as tertiary step for municipal wastewater treatment. The results of these studies are emphasizing the idea that PMR configuration with suspended catalysts seems to be the most promising alternative for future large-scale application. In the present study, performance of a lab scale suspended catalyst PMR for the removal of organic compounds from real municipal wastewater treatment plant (WWTP) inflow was investigated.

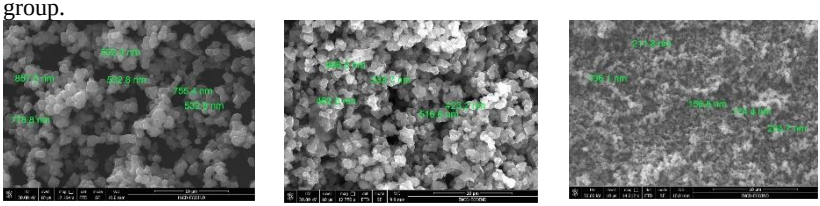
## *Materials and methods*

The catalysts (un-doped $TiO_2$ and 1%wt.Fe-$TiO_2$) were prepared starting from titanium isopropoxide and $Fe(NO_3)_3 \cdot 9H_2O$ as precursors, via well-known sol-gel method. Commercial $TiO_2$ anatase form was used as reference. A polymeric membrane was prepared via phase inversion process starting from a solution of 10% Polysulfone (Psf). A FEI Quanta FEG 250 equipment was used for morphological characterisation. Dimensional analysis for catalysts was performed using a Mastersizer 2000 equipment. Compositional structure of catalysts was investigated by X-Ray fluorescence (XRF) using a Rigaku NEX CG EDXRF equipment. Photocatalytic tests were performed using a Heraeus UV-VIS reactor and a KMS Laboratory Cell – CF 2 module was used for membrane process.

## *Results and conclusions*

Both dimensional analyses and scanning electronic microscopy showed that particle size varied in the following order 1%wt. Fe-$TiO_2$ > $TiO_2$ > Commercial $TiO_2$. XRF analyses confirmed the iron presence within 1%wt. Fe-$TiO_2$ catalyst while the

morphological characterisation of membrane showed that belongs to microfiltration group.



1wt% Fe-$TiO_2$ $TiO_2$ Commercial $TiO_2$

**Figure 1.** SEM images of catalysts

The UV-VIS photocatalytic degradation results proved that the most efficient catalyst was 1%wt. Fe-$TiO_2$ and that degradation of global organic loading expressed as Chemical Oxygen Demand (COD) follows a pseudo-first order kinetic.

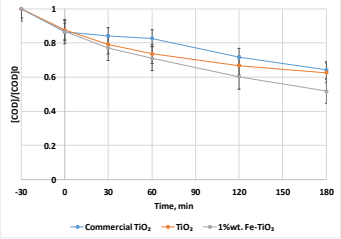



**Figure 2.** Normalised degradation curves

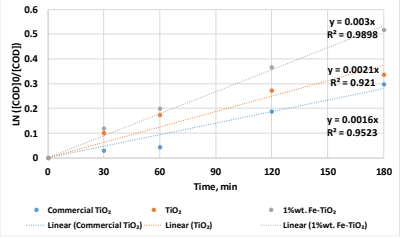



**Figure 3.** Pseudo-first order kinetics for photocatalytic step

Membrane separation experiments showed that Psf membrane acts also as a barrier to organic compounds, with a maximum COD overall removal efficiency of 66.32% for the wastewater treated with 1% Fe-$TiO_2$ catalyst.

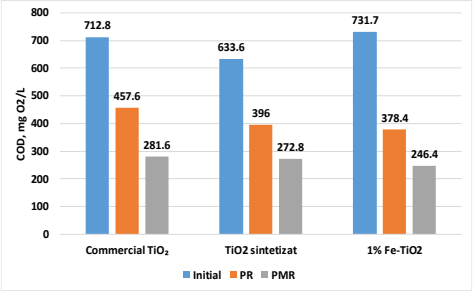



**Figure 4.** Overall COD removal

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