Performance of a Trickled-Bed Biofilter for a MTBE-Contaminated Airstream

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ABSTRACT

Methyl tertiary butyl ether (MTBE) with the properties of high vapor pressure and high water solubility, is an oxygenated gasoline additive. Due to its contamination to air, soil, and groundwater, MTBE is listed as the fourth category toxic chemical by Environmental Protection Administration. This study aims to improve the existing biofilter and takes advantage of high recirculation rate of the conventional trickling filter. Therefore, the developed trickled-bed biofilter can be operated in sufficient water content which prevent from growing limitation for microorganism. Overall, the objectives of the study are to construct a bench-scale bioflter, and to investigate the effects of environmental conditions on MTBE removal. The various environmental conditions include inlet MTBE concentration, liquid flow rate, and empty bed residence time (EBRT). Results of the trickled-bed biofilter removal experiments show that: (1) After 30~40 min operation, the incoming MTBE with 50 and 100 ppm was completely absorb/adsorb by the biofilter. (2) More than 80% removal efficiencies were observed with organic loading rate of MTBE below 10 g/m3.h. However, the elimination capacity approached a constant value, and removal efficiency decreased to 50% while organic loading rate increased to 28 g/m3.h. (3) MTBE removal efficiency increased from 72% to 86% as nutrient feeding rate (NFR) increased from 10 to 40ml/min, which indicates elevated nutrient feeding enhances MTBE removal. However, the removal decreases to 83% and 78% if keep increasing the NFR to 50 and 60ml/min, respectively. It is believe that too high of water content in the biofilter causes the reduction of mass transfer rate leading to the decrease of removal efficiency. (4) More than 88% and 85% removal efficiencies were achieved for inlet MTBE concentrations of 50ppm and 100ppm in EBRT of 83 seconds. However, the MTBE removal decreased to 43% as increasing MTBE concentration to 200ppm. Under inlet concentration of 200ppm, MTBE removal efficiencies were 50%, 65% and 75% for EBRT of 100, 140, and 188 seconds, respectively. Hence, MTBE removal efficiency increases while EBRT increases.

Keywords : Trickled-bed biofilter ; Biodegration ; Organic loading ; MTBE

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