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4C3) Biological Treatment of Trimethylamine Containing Waste Gas

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1. Introduction

Trimethylamine(TMA) is a volatile organic compound responsible for strong odor emission. TMA is potentially toxic and likely carcinogenic as a threat to public health, causing odor and visibility problems. In the past decade, attentions on treatment of TMA have been paid on the bioremediation perspective as this believed to be one of the most efficient technologies in terms of its technical and economical qualities. The biological removal of trimethylamine was studied in lab-scale biofilters. In pilot scale biotrickling filter showed better elimination of ammonia, and amines than chemical scrubber and biofilter suggesting that biotrickling filter is safer and economical technique. The main objective of this study is to determine the optimal condition for the removal of trimethylamine in lab-scale biotrickling filter and to evaluate the microbial community changes within the reactors.

2. Materials and Methods

2.1 Lab-scale biotrickling filtration of trimethylamine

The biotrickling filter system consisted of gas source(air pump and syringe pump), a mixing chamber a gas flow control unit(flow meter, valves) an air treatment unit(3 biotrickling filters same as described in the scheme). Polyurethane packing was used in this study due to its high surface area, porosity and inertness.

Table 1. Parameters of biotrickling filter.

Bed Dimension: i. Bed height ii. Bed diameter iii. Bed Volume	49.0 cm 6.5 cm 1.6 L = 0.0016 m3		
Gas air Flow rate	BTF1	BTF2	BTF3
	20 L/min	10 L/min	5 L/min
EBRT(s)	4.8	9.6	19.2
Nutrient supply	500 mL/week		
Nutrient composition (g/L)	KH_2PO_4-0.62; K_2HPO_4-1.2; $CaCl_2$-0.025g/L; $MgSO_4 \cdot 7H_2O$-0.2g/L; Trace element sol- 1mL/L		
Inlet concentration	25-150 ppm		
pH control	-		
Gas/liquid flow	Co-current flow/counter-current flow		

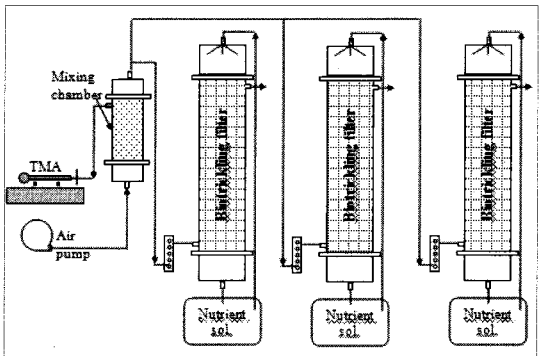


Figure 1. Schematic diagram of biotrickling filter

2.2 Inoculation of microorganisms

Packing material covered with active biomass layer from previously operated pilot scale biotrickling filter was used for the inoculation biotrickling filters. The packing materials were enriched in mineral mediumand inoculated in polyurethane packing. The mineral medium composition(g/L) is K_2HPO_4-1.2; KH_2PO_4-0.62; $MgSO_4 \times 7H_2O$-0.2; $(NH_4)_2SO_4$-0.5; Urea-2.0; trace

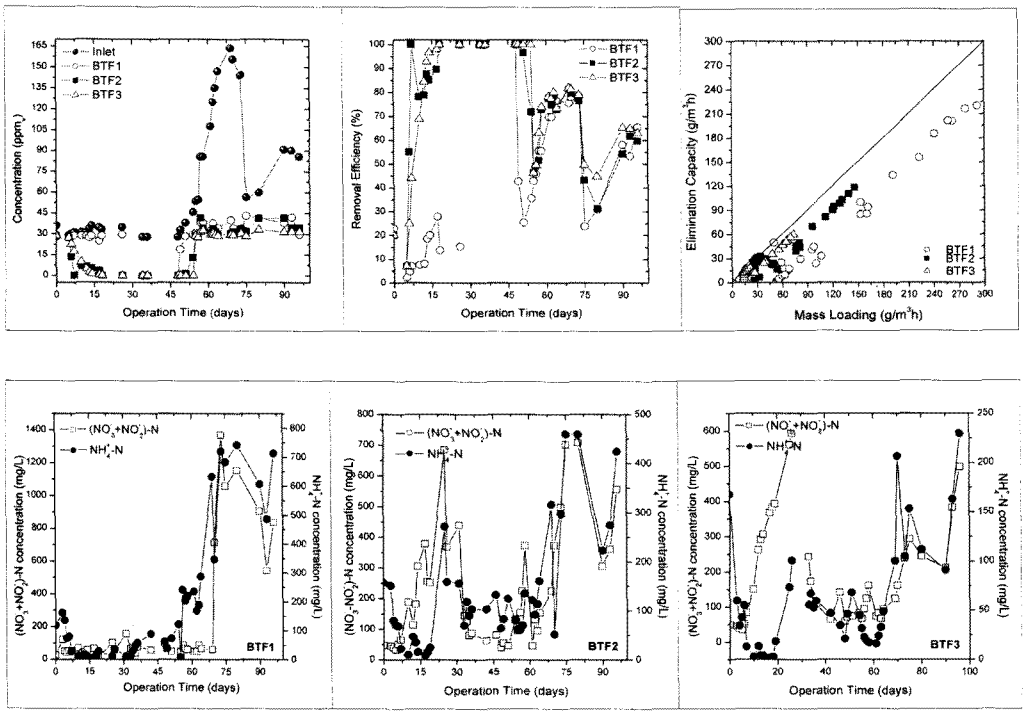
element solution-1mL. After enrichment the mineral medium was harvested at 7000×g for 15 min.

2.3 Analytical methods

TMA-1μL gas sample will be injected into GC-FID/ECD. Packing material-moisture content, organic matter, NO_3-N; NO_2-N and NH_4^+-N was determined. Get 2g of sample(wet basis) from reactors and filtered after shaking the samples with 2M KCl for 30 minutes for 30 min to analyze NH_4^+, NO_2-N and NO_3-N.

3. Results and discussions

The biotrickling filters were operated at EBRT of 4.8s(BTF1); 9.6s(BTF2) and 19.2s(BTF3). The EBRT effect on the removal efficiency was studied. At the startup the TMA concentration was maintained at 30ppm$_v$. The removal efficiency(RE) in BTF1 was low compare with BTF2 and BTF3.



In the BTF3 fast removal(>95%) was observed while in BTF2 gradual increase of RE was obtained. The production of nitrate and nitrite was higher in BTF2 and BTF3. Only after 30 days of operation RE in BTF1 was reached 100%. When the inlet concentration was increased up to 150 ppm$_v$ outlet concentrations of three filters were at 30ppm$_v$. The saturation of TMA in trickling solution was observed 20.25μg/mL. When the EBRT was at 19.2s highest removal efficiency was observed at inlet concentration of 45ppm$_v$. At 45ppm$_v$ at short EBRT(at 4.8s) decrease of RE(31%) was observed. The highest elimination capacity was 300g/m^{3}h, 150g/m^{3}h and 75g/m^{3}h respectively BTF1, BTF2 and BTF3. The pH value at the start up experiment was reached up to 10.0. When the biological break down of TMA observed pH decreased up to 4.66.

Also other gas compositions were measured at inlet and outlet of filters. The CO_2 concentration

was increased at the outlet, suggesting that successful degradation of TMA occurred in filters. Also trace amount of NO_2(less than 3ppm) was detected. The ammonia gas was not detected in the outlet of bioreactors. Microbial community was studied and was isolated 6 strains from the biotrickling filters.

Acknowledgement

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Reference

Chang-Tang Chang et al. (2004) Biofiltration of trimethylamine-containing waste gas by entrapped mixed microbial cells, Chemosphere, 55, 751-756.

I-Fang Mao et al. (2006) Critical components of odors in evaluating the performance of food waste composting plants, Science of total environment, 370, 323-329.

Ying Ding et al. (2006) Trimethylamine(TMA) biofiltration and transformation in biofilters, Journal of Hazardous materials.