Richards Examples

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1 Introduction

The Richards' equation describes slow fluid flow through a porous medium. This document outlines input-file examples for the Richards MOOSE code, drawing mainly upon the test suite. There are two other accompanying documents: (1) The theoretical and numerical foundations of the code, which also describes the notation used throughout this document; (2) The test suite, which describes the benchmark tests used to validate the code.

2 The examples

Each example is located in the *test* directory, which has path

`<install_dir>/trunk/elk/tests/richards`

or the *user* directory, which has path

`<install_dir>/trunk/elk/doc/richards/user`

2.1 Convergence criteria

2.2 Two-phase, almost saturated

If a two-phase model has regions that are fully saturated with the "1" phase (typically this is water), then the residual for the "2" phase is zero. This means the "2"-phase pressure will not change in those regions, potentially violating $P_1 \leq P_2$. If the "2" phase subsequently infiltrates to these regions, an initially crazy P_2 might affect the results. This sometimes also holds for almost-saturated situations, depending on the exact simulation.

In these cases it is useful to add a penalty term to the residual to ensure that $P_1 \leq P_2$. An example can be found in the tests directory `pressure_pulse/pp22.i`. The choice of the a parameter is sometimes difficult: too big and the penalty term dominates the Darcy flow; too small and the penalty term does nothing. In both cases, convergence is poor as the penalty term switches on and off during the Newton-Raphson procedure. The documentation for `RichardsPPenalty` describes how to set a (run MOOSE with a `--dump` flag).

The penalty term should *not* be used unless absolutely necessary as it will lead to poorer convergence characteristics. In many cases it is not necessary.

2.3 An excavation

In the user directory `excav/ex01.i` contains a single excavation, and the associated mass flux and mass balance.