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Generalized analytical solution of multispecies reactive transport involving a wide range of boundary, initial, and production conditions

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Transport processes of some contaminants such as radionuclide, chlorinated solvent, nitrogen may undergo a series of either first-order or pseudo first-order sequential reaction kinetics. When more mobile, toxic, and/or persistent daughter products of these decaying contaminants formed, we will concern about the potentially greater down-gradient plume extent and higher concentration levels of these target species besides the parent species. The single-species analytical solution does not permit to evaluate transport behavior of daughter species of the decaying contaminants. The analytical solution for multispecies transport equations with first-order sequential reactions will be a useful tool for the simultaneous evaluation of the fate and transport of the parent and daughter species of the decaying contaminants. The analytical solutions for multispecies transport equations in literature are mostly limited to one-dimensional transport systems with boundary source. Accordingly, this study attempts to present an explicit analytical solution for simulating multi-species transport involving a wide range of boundary, initial, and production conditions. The derived analytical solution has greater applications for evaluation of concentration distribution of arbitrary target species of the long-chain decaying contaminants.