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Toxicity and Binding of Chlorophenolic Compounds onto Biomass Derived from Aerobic and Anaerobic Sludge

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Chlorophenolic compounds (CP) are persistent classes of contaminants commonly found in contaminated soil and groundwater. Microbial biodegradation and binding onto biomass can play a significant role on the removal of chlorophenolic compounds from soil and groundwater systems. The aim of this study was to evaluate the removal of chlorophenolic compounds (e.g., 2-CP, 4-CP, 2,3-di CP, 2,4-di CP, 2,4,6-tri CP) from aqueous phase using biomass extracted from aerobic and anaerobic sludge. The batch experiments suggest that the removal of CP from aqueous solution was highly dependent on CP type and the type of sludge used. While the binding of CP onto aerobic sludge decreased in the order: ; 2-CP > 2,4-di CP> 4-CP> 2,3-di CP > 2,4,6-tri-CP, that onto biomass from anaerobic sludge was in the decreasing order of: 2,3-di CP≈2,4-di CP > 4-CP > 2-CP > 2,4,6-tri CP. The binding of CP onto biomass mainly occurred through hydrophobic bonding between biosorbents and phenolic functional groups of CP compounds. The biomass from anaerobic sludge exhibited much higher binding affinity for CP compounds compared to aerobic sludge. Our experiments also show that the CP compounds were toxic to microbial cells from both aerobic and anaerobic sludge, and resulted in significant cell lysis depending on the type of CP used. The toxicity decreased in the order: 2,4,6-tri CP > 2,3-di CP > 2,4-di CP > 4-CP > 2-CP for aerobic sludge, and 2,4-di CP > 2,4,6-tri CP > 2,3-di CP > 4-CP > 2-CP for anaerobic sludge. Overall, it is clear that the biomass derived from both aerobic and anaerobic can be used as a cost effective biosorbent for CP removal, but a pretreatment process prior to microbial degradation must be applied to lower the toxicity of CP compounds on microbial cells.