

## Accepted Manuscript

Investigation of fixed-bed photocatalytic membrane reactors based on submerged ceramic membranes

Phan Duy Dũng, Frank Babick, Trịnh Thị Huyền Trang, Minh Tan Nguyen, Wolfgang Samhaber, Michael Stintz

PII: S0009-2509(18)30440-8  
DOI: <https://doi.org/10.1016/j.ces.2018.06.062>  
Reference: CES 14336

To appear in: *Chemical Engineering Science*

Received Date: 12 February 2018  
Revised Date: 12 June 2018  
Accepted Date: 23 June 2018

Please cite this article as: P. Duy Dũng, F. Babick, T. Thị Huyền Trang, M. Tan Nguyen, W. Samhaber, M. Stintz, Investigation of fixed-bed photocatalytic membrane reactors based on submerged ceramic membranes, *Chemical Engineering Science* (2018), doi: <https://doi.org/10.1016/j.ces.2018.06.062>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



# Investigation of fixed-bed photocatalytic membrane reactors based on submerged ceramic membranes

Phan Duy Dũng<sup>a,\*</sup>, Frank Babick<sup>a</sup>, Trĩnh Thĩ Huyĩn Trang<sup>b</sup>, Minh Tan Nguyen<sup>c</sup>, Wolfgang Samhaber<sup>b</sup>, Michael Stintz<sup>a</sup>

<sup>a</sup> *Institute of Process Engineering and Environmental Technology, Technische Universität Dresden, 01062 Dresden, Germany*

<sup>b</sup> *Institute of Process Engineering, Johannes Kepler University Linz, 4040 Linz, Austria*

<sup>c</sup> *Institute for R&D of Natural Products, Hanoi University of Science and Technology, 1 Dai Co Viet Road, Hanoi, Vietnam*

\* Corresponding author:

Email address: duydung.phan@tu-dresden.de

---

## Abstract

Though having been studied for more than four decades, photocatalysis is still hardly applied in large-scale water and wastewater treatment. This is mainly due to the low energy efficiency of conventional photocatalytic reactors. A recently introduced reactor concept, the fixed-bed photocatalytic membrane reactor (FPMR), can potentially overcome this shortcoming. Its performance for the degradation of organic compounds is examined for different modes of operation. For this purpose, FPMRs based on commercial submerged ceramic membranes were used, which are covered by a photocatalytic layer of pyrogenic titania. The FPMRs were performed in two operational modes: closed-loop reactor and continuous-flow reactor. Oxalic acid was used as a model organic compound to conduct photocatalysis. The influence of light intensity and catalyst layer thickness as well as mass transfer inside the layer were thoroughly studied. The evaluation of the reactors was based on the apparent quantum yield, the photocatalytic space-time yield and specific energy consumption. The results demonstrate that the FPMRs are considerably more efficient than other reported reactor concepts. Its apparent quantum yield can reach up to 11.1 %. Furthermore, its specific light energy consumption is merely around 0.1 kWh/g (TOC). The results also reveal that closed-loop FPMRs achieve higher efficiencies than continuous-flow FPMRs. Last but not least, a quantitative model for calculating the reaction rate constant of a photocatalytic membrane from observed reaction rate constant of a photocatalytic membrane reactor was developed and experimentally verified.

*Keywords:* photocatalytic membrane reactor, microreactor, apparent quantum yield, oxalic acid, mass transfer, light energy consumption

---

## 1 Introduction

Recent developments in photocatalysis have refreshed the interest of applying photocatalysis to water and wastewater treatment. For this purpose, photocatalytic membrane reactors (PMRs) are considered as the best technical solution because they combine the advantages of membrane processes and photocatalysis, allow continuous operation at low capital and operational costs, ensure compact apparatuses and simplify up-scaling (Leong et al., 2014; Molinari et al., 2017).

Download English Version:

<https://daneshyari.com/en/article/6588261>

Download Persian Version:

<https://daneshyari.com/article/6588261>

[Daneshyari.com](https://daneshyari.com)