



Flow patterns of multi-soil-layering systems

Yi-Dong Guan^{a,b,c,*}, De-Fu Xu^{a,b}, Xin Chen^d, An-Cheng Luo^c, Hua Fang^b, Yu-Zhi Song^b

^aJiangsu Key Laboratory of Atmospheric Environment Monitoring and Pollution Control, China

Tel. +86 25 5873 1090; Fax: +86 25 5873 1090; email: yidongguan@163.com

^bSchool of Environmental Sciences and Engineering, Nanjing University of Information Science & Technology, Nanjing 210044, China

^cCollege of Environmental and Resource Sciences, Zhejiang University, Hangzhou 300191, China

^dNanjing Institute of Environmental Science (Ministry of Environmental Protection), Nanjing 210042, China

Received 6 January 2013; Accepted 24 April 2013

ABSTRACT

Multi-soil-layering (MSL) systems permit higher hydraulic load rates (HLR) and pollutant loads than some conventional soil systems by forming the alternating structures inside to enhance the filtration ability of soil. However, the quantitative evaluations of water movement in MSL are insufficient to be understood. Residence time distribution (RTD) is a tool to characterize the mixing and flow within reactors and is useful for troubleshooting existing reactors. In this study, pulse tracer tests were conducted to determine the RTD to investigate the flow patterns of MSL. Results show that the back-mixing extent of MSLs was moderate dispersion under HLR 200, 400, 800, and 1,600 L/(m²d), and the RTD of them indicate evident flow patterns of CSTR. Residence time shows a significantly negative correlation with the dead zone ($p=0.001$). The dead zone ratio of the MSLs were 41.0%, 52.3%, 59.6%, and 38.8% under HLR 200, 400, 800, and 1,600 L/(m²d), respectively.

Keywords: Multi-soil-layering system; Flow patterns; Dead space; Tracers; Residence time distribution

*Corresponding author.