

The authors sincerely thank Prof. Zhan for his detailed and helpful suggestions and editorial corrections which will substantially improve the readability of the paper. All editorial corrections and suggestions are addressed and incorporated to the revised manuscript. Detailed responses to the referee's comments are as follows.

Please note. Referee's comments are bold-faced. Authors' responses follow immediately below the comments.

1. General Comment:

This paper presents a generalized analytical solution for solute transport in a finite spatial domain with arbitrarily time-dependent inlet boundary condition by successively using Laplace transform and generalized integral transform techniques. Validity of the developed solution is checked by comparing with numerical solution using the Laplace transform finite difference technique under the condition of sinusoidally periodic input concentration. Numerical integration method is introduced to calculate the developed analytic solution, whose accuracy is checked by comparing with the solution using analytic integration under special case. There are some mistakes in grammar and mathematical derivation. The sensitivity analysis in section 4.2 seems to be not thorough enough. However, the solution in this paper provides a more realistic solution to model the natural contaminant releasing and transport process and has scientific significance. I suggest publication of this paper after the following revisions.

Authors' response:

We would like to thank the detailed and helpful review. Errors in grammar and

mathematical derivation are amended in the revised manuscript. We fully agree the comment on the sensitivity analysis in section 4.2. The comprehensive and detailed investigations on the sensibility of the primary parameters are included in the revised manuscript.

2. Specific comment:

(1) Abstract

a. Page 4100, line 8: It is better to say” Result shows an excellent agreement between the analytical and numerical solutions”.

Authors’ response:

We agree the suggestion and incorporate it to the revised manuscript.

(2) Introduction

a. Page 4101, line 2: change “advection-dispersion equation” to “ADEs”;

Authors’ response:

“advection-dispersion equation” is changed into “ADEs” in the revised manuscript.

b. Page 4101, line 7: it is better to replace “ the analytical solutions” to “ the closed-form analytical solutions”;

Authors’ response:

We replace “ the analytical solutions” with “ the closed-form analytical solutions”;

c. Page 4101, line 20: change” due to” to “, because”;

Authors' response:

“due to” is changed to “because”.

d. Page 4102, lines 6-8: the sentence “ naturally occurring isotopes into a system from a flow through-lake can be dependent upon natural, cyclic, water-quality variations or liquid waste disposal operates on a periodic cycle” is not clear and not easy to understand;

Authors' response:

This sentence is rewritten to make it more clear and readable. The revised sentence is as follows.

“...such as naturally occurring isotopes moving from a flow-through lake into an aquifer can be dependent upon natural, cyclic, water-quality variations; or liquid waste disposal of a human-made system operating on a periodic cycle.”

e. Page 4102, line 14: delete “the” in front of “ Laplace transform”;

Authors' response:

“the” is deleted in the revised manuscript.

f. Page 4102, line 17: change “and the constraint” into “. Thus, the constraint”, or add “;” between “boundary condition” and “and the constraint”;

Authors' response:

“and the constraint” is changed to “. Thus, the constraint”

g. Page 4102, line 18: change “in finite special domain” into “in finite spacial domain”;

Authors’ response:

“in finite special domain” is changed to “in finite spatial domain”

(3) Governing equations

a. Page 4103, line 3: change “for the solute transport problem” into “ for this solute transport problem”;

Authors’ response:

“for the solute transport problem” is changed to “for this solute transport problem”.

b. Page 4103, line 7: add “,” between “the solute” and “k”; add “the” before “ the first-order”;

Authors’ response:

The sentence is revised according to the suggestion.

c. Page 4103, line 14: change “expression input function” into “solute concentration”;

Authors’ response:

“expression input function” is changed to “solute concentration”;

(4) Derivation of the generalized analytical solution

a. Page 4104, line 8: add “in” before “ Eqs. (7) and (8)”;

Authors' response:

The sentence is revised according to the suggestion.

b. Page 4104: There is a mistake in Eq. (9) and the following equations. The retardation factor “R” seems to be lost from here.

Authors' response:

The dimensionless time is denoted as $t_D = \frac{Vt}{RL}$, thus the retardation factor “R”

does not appear in Eq. (9).

c. Page 4104, line 14: add “dimensionless” before “Laplace transform”; add “,” or “;” before “CL(xD,s)”;

Authors' response:

“dimensionless” and “;” is incorporated to the sentence in the revised manuscript.

d. Page 4104, line 15: change “which is” into “which are”;

Authors' response:

“which is” is changed to “which are”.

e. Page 4105, line 3: delete “initial and”; add “in” before “Eqs. (10)”;

Authors' response:

This sentence is amended according to the suggestion.

f. Page 4105, line 5: add “the” before “general integral transform”;

Authors' response:

The sentence is corrected according to the suggestion.

g. Page 4105, line 7: change “Eq. (12)” into “ in Eq. (10)”;

Authors' response:

“Eq. (12)” is changed to “ in Eq. (10)”.

h. Page 4105, line 10: delete “the” before “CV(xD,s)”;

Authors' response:

“the” is deleted.

i. Page 4106, Eq. (21): subscript “m” is lost in “”;

Authors' response:

The typo is amended.

j. Page 4106: what does “CG” mean in Eq. (22b)? Is $C(x, s) VD$ the same as $C(x, s) VD$?

Authors' response:

“ C_G ” and “ $\overline{C}_V(x_D, s)$ ” are typos. These typos in Eqs. (22a) and (22b) are amended.

(5) Results and discussion

a. Page 4108, line 2: change “exponential” into “exponentially”;

Authors' response:

“exponential” is changed to “exponentially”.

b. Page 4108, line 9: change “interesting” into “interested”;

Authors' response:

“interesting” is changed to “interested”.

c. Page 4108: what is “the conventional time-marching finite difference method”?

What is the advantage of “LTFD technique” over “the conventional time-marching finite difference method”?;

Authors' response:

“the conventional time-marching finite difference method” means that the classical finite difference method which use the forward finite difference to deal with the temporal derivative of the transient partial differential equation. In classical finite difference approach the solution is evaluated stepwise. For better understandings to the readers, “the conventional time-marching finite difference method” will be changed into “the classical finite difference method” In Laplace transform finite difference (LTFD) approach, Laplace transform is performed to remove the temporal derivative and finite difference method is used to discretize the spatial derivatives. The solution is continuous in time, and the numerical error is restricted only to that introduced by discretizing space and evaluating the eigensystem (Sudicky, 1989; Moridis and Reddell, 1991; Sudicky and McLaren, 1992). Therefore, the solutions at any time can be evaluated independent of each other, without evaluation of the solution step by step.

Besides the advantage of the time-continuous characteristic, the LTFD have wider numerical convergence criterion (larger numerical Peclet number for solution convergence).

d. Sensitivity analysis in part 4.2 seems to be not thorough enough?

Authors' response:

The comprehensive and detailed investigations on the sensibility of the primary parameters are included in the revised manuscript.

References

Sudicky, E.A., 1989. The Laplace transform Galerkin technique: a time-continuous finite element theory and application to mass transport in groundwater. *Water Resour. Res.* 25 (8), 1833–1846.

Res. 25 (8), 1833–1846.

Sudicky, E.A., McLaren, R.G., 1992. The Laplace transform Galerkin technique for large-scale simulation of mass transport in discretely fracture porous formations. *Water Resour. Res.* 28(2), 499–513.

Water Resour. Res. 28(2), 499–513.

Moridis, G.J., Reddell, D.L., 1991. The Laplace transform finite difference method for simulation of flow through porous media. *Water Resour. Res.* 27 (8), 1873–1884.

e. Page 4108: lines 27-28: Change the sentence “ we use this analytical solution to carry out the parametric investigation in which the effect of D and k on periodic solute transport are illustrated and discussed” into “ we use this analytical solution to investigate the effect of D and k on the periodic solute transport”;

Authors' response:

This sentence is amended.

f. Page 4109, line 4: add “the” before “concentration”;

Authors' response:

This sentence is amended.

g. Page 4109, line 5: change “large” into “larger”.

Authors' response:

“large” is changed to “larger”

h. Page 4109, line 9: change “solution” into “solutions”;

Authors' response:

“solution” is changed to “solutions”.

i. Page 4109, line 14: delete “due to”;

Authors' response:

“due to” is deleted.

j. Page 4109, line 15: add “,” before “or the input function”;

Authors' response:

This typo is amended.

k. Page 4109, line 20: change “is compared with” into “ is checked by comparing with”;

Authors’ response:

“is compared with” is changed to “ is checked by comparing with”

l. Page 4109, line 21: change “exponential” into “exponentially”;

Authors’ response:

“exponential” is changed to “exponentially”.

m. Page 4109, line 24: delete “the” before “Eq. (24)”; change “with excellent agreements” into “ by the excellent agreements”.

Authors’ response:

These grammatical errors are amended.

n. Page 4109, line 28: add “the” before “development”; change “solution” into “solutions”.

Authors’ response:

This sentence is revised according to the suggestion.

(6) Conclusions

a. page 4110, line 5: change “dependent” into “time-dependent”;

Authors’ response:

“dependent” is changed into “time-dependent”

b. Page 4110, line 19: change “solution” into “solutions”;

Authors’ response:

“solution” is changed to “solutions”;

c. Page 4110, line 22: change “because several” into “ , because some”.

Authors’ response:

“because several” is changed into “ , because some”.