

Formaldehyde Removal from Airstreams Using a Biofilter with a Mixture of Compost and Woodchips Medium

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Received: 19 July 2014 / Accepted: 19 November 2014
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Abstract The performance of a laboratory-scale biofilter packed with a mixture of compost and woodchip on formaldehyde removal from polluted air streams was investigated. The reactor was inoculated with aerobic sludge as a source of bacteria, obtained from a municipal wastewater treatment plant. A nutrient solution was daily added to the reactor media. An airflow containing different concentrations of formaldehyde (from 20 ± 2 to 276 ± 5 mg m^{-3}) was introduced into the reactor. In inlet formaldehyde concentration, an average removal efficiency and elimination capacity of 91 % and $0.36 \text{ g m}^{-3} \text{ h}^{-1}$ were attained, respectively, at 180 s empty bed residence time (EBRT). After acclimatization of the system for increased formaldehyde concentrations of up to 276 ± 5 mg m^{-3} and for EBRT of 180 s, those values were stabilized at around 72 % and $3.98 \text{ g m}^{-3} \text{ h}^{-1}$, respectively. The experimental results showed that the system was effective for a high loading rate of formaldehyde with an acceptable EBRT. Compared to the application of compost alone as a media, a mixture of compost and woodchip (50/50 v/v%) enhanced the performance of the biofilter. The most predominant microorganism involved in the biodegradation of formaldehyde was a

species of *citrobacter* called *Citrobacter freundii*, an aerobic gram-negative bacillus. Pressure drop of the reactor over the entire operations was about $1 \text{ mm}_{\text{H}_2\text{O}} \text{ m}^{-1}$.

Keywords Biofiltration · Bioreactor · Formaldehyde · Air pollution

1 Introduction

Atmospheric emission of volatile organic compounds (VOCs) has been increased in the recent decades mainly due to the combustion of organic fuels and various industrial activities (Talapatra and Srivastava 2011; Kansal 2009; Prado et al. 2006; Arulneyam and Swaminathan 2003). Formaldehyde (HCHO) is a component of VOCs that mostly emits from the burning of fuels, papers, and synthetic resins, Neopan production industries and reaction of hydrocarbons with ozone in the atmosphere (Talapatra and Srivastava 2011; Delhoménie and Heitz 2005; Oliveira et al. 2004; Prado et al. 2004). Recently, the International Agency for Research on Cancer (IARC) reclassified formaldehyde from “probably carcinogenic to humans” to “carcinogenic to humans.” Excessive emission of formaldehyde can impose a serious damage to the environment. In addition, exposure to high levels of formaldehyde concentration may cause nausea, vomiting, diarrhea, abdominal pain, optic nerve damage, and even death (Talapatra and Srivastava 2011; Delhoménie and Heitz 2005; Prado et al. 2004; Xu et al. 2010). Permissible exposure limit (PEL) for formaldehyde in outdoor air is 0.5 ppm (Akbar-Khanzadeh and Park 1997).

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