LBNL-4590E

ECO2M: A TOUGH2 Fluid Property Module for Mixtures of Water, NaCl, and CO_2, Including Super- and Sub-Critical Conditions, and Phase Change Between Liquid and Gaseous CO_2

Karsten Pruess

Earth Sciences Division, Lawrence Berkeley National Laboratory
University of California, Berkeley, CA 94720

April 2011
updated September 2013

This work was supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231 with the Lawrence Berkeley National Laboratory.

DISCLAIMER

Abstract

ECO2M is a fluid property module for the TOUGH2 simulator (Version 2.0) that was designed for applications to geologic storage of CO_2 in saline aquifers. It includes a comprehensive description of the thermodynamics and thermophysical properties of H_2O - NaCl - CO_2 mixtures, that reproduces fluid properties largely within experimental error for temperature, pressure and salinity conditions in the range of 10 ˚C ≤ T ≤ 110 ˚C, P ≤ 600 bar, and salinity from zero up to full halite saturation. The fluid property correlations used in ECO2M are identical to the earlier ECO2N fluid property package, but whereas ECO2N could represent only a single CO_2-rich phase, ECO2M can describe all possible phase conditions for brine-CO_2 mixtures, including transitions between super- and sub-critical conditions, and phase change between liquid and gaseous CO_2. This allows for seamless modeling of CO_2 storage and leakage. Flow processes can be modeled isothermally or non-isothermally, and phase conditions represented may include a single (aqueous or CO_2-rich) phase, as well as two-and three-phase mixtures of aqueous, liquid CO_2 and gaseous CO_2 phases. Fluid phases may appear or disappear in the course of a simulation, and solid salt may precipitate or dissolve. TOUGH2/ECO2M is upwardly compatible with ECO2N and accepts ECO2N-style inputs. This report gives technical specifications of ECO2M and includes instructions for preparing input data. Code applications are illustrated by means of several sample problems, including problems that had been previously solved with TOUGH2/ECO2N.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES