

A combined method for determining inhibition type, kinetic parameters, and inhibition coefficients for aerobic cometabolism of 1,1,1-trichloroethane by a butane-grown mixed culture

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Abstract:

A combined method for determining inhibition type, kinetic parameters, and inhibition coefficients is developed and presented. The method was validated by applying it to data obtained from batch kinetics of the aerobic cometabolism of 1,1,1-trichloroethane (1,1,1-TCA) by a butane-grown mixed culture. The maximum degradation rates ($k(\max)$) and half-saturation coefficients (K_s) were independently determined in single compound tests, and compared with those obtained from inhibition tests. The inhibition type was determined using direct linear plots at various substrate and inhibitor concentrations. Kinetic parameters ($k(\max)$ and K_s) and inhibition coefficients (K_{ic} and K_{iu}) were determined by nonlinear least squares regression (NLSR) fits of the inhibition model determined from the direct linear plots. Initial guesses of the kinetic parameters for NLSR were determined from linearized inhibition equations that were derived from the correlations between apparent maximum degradation rates ($k(\max)(app)$) and/or the apparent half-saturation coefficient ($K_s(app)$) and the $k(\max)$, K_s , and inhibitor concentration ($I-L$) for each inhibition equation. Two different inhibition types were indicated from the direct linear plots: competitive inhibition of 1,1,1-TCA on butane degradation, and mixed inhibition of 1,1,1-TCA transformation by butane. Good agreement was achieved between independently measured $k(\max)$, and K_s values and those obtained from both NLSR and the linearized inhibition equations. The initial guesses of all the kinetic parameters determined from linear plots were in the range of the values estimated from NLSR analysis. Overall the results show that use of the direct linear plot method to identify the inhibition type, coupled with initial guesses from linearized plots for NLSR analysis, results in an accurate method for determining inhibition types and coefficients. Detailed studies with pure cultures and purified enzymes are needed to further demonstrate the utility of this method. (C) 2002 John Wiley Sons, Inc.