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Analytical Solution to the One-Dimensional Advection-Diffusion Equation with Temporally Dependent Coefficients

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ABSTRACT

In a one-dimensional advection-diffusion equation with temporally dependent coefficients three cases may arise: solute dispersion parameter is time dependent while the flow domain transporting the solutes is uniform, the former is uniform and the latter is time dependent and lastly the both parameters are time dependent. In the present work analytical solutions are obtained for the last case, studying the dispersion of continuous input point sources of uniform and increasing nature in an initially solute free semi-infinite domain. The solutions for the first two cases and for uniform dispersion along uniform flow are derived as particular cases. The dispersion parameter is not proportional to the velocity of the flow. The Laplace transformation technique is used. New space and time variables are introduced to get the solutions. The solutions in all possible combinations of increasing/decreasing temporal dependence are compared with each other with the help of graphs. It has been observed that the concentration attenuation with position and time is the fastest in case of decreasing dispersion in accelerating flow field.

KEYWORDS

Advection, Diffusion, Dispersion, Continuous Input, Flux Type Condition

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