ANALYSIS OF SHEAR FLOW DISPERSION USING SEQUENTIAL MIXING MODEL

IL WON SEO[1] and EUN WOO SON [2]

[1] Professor, School of Civil, Urban, Geosystem Engrg., Seoul National University.
San 56-1 Shinlim-Dong Gwanak-Gu, Seoul, Korea
(Tel: +82-2-880-7345, Fax: +82-2-873-2684, e-mail: seoilwon@snu.ac.kr)
[2] Graduate Student, School of Civil, Urban, Geosystem Engrg., Seoul National University.
San 56-1 Shinlim-Dong Gwanak-Gu, Seoul, Korea
(Tel: +82-2-880-8355, Fax: +82-2-873-2684, e-mail: eunus99@snu.ac.kr)

The objective of this study is to investigate the one dimensional advection-diffusion process and to develop a new model of shear flow dispersion which can reflect the physical phenomenon properly. Through comparing the results from the model with theory, the theoretical method for determining dispersion coefficient will be developed.

From the Taylor's theory, the main concept of the shear flow dispersion is the balance between longitudinal advection and transverse diffusion. And the transverse distribution of the longitudinal velocity can largely influence the longitudinal dispersion. The one dimensional longitudinal dispersion has the analytical solution following Gaussian distribution.

The sequential mixing model is proposed based on the main concept that the longitudinal advection and the transverse diffusion are separate and additive after reaching the balanced state and the lateral distribution of the longitudinal velocity plays an important role on the mixing process.

From the comparison between the model and the one dimensional advection-diffusion model, the concentration profile from the newly-proposed model showed good agreement with the analytical solution following Gaussian distribution. From fitting the analytical Gaussian solution to the concentration profile of the model, the longitudinal dispersion coefficient observed to have linear relationships with time for mixing t_m and the square of the intensity of the velocity deviation, which coincides with Fischer(1975)'s result. Using a variety of the velocity distributions the dimensionless integral can be deduced to be a power function of the width-to-depth ratio of the channel.

REFERENCES

Fischer, H. B. (1975). "Discussion of 'Simple method for predicting dispersion in stream' by R. S. McQuivey and T. N. Keefer." J. Enbiron. Eng. Div. ASCE, 101(3), 453-455.