

[ENV01]

Recalcitrant organics removal using adsorption and biofilm process

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The removal of the recalcitrant chloroorganic compounds - pentachlorophenol (PCP) by a combination of biofilm and adsorption systems was investigated. Mixed culture from the pulp and paper mill wastewater treatment plant were taken and acclimatized to the PCP inside a granular activated carbon sequencing batch biofilm reactor (GAC-SBBR) to form a combined biofilm and adsorption system. The treatability and kinetic for the process were evaluated; microbe analysis and metabolites pathway taken by the system also been studied. Treatability study on the GAC-SBBR has shown that the system can withstands PCP shock loadings well and has a high PCP removal efficiency that the system still can maintained approximately 90% of its PCP removal efficiency after three month of continuous operation. Kinetic process model was developed and the kinetic studies were carried out to obtain the GAC adsorption, biosorption, biodegradation and growth kinetics for the GAC-SBBR system. The Freudlich isotherm found to be the most convenient model to describe the adsorption and biosorption systems. The Freudlich parameters for the GAC adsorption were 52.79 mg/g for GAC capacity (K) and 0.3862 for 1/n. As for the biosorption systems, the K and 1/n values were 1.19 mg/g and 0.56, respectively. Calculation using the mathematical model showed that the percentage of PCP removal taken by each individual processes (adsorption, biosorption and biodegradation) in GAC-SBBR system is related to the system's HRT and the ideal operation HRT duration was calculated to be 47days. Beside that, analysis for the growth kinetic parameters (Y_H , b_H , μ_h and K_s) founded in GAC-SBBR had deduced that the system is suitable to operate at a long BRT and anoxic condition (or less oxygen). Six dominant bacteria have found in the microbe analysis test. They were *Pseudomonas aeruginosa*, *Bordetella/Alcaligenes/Moraxella spp.*, *Pseudomonas putida*, *Corynebacterium nitrilophilus*, *Ochrobactum anthropi* and *Non fermenter spp.* Analysis on their metabolites using HPLC showed that the reductive dechlorination might be carried out by these microorganisms to convert the PCP to lesser-chlorinated compounds such as phenol, dichlorophenol and monochlorophenol. Finally, case study on the real wastewater from a paper mill showed that approximately 50% of the refractory COD and 70% of PCP in the wastewater could be removed by GAC-SBBR system within one-day time. These results showed the potential of a combination of biofilm and adsorption system in real industrial application for treatment of high-strength wastewater polluted by recalcitrant organic compounds.