FINITE ELEMENT MASS TRANSPORT MODEL USING DISPERSION TENSORS AS COEFFICIENTS

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If the principle direction of flow coincides with the x-direction, vertically integrated transport equation for conservative substances in the Cartesian frame can be described by the equation with longitudinal and transverse dispersion coefficient. However in the meandering channel, the alignment of the coordinate axes along the principle directions is not possible. In this case, dispersion along and normal to the streamlines can be mapped onto the fixed Cartesian frame of reference. This mapping produces dispersion tensors with the components of D_{xx}, D_{xy}, D_{yx} and D_{yy} which vary with respect to the local velocity vector. With these dispersion tensor, depth-averaged advection-dispersion equation in the Cartesian frame can be written as (Fischer *et al.*, 1979):

$$\frac{\partial(hC)}{\partial t}+\frac{\partial(uhC)}{\partial x}+\frac{\partial(vhC)}{\partial y}-\frac{\partial}{\partial x}\left[h\left(D_{xx}\frac{\partial C}{\partial x}+D_{xy}\frac{\partial C}{\partial y}\right)\right]-\frac{\partial}{\partial y}\left[h\left(D_{yx}\frac{\partial C}{\partial x}+D_{yy}\frac{\partial C}{\partial y}\right)\right]=0$$

The objective of this study is to organize the 2D computational model that includes the physical characteristics of mixing motion especially meandering streams. For the study of physical phenomena, laboratory experiments of tracer test were conducted. S-curved channel was built to represent the meander pattern of natural streams. The finite element method was used to construct the numerical model of depth-averaged mass transport equation. The finite element method is useful to the application in the domain of complex geometry like natural streams. The numerical solutions of constructed model are compared with the result by RMA4 to verify the applicability of constructed model in the meandering channel. And the experimental results were also compared with the numerical solution for verification.

In this study RMA4 produced an inappropriate result for the simulation of dispersion in the meandering channel because RMA4 uses the different governing equation. Numerical results by the governing equation using dispersion tentsor and the experimental results matched well each other.

REFERENCES

Ficher *et al.* (1979). *Mixing in inlands and coastal waters*, Academic Press, Inc.