Office of Research and Development

National Exposure Research Laboratory

The OnSite On-line Calculators For Subsurface Contaminant Transport Site Assessment

The U.S. Environmental Protection Agency (EPA) has developed a suite of on-line calculators called "OnSite" for assessing transport of environmental contaminants in the subsurface. The calculators are available on the Internet at http://www.epa.gov/athens/onsite and are divided into four categories:

1) Parameter Estimates
   - Hydraulic gradient
   - Moisture content in a sample
   - Retardation factor
   - Henry's constants
   - Estimated longitudinal dispersivity
   - Darcy's Law
   - Seepage Velocity
   - Effective solubility from fuels
   - Multiphase mass distribution
2) Simple Transport Models
   - Plume diving
   - Steady plume length
   - One-dimensional transport from a pulse, continuing, or fuel source
   - "Domenico" models: steady state centerline, unsteady
3) Unit Conversions
   - Flow rates
   - Hydraulic conductivity
   - Half lives/rate constants
   - Henry's Law constants
   - Dates/sequential times
   - Latitude-longitude to distance
4) Scientific Demos
   - Darcy flow in a laboratory column
   - Unsteady mass balance
   - Flow in a one-dimensional aquifer
   - Borehole concentration averaging

Purpose of OnSite: The purpose of these calculators is to provide methods and data for common calculations used in assessing impacts from subsurface contamination. Parameter estimates are included in OnSite for the convenience of experienced personnel, the education of inexperienced personnel, and for the potential to provide consistency among a diverse user community. The simple transport models were developed for two purposes — to demonstrate concepts of ground water flow and contaminant transport and to calculate concentrations given a set of input parameters. Unit conversions were provided for unit sets unique to subsurface transport calculations. These were intended to facilitate the correct application of transport formulas, because some of the units and conversions included are unfamiliar to many people. The scientific demos were outgrowths of modeling courses, where general concepts of transport need to be introduced.

A focus of some of the methods is on simple calculations, such as the retardation factor. Ideally there would be nearly universal ability to perform this calculation, but interaction with various client groups showed this not to be the case. Even for experienced analysts, the availability of a prepackaged calculation is viewed as a convenience. Beyond obvious labor savings, "convenience" facilitates correct application of the principles and ultimately more scientific decision making. Web site usage statistics show that even the

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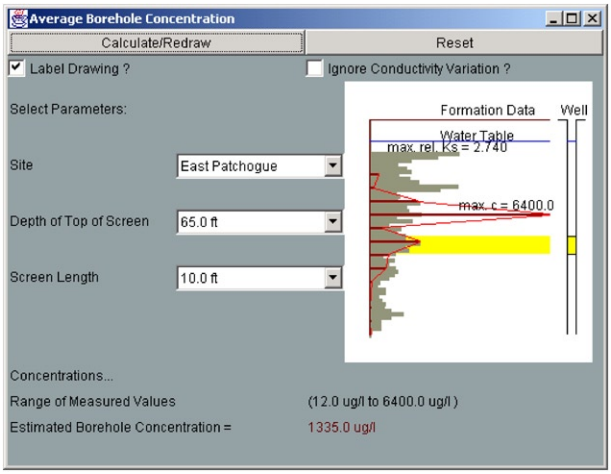
simple calculators are used commonly. A somewhat different class of calculation is represented by the effective solubility calculator. This calculator determines concentrations of chemicals in equilibrium with various fuels. In contrast to the retardation factor, the formula itself is much less well-known, and the required input data are not commonly available. In this case the calculator provides a unique resource to the community as the ability to calculate this quantity is not expected to be widespread.

Unique concepts were introduced through the calculators, primarily to the underground storage tank community. The premier example of this concerns the effect of rainwater infiltration on contaminant plumes. Research conducted at contaminated sites showed that plumes were pushed downward, rather than diluted. Development and testing of assessment methodologies provided software for predicting this behavior. Providing an on-line calculator (plume diving) placed this technology directly into the hands of the Leaking Underground Storage Tank community. The calculators allow estimation of the amount of vertical displacement of the plume (plume diving) and show the effects on measured concentrations of placing well screens in the wrong vertical position (average borehole concentration).

History: Since their inception in 1998 the calculators have been used by several state agencies, EPA Regional Offices and private consulting firms. From the web logs we know that there has been a steady increase in usage of the site and that the most commonly-used calculators are the estimators for effective solubility, the retardation coefficient, plume diving in aquifers, estimation of hydraulic gradients, seepage velocity and moisture contents. In June of 2002, web site usage went above 10,000 per month for the first time.

Computer Details: The calculators are implemented in either JavaScript or Java. JavaScript is well suited for a simple calculation that does not require a graphical output. Java was used to create applets for calculations with complex inputs or the need for graphical output. In either case all calculation is performed on the end-user's computer. No information that is entered into any OnSite calculator is collected by EPA. EPA does, however, accumulate statistics on the number of times pages are accessed, browsers used, user's domain names (.com, .edu, .gov, etc), and similar generalized information (see http://www.epa.gov/epafiles/usenotice.htm for details)

Ideas for new calculators are developed from suggestions from users and in response to requests for information. These have come from State Agencies, EPA Regional and Program Offices and the private sector.



The Average Borehole Concentration calculator that is illustrating the concentration that would be seen in a well with a 10 foot long screen located 65 feet below the ground surface. The maximum peak concentration nearby this well was 6400 ug/l, but the effect of borehole averaging was to reduce the observed concentration to 1335 ug/l.

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http://www.epa.gov/athens/onsite