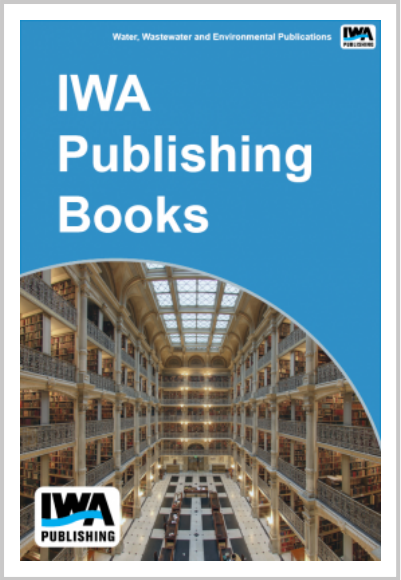
Research Digest: Field Validation of Biokinetic Coefficients for Predicting Degradation of Organic Compounds



This research was the first significant demonstration of an extant respirometric test to determine the biodegradation rate parameters (biokinetics) of select individual organic compounds at full scale wastewater treatment plants. Extant kinetics were measured at five different municipal and industrial activated sludge systems. The respirograms were well correlated with actual analytical measurements of compound disappearance for ethylene glycol and acetone. Furfural respirograms revealed differential rates of oxygen consumption, indicative of the formation of an intermediate compound which was identified as furoic acid in subsequent analysis. A calibration procedure was developed to assess the competent biomass concentration, since the COD fraction tended to underestimate the degrading fraction for two of the four test compounds. Acetone, for instance, had a measured influent COD fraction of 0.08%, and the actual competent fraction was estimated to be 2.3% based on the model calibration. Once the competent biomass concentration was determined, extant kinetic parameters were subsequently used to predict activated sludge system performance. Predicted effluent concentrations were within 2, 5, and 16% of the average measured concentrations for acetone, linear alkyl benzene sulfonate, and furfural, respectively. Day to day predictions for these compounds were less accurate, possibly due to the non-steady state nature of the activated sludge systems studied. Alkyl sulfate (AS) was not predicted well with respect to the percentage difference between predicted and measured concentrations. However, the overall mass difference was small (4.2 µgCOD/L predicted versus 0.82 µgCOD/L measured). The sub part per billion measured concentrations for AS were at least a magnitude of order lower than any of the other target compound concentrations. One of the surprising findings of the study was that the variability in kinetic parameter values was no more than typically observed in laboratory activated sludge reactors operated at steady-state. The dynamic operating nature and varying influent concentrations resulted in the maximum standard deviations for furfural at the Cedar Rapids Water Pollution Control Facility (standard deviations were 54 and 79% of the average values of and KS, respectively). From these results, a sampling and testing period of 8 to 10 tests over a three month period is recommended to accurately characterize the biodegradation performance of an activated sludge system with respect to specific organic compounds in the influent.

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