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Study on the accuracy of numerical simulations for convection-dominated problems for subsurface environmental protection

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For safety assessment of repository sites, in which highly toxic materials such as nuclear wastes are to be disposed of, it is very important to calculate solute transfer in subsurface area with high accuracy for the quantitative assessment of harmful effect on underground environment and human beings. If conventional numerical methods such as Finite Element Method or Finite Volume Method are used for convection-dominated solute transport problems, it is well known that the mesh size or control volume size should be discretized so that the Peclet number of each mesh or cell in numerical models satisfy less than 2 in order to avoid numerical oscillation. Therefore, if conventional methods are used, a huge volume of computer capacity will be needed for safety assessment of waste disposal facilities located around coastal area where the influence of density-driven flow should not be neglected.
Recently, several kinds of Discontinuous Galerkin Methods are being applied to convection-dominated problems because those methods give high accurate results without numerical oscillation or numerical dispersion on the condition that the Peclet numbers of meshs or cells in the numerical model are even over 2.
In this study, some results of numerical tests for convection-dominated problems by a proposed method, which is based on operator splitting technique by using Mixed Hybrid Finite Element Method and Discontinuous Galerkin Method, are shown.

Keywords: Mixed Hybrid Finite Element Method, Discontinuous Galerkin Method