

主 論 文 要 旨

論文題名 **Optimization of Operating Conditions in Biofilters
Treating Gaseous Volatile Organic Compounds**

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Abstract

Technological developments for the treatment of volatile organic compounds (VOCs) are urgently required, to comply with stringent regulations by Air Pollution Control Law amendment in Japan. Biofiltration is being desired as an environmentally-friendly alternative to control VOC emissions. However, this technology hasn't become a practical method for VOC removal at present because several unresolved problems are still concern (e.g., slow VOC removal or clogging problems by excess biomass). This study focused on the systems improvement and their operational optimization, through designing and operating a newly-developed biofilter, switch-feed multi column biofiltration system (SFMC).

The application of the SFMC for gaseous VOCs treatment is presented in this paper, including backgrounds and implications of this study (Chapter 1) and reviews for technological challenges for VOC treatment (Chapter 2). Chapter 3 describes an experimental study on the removal of solvent-based VOCs using SFMC. Results showed high performance for hydrophilic VOCs. However, the need for washing excess biomass was indicated, to prevent significant increase of pressure drop occurred under the high-VOC load (EC of $160 \text{ gm}^{-3}\text{h}^{-1}$). Chapter 4 discusses the characteristics of the treatment of hydrophilic—hydrophobic VOC mixtures aimed at treating VOC emissions from a vehicle-body painting. The EC of greater than $165 \text{ gm}^{-3}\text{h}^{-1}$ achieved at VOCs load of $286 \text{ gm}^{-3}\text{h}^{-1}$. With the application of chemical washing, clogging and pressure drop problems were mitigated. However, the need for moisture control of filter bed drying that affects to VOC removal was indicated. Chapter 5 describes a further improved model of SFMC, named rotatory-switching biofilter (RSB), designed for optimizing nutrient supply, and discusses the control strategy of nutrient supply. Results indicated that appropriate nutrient level can be maintained by adjusting nutrient concentration corresponding to the inlet VOC load.

A conclusion of this study is that biofiltration can be applied to gaseous VOC treatment, under well-controlled SFMC operation.