103c Biodegradation of Gaseous Mixtures in a Trickle Bed Air Biofilter

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Biofiltration has been proven to be an effective and economical technology compared with other air pollution control technologies in reducing volatile organic compounds (VOCs) and odorous emission. Emission of VOC mixture is a common practice encountered in the chemical industry. This study characterizes the performance of trickle bed air biofilter (TBAB) for removing VOC mixtures. The efficacy of the TBAB was evaluated against step changes in influent concentration and response to backwashing for biomass control.

Two VOC mixtures with different compositions were fed to a TBAB with step-change in influent mixture concentration from 50 ppmv to 1000 ppmv. The first mixture was an equimolar ratio of toluene, styrene, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK). The second mixture was a typical ratio based on point source air emission in *EPA 2003 toxic release report* for chemical industries with a molar ratio of 0.448: 0.260: 0.234: 0.058 for toluene: styrene: MEK: MIBK, respectively.

The empty bed retention time was maintained at 2.02 min based on our previous study for styrene biodegradation. Backwashing was conducted once a week with one hour *in-situ* upflow media fluidization. Biofilter response after backwashing was investigated. Reacclimation was considered to have been achieved when 99% of the original biofilter performance was attained. VOC mixture removal profile along the biofilter media depth was also evaluated.

The biofilter maintained 99% overall removal efficiency with backwashing once a week after start-up for the first mixture when the influent concentration did not exceed 500 ppmv (3.94 kg COD/m^3-day). Styrene, MEK, and MIBK in the mixture were not detected in the effluent, and the removal efficiency of toluene was above 96%. But when the influent concentration was increased to 1000 ppmv, the overall removal efficiency decreased to 80%. Although MEK and MIBK were removed completely, 20% of the feed styrene and 55% of the feed toluene were detected in the effluent. The overall performance and the individual VOC performance in the first mixture is presented in Figure 1. In case of the second mixture, the biofilter only maintained 95% removal when the influent concentration was increased to 500 ppmv with a corresponding volumetric loading rate of 4.01 kg COD/m^3-day. Although styrene, MEK, and MIBK were not detected in the effluent, 10% toluene remained in the effluent. The overall performance and the individual VOC performance in the second mixture is presented in Figure 2.

Re-acclimation of the biofilter performance was delayed with increase of influent concentration for both mixtures. When the employed concentration was 1000 ppmv and 500 ppmv for the first and second mixture, respectively, the biofilter failed to get re-acclimated. Furthermore, re-acclamation for the second mixture was delayed due to its high toluene content as compared to the first mixture.

Removal behaviors of MEK, MIBK, and styrene along the biofilter depth were similar for both mixtures. MEK and MIBK were completely removed in the upper 3/8 media depth, and styrene was removed in the upper 5/8 media depth. However, toluene removal utilized more biofilter depth for the second mixture as compared to the first mixture.

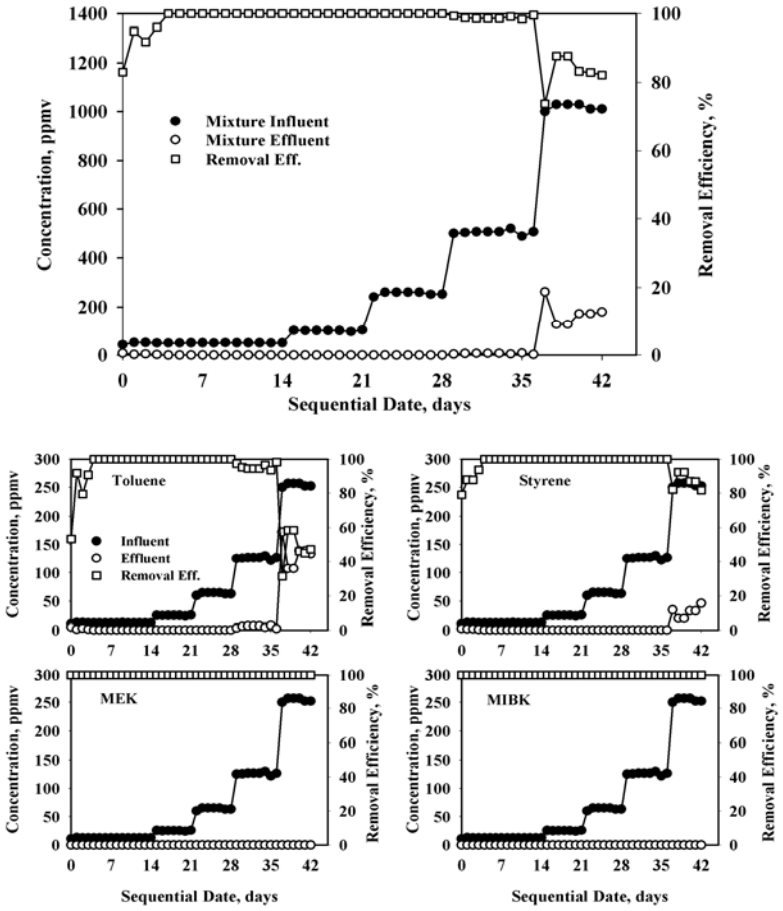

Figure 1. Biofilter performance for the first mixture

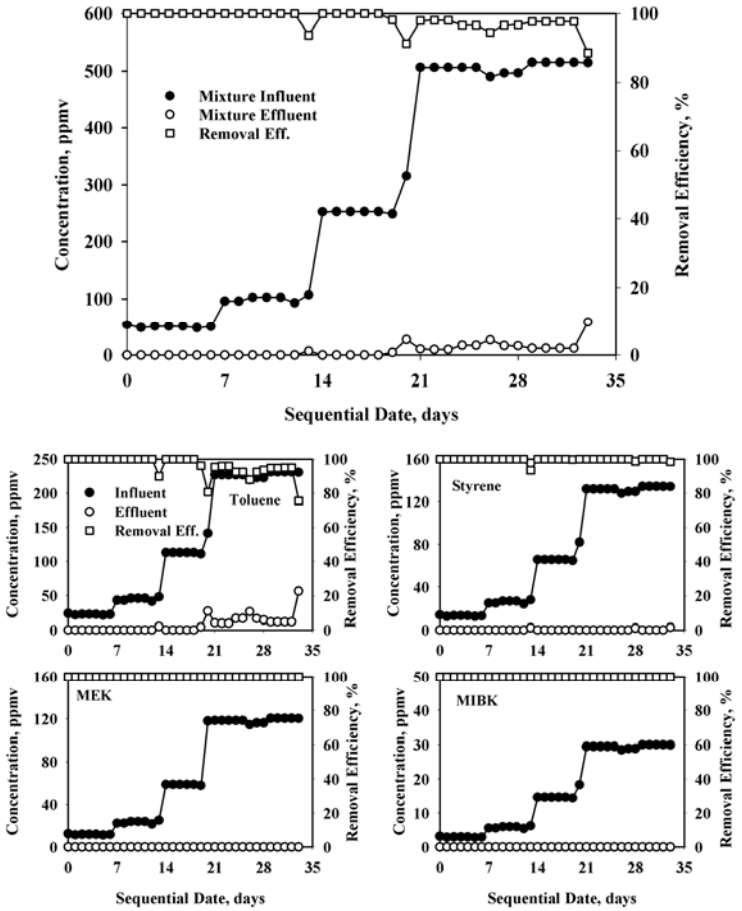

Figure 2. Biofilter performance for the second mixture