Chapter 7

Conclusion

In this chapter we will summarize the work done on this dissertation and give some suggestions for future research.

7.1 Summary

A numerical model of the Reaction-Infiltration Instability problem was developed and analyzed. The mathematical model is a coupled nonlinear system of flow, transport, and reaction equations. The nonlinearities present difficulties for accurate numerical modeling. We derived an optimal order a priori error estimates for the discretization of the coupled nonlinear system. Operator-splitting error was also derived. The algorithm we presented to solve this problem is sequential (time-split) and uses the idea of operator splitting. To implement the algorithm we modified the code Parssim 1. We tested the algorithm and verified some of the analytical results numerically using many test problems including a case with parameter resembling a

uranium mill tailings in Wyoming, USA. In particular we verified the effect of the Peclet number and the dispersion on the stability of the front were homogeneous, layered, and heterogeneous porous media were considered.

7.2 Suggestion for future research

There are many points that can be considered for future research in both the analysis and the application part of this work. We list a few:

- Test stability with respect to wave number of the initial perturbation.
- Consider a multi-phase, multi-component systems.
- Use the Characteristics-Mixed Method, [3, 5], to solve the advection part of the transport equation, where no CFL time step constraint is imposed.
- Newton-type method to solve the coupled non-linear system.