



Simultaneous photodegradation of VOC mixture by TiO₂ powders



Marta Stucchi^a, Federico Galli^{a,*}, Claudia L. Bianchi^b, Carlo Pirola^b, Daria C. Boffito^a, Franco Biasioli^c, Valentino Capucci^d

^a Polytechnique Montreal, Departement de Genie Chimique, 2900 Edouard Montpetit Blvd, H3C 3A4 Montreal (QC), Canada

^b Università di Milano, Dipartimento di Chimica, Via Golgi 19, 20133 Milano, Italy

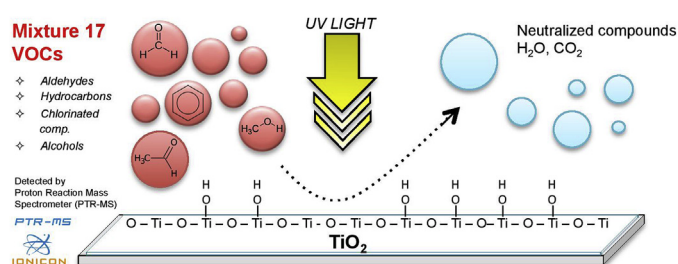
^c Research & Innovation Centre, Fondazione Edmund Mach, Via E. Mach 1, 38010 San Michele a/A, Italy

^d GranitiFiandre SpA, Via Ghiarola Nuova 119, 42014 Castellarano, Italy

HIGHLIGHTS

- UV-activated titanium dioxide degraded a mixture of 17 volatile organic compounds.
- We compared nano- and micro-sized TiO₂ catalysts.
- Proton mass transfer reaction spectrometer followed the pollutants' concentration.
- Micrometric catalyst is as effective as nanometric and can replace it.
- Volatile organic compounds compete for the adsorption on catalyst's active sites.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 22 September 2017

Received in revised form

31 October 2017

Accepted 1 November 2017

Available online 5 November 2017

Handling Editor: R Ebinghaus

Keywords:

Photocatalysis

PTR-MS

VOCs mix

Titanium dioxide

Micrometric

Indoor pollution

ABSTRACT

Volatile and semi volatile organic compounds' concentration have dramatically increased in indoor environments in recent years. UV light promotes titanium dioxide, which oxidises various molecules; however, most of the studies report the degradation of a single VOC. Here, we investigate the photo-oxidation of 17 molecules in mixture to have a realistic test of TiO₂ efficacy. We compare P25, a nanometric catalyst, and 1077, a micrometric sample, that poses less health concerns. A proton-transfer-reaction mass spectrometer measured online the concentration of all the pollutants simultaneously. Aldehydes compete for the adsorption on both the catalyst's active sites and thus they degrade 70% and 55% with P25 and 1077 respectively. Considering the single pollutant oxidation, instead, aldehydes fully oxidize. Even though benzene is recalcitrant to degradation, P25 and 1077 reduced toluene's concentration to 97% and 96% in 55 min, respectively. Acetonitrile is refractory to photocatalysis.

© 2017 Published by Elsevier Ltd.

1. Introduction

European Environmental Agency estimated that Europeans spend 90% of their time indoor (European Environment Agency, 2013). Americans and Canadians spend 87% of time indoors and an additional 6% in a vehicle (Klepeis et al., 2001).

* Corresponding author.

E-mail address: federico.galli@polymtl.ca (F. Galli).