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Simultaneous photodegradation of VOC mixture by TiO_2 powders

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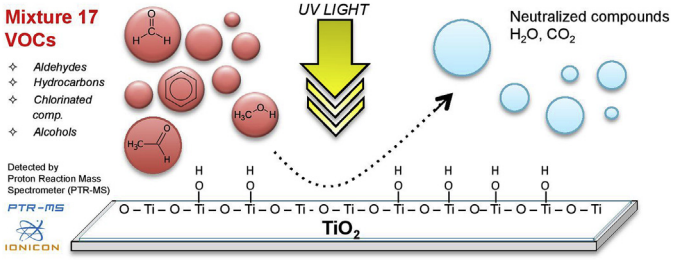
HIGHLIGHTS

- UV-activated titanium dioxide degraded a mixture of 17 volatile organic compounds.
- We compared nano- and micro-sized TiO_2 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



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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 TiO_2 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.

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).

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