In a previous study, pilot-scale bioslurry reactors were used to treat soils contaminated with high levels of 2,4-dinitrotoluene (DNT). The study showed that DNT could be remediated rapidly, but constant monitoring was necessary to avoid long lag phases upon refeeding the reactors. Monitoring DNT concentrations was complicated by the heterogeneous DNT distribution in the reactor, and measuring DNT concentrations from reactor samples was not accurate or feasible in predicting reactor performance. A model was developed to analyze reactor performance based on the biodegradation and partitioning of dinitrotoluene in a bioslurry reactor. The model assumed instantaneous equilibrium applied to the dissolution of the DNT crystals and the desorption of the soil bound DNT, and biodegradation was described using Monod kinetics. Analysis of the model results showed that the maximum substrate utilization rate controlled the rate of DNT degradation in the reactor. The model was also used to predict the time required for complete DNT degradation, which matched well with the experimental results. Comparison of the experimental data to the model results also revealed that rates of degradation were not constant throughout the study or in individual feed cycles, presumably due to factors such as a bacterial population shifts, phosphorous limitations, or nitrite inhibition in the slurry reactor.