Interactive modeling system for risk assessment of microbial pathogens in soils and groundwater

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Federal agencies such as the US EPA are required by various statutes to assess the ecological and human health risks of chemical and biological contaminants. Such assessment provides the basis for numerous activities including setting regulatory standards, developing exposure guidelines, making decisions whether or not to regulate the contaminant, and identifying data and research gaps. Traditionally, the assessment of risks has been based on toxic responses of laboratory animals. In recent years, however, it has become increasingly clear that additional quantitative analysis is needed for holistic and accurate assessment of risk. Models provide the tools for characterizing the ecological and human health effects of contaminants and facilitate assessment of exposure and determination of dose-response functions. This paper describes an interactive modeling system developed for evaluation of the risk associated with microbial pathogens in the subsurface environment. The modeling system combines a linked unsaturated/saturated microbial fate and transport model in conjunction with a modeling data base and expert system to provide simulations that yield potential risks associated with the exposure to a number of microbial pathogens. The expert system assists the user in selecting model input parameters from the data base and interpreting results. A graphical user interface also is provided to facilitate visualization of the model output. The interactive modeling system is used to analyze several water treatment and policy guidelines stipulated under the strawman Groundwater Disinfection Rule. The paper examines, through case studies, the utility of modeling systems for water quality management decision making.

Use of an indoor air quality/exposure model to identify important exposure factors from inhalation

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Domestic water supplies that are contaminated with volatile organic compounds (VOCs) impose a risk to the public, creating concern among public health officials. During past contamination incidents, health officials have warned residents to limit water consumption, but recent research indicates that other uses of the water should also be restricted. It has become apparent, based on our laboratory research and measurements in homes,

that inhalation of volatilized VOCs from contaminated water supplies is an important route of exposure compared to that of direct ingestion.

Estimation of the potential dose due to the ingestion of contaminated water is a relatively straightforward calculation, dependent on the volume of consumption, without regard to the environment or variations in behavior. However, estimation of potential dose due to the inhalation route is more complex. Comprehensive exposure predictions must consider a multitude of personal activity and environmental factors that are difficult to quantify.

Through the use of our indoor air quality/exposure microcomputer model MAVRIQ (**M**odel for the **A**nalysis of **V**olatiles and **R**esidential **I**ndoor air **Q**uality), the effects of various human activities on potential dose have been analyzed. We have investigated the correlation between environmental factors, human activity patterns and the resulting potential inhalation doses for different individuals and pairs of individuals for the purpose of examining exposure and co-exposure effects. This has resulted in an algorithm for relating simulated daily exposure to the total water use in the home, the individual's shower water use, time spent in the bathroom and fraction of time spent at home. Simulated exposure is also directly scaled by the ventilation rate of the home. These results can be used to identify high risk individuals and households.