Toluene Biodegradation using a Lab-Scale Biofilter Inoculated with *Pseudomonas Putida* PTCC 1694

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Abstract

Biomanipulation is reliable method for treating volatile organic compounds (VOCs) in polluted air. The performances of two biofilters in the removal of toluene vapors from air stream were compared. Two identical biofilters designed in parallel configuration were operated in lab-scale for 20 days; one of them was filled by sterilized media (compost and wood charcoal 2:1 v/v) and another was filled by the same media inoculated with *Pseudomonas putida* PTCC 1694, as a native strain. Moreover, batch tests were performed to determine the biodegradation rate of toluene. The results showed that, in comparison with the sterilized BF (89% vs 58%), the inoculated BF could effectively eliminate toluene from air stream. The pressure drop across the inoculated BF and the sterilized BF were 0.66 ± 0.28 and 0.47 ± 0.27 mm water respectively. The batch test results showed that loss of toluene in the control bottles was greater than the blanks. Based on the experimental results, inoculated BFs can effectively treat toluene vapors from gaseous streams.

Full-text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed.

However, the manuscript can be downloaded and accessed as a PDF.

Tables

Table 1.

Item	Compost	Wood Charcoal
Particle mean diameter (mm)	2-4	15 ± 0.5
Void fraction (%)	55	50
Wet bulk density (Kg/L)	0.628	0.8
Dry bulk density (Kg/L)	0.302	0.44
Moisture Content (%)	48 - 70	43-67
Moisture-Holding Capacity (%)	72	78

Table 2.

Trace element		Macro element	
compounds	Concentration(mgl ⁻¹)	compounds	Concentration(gl ⁻¹)
CaCl ₂ .2H ₂ O	26	KH ₂ PO ₄	1
EDTA Na ₄ (H ₂ O) ₂	5.5	K ₂ HPO ₄	1
FeCl ₃ .4H ₂ O	1.3	MgSO ₄	0.2
CoCl ₂ .6H ₂ O	0.12	NaCl	1
MnCl ₂ .2H ₂ O	100	KNO ₃	1
ZnCl ₂	0.07		
H ₃ BO ₃	0.06		
NiCl ₂ .6H ₂ O	0.025		
NaMoO ₄ .2H ₂ O	0.025		
CuCl ₂ . 2H ₂ O	0.015		

Table 3.

Part	Day	C _{in} (mg/m ³)	LR (g/m ³ .h)	EC (g/m ³ .h)	RE (%)
Sterilized BF (A)	1-20	134.5±26.2	11.56±2.26	6.22±1.45	52.96±4.12
Inoculated BF (B)	1-20	134.5±26.2	11.65±2.26	9.2±2.65	77.21±13.55

Figures

Figure 1

Experimental set-up of the biofilter system: 1. Gas flow controllers, 2. Toluene evaporation chamber, 3. Humidifying column, 4. Mix chamber, 5. Gas sampling ports, 6. Air pump.

Figure 2

Influence of inlet toluene concentration on the removal efficiency of the BFs (BF-A, BF-B) as a function of time

Figure 3

Influence of inlet toluene loading on the elimination capacity of the BF_s (BF-A, BF-B) as a function of time

Figure 4

pressure drop as a function of time for the two parallel biofilters (BF-A, BF-B)

Figure 5

Biodegradation of toluene by pseudomonas putida, control (x) and blank (♦) for 45 ppmv

Figure 6

Biodegradation of toluene by *pseudomonas putida*, control (x) and blank (♦) for 95 ppmv

Figure 7

Biodegradation of toluene by *pseudomonas putida*, control (x) and blank (♦) for 255 ppmv