Fact Sheet

Simplified Model for Prediction of Nitrogen Behavior in Land Treatment of Wastewater (WASTEN)

PROBLEM

With increased concern and more stringent groundwater regulations, it is important to be able to predict water movement and subsequent nitrogen transport and transformations in the soil vadose (unsaturated) zone. Models for predicting nitrogen behavior in soils can be extended for use with other contaminants or used with other technologies. For example, a nitrogen model could help determine how much nitrogen could be added to enhance in-situ bioremediation of contaminated soils without using excessive nitrogen, which could leach into the groundwater.

SOLUTION

WASTEN is a one-dimensional, dynamic simulation model that describes nitrogen transformation and transport processes in a multilayered soil profile. It was developed at CRREL under the Corps Civil Works Land Treatment Program, and is available on disk for use on DOS-based personal computers. WASTEN considers nitrate, exchangeable ammonia, solution ammonia, volume and concentration of wastewater applied, and timing and scheduling, as well as sorption, denitrification, plant uptake, and evapotranspiration. WASTEN is written as a series of coupled partial differential equations describing the fate and interactions of different nitrogen species in the soil. Numerical solution is by a finite difference method (Modified Crank-Nicolson implicit-explicit method).

RESULTS

WASTEN's main use is to predict nitrate output from soil-based wastewater treatment systems. CRREL used WASTEN to develop design and operation guidelines for a proposed wastewater treatment plant at Fort Dix, New Jersey. The model allowed researchers to investigate parameters (loading rate, dosing frequency, nitrate levels, water-table depth, etc.) for their impact on nitrate levels in the leachate.

Another potential application of WASTEN is with enhanced bioremediation of contaminated soils. In these situations, limiting nutrients (generally including nitrate) are added to contaminated soil in situ to enhance microbial degradation of organic contaminants. WASTEN could be used to estimate the amount of nitrate in the treatment zone, thus optimizing the operation of biotreatment systems to accurately balance nitrate additions with the activity requirements of the microbial population.

PRODUCTS AVAILABLE

- Reynolds, C.M. and I.K. Iskandar (1995) A modeling-based evaluation of wastewater application practices on groundwater quality. CRREL Report (in press).
- Selim, H.M. and I.K. Iskandar (1980) Simplified model for prediction of nitrogen behavior in land treatment of wastewater. CRREL Report 80-12, USACRREL, Hanover, NH 03755-1290.
- WASTEN computer model for DOS-based personal computers (5.25" or 3.5" disks; brief instructions included on disk).

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