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Toluene degradation by a water/silicone oil mixture for the design of Two Phase Partitioning Bioreactors

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Highlights

- Toluene degradation was studied in a Two-Phase Partitioning Bioreactor (TPPB)
- The liquid phase consisted of 75 % water and 25 % silicone oil (PDMS 50)
- Biodegradation rates reached 104 g m^{-3} h^{-1} for 100 % toluene removal efficiency
- A TPPB for toluene removal can therefore be designed for large-scale applications

Abstract

Toluene degradation performances were studied in a 10 L Two-Phase Partitioning Bioreactor (TPPB). The liquid phase consisted of a mixture of water and PDMS 50 (PolyDiMethylSiloxane, i.e. silicone oil, viscosity of 46 mPa·s) in the volume ratio of 75 %/25 %. Two series of experiments were carried out: in the first, the reactor was sequentially supplied with toluene whereas in the second, toluene was continuously supplied. Activated sludge from the wastewater treatment plant of Beaurade (Rennes, France) was used at an initial concentration of 0.5 dry mass g· (mixture L)$^{-1}$. The Elimination Capacity (EC) was investigated as well as the change in biomass concentration over time. Toluene biodegradation was very efficient (Removal Efficiency, RE = 100 %) for toluene flows ranging from 0.2 to 1.2 ml· h^{-1}, corresponding to elimination capacities of up to 104 g·m^{-3}·h^{-1}. For a toluene flow of 1.2 ml· h^{-1}, the biomass concentration measured at the end of the experiment was 4.7 dry mass g· (mixture L)$^{-1}$. The oxygen concentration in the liquid phase was clearly not a limiting factor in these operating conditions. Based on these results, an extrapolation leading to the design of an large-scale pilot TPPB can now be considered to study toluene degradation performances in industrial conditions.