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Backward tracing of the unknown DNAPL source information based on analytical approach of source strength functions

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The absence of information for contaminant sources spilled at DNAPL-contaminated sites leads to the deterioration of the groundwater quality and the inefficient augmentation of remedial action. This study used an analytical approach considering the time-dependent exponential reduction of contaminant to estimate roughly the unknown initial DNAPL source mass and dissolved concentration and predict the residual source mass and dissolved concentration of the study site. The python programming language was used for the convenience of solving the analytical approach. Monitoring works for water quality were regularly performed to collect continuous concentration data for 13 years from 2009 to 2022 at DNAPL contaminated site, Korea. Harmonic mean values of the trichloroethylene (TCE) concentration data at each representative monitoring well (KDPW-2, SKW -1, -3, -4, -6, -7, and MLW-1) of the hot source zone which was shown the continuous high level of TCE during 6 years from August 2010 to November 2015 were used to estimate the source mass and dissolved concentration at the time of the TCE spill. Through the analytical modeling of source strength functions, the spilled source mass and dissolved concentration in groundwater of TCE in the hot source zone was estimated. Also, the results of TCE concentration monitoring before and after remediation at the hot source zone were utilized to evaluate the efficiency of intensive remedial action using different three fractions (X) values (50, 60, 70 %) which mean the reduction rate of source mass induced by the remedial action. The quantitative evaluation method applied in this study has been proven to be a useful tool in estimating the unknown contaminant source mass and dissolved concentration at the initial spilled stage of the DNAPL-contaminated site using long-term monitoring data.

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