

**ECO2M: A TOUGH2 Fluid Property Module for Mixtures of
Water, NaCl, and CO₂, Including Super- and Sub-Critical Conditions, and
Phase Change Between Liquid and Gaseous CO₂**

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Abstract

ECO2M is a fluid property module for the TOUGH2 simulator (Version 2.0) that was designed for applications to geologic storage of CO₂ in saline aquifers. It includes a comprehensive description of the thermodynamics and thermophysical properties of H₂O - NaCl - CO₂ mixtures, that reproduces fluid properties largely within experimental error for temperature, pressure and salinity conditions in the range of $10\text{ }^{\circ}\text{C} \leq T \leq 110\text{ }^{\circ}\text{C}$, $P \leq 600\text{ bar}$, 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 CO₂-rich phase, ECO2M can describe all possible phase conditions for brine-CO₂ mixtures, including transitions between super- and sub-critical conditions, and phase change between liquid and gaseous CO₂. This allows for seamless modeling of CO₂ storage and leakage. Flow processes can be modeled isothermally or non-isothermally, and phase conditions represented may include a single (aqueous or CO₂-rich) phase, as well as two- and three-phase mixtures of aqueous, liquid CO₂ and gaseous CO₂ 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	vii
LIST OF TABLES	ix
PREFACE	1
1. INTRODUCTION	1
2. COMPONENTS, PHASES, AND THERMODYNAMIC VARIABLES	
IN THE SYSTEM Water-NaCl-CO ₂	3
2.1 Treatment of Dissolved and Solid Salt	7
2.2 Partitioning of Fluid Components among Phases	8
2.3 Phase Change	13
2.4 “Hairtrigger” vs. “Finite Window” for Phase Change	15
2.5 Conversion of Units	16
3. THERMOPHYSICAL PROPERTIES OF Water-NaCl-CO ₂ MIXTURES	18
3.1 Density	20
3.2 Viscosity	21
3.3 Specific Enthalpy	21
4. HEAT EXCHANGE WITH IMPERMEABLE REGIONS	25
5. PREPARATION OF INPUT DATA	28
5.1 Initialization Choices with ECO2N-style Primary Variables	28
5.2 Permeability Change from Precipitation and Dissolution of Salt	32
5.3 Choice of Program Options	34
6. SAMPLE PROBLEMS	40
6.1 Problem No. 1 (*rtab*) - Demonstration of Initialization Options	40
6.2 Problem No. 2 (*rcc3*) - Radial Flow from a CO ₂ Injection Well	44
6.3 Problem No. 3 (*r1d*) - CO ₂ Leakage from a Deep Fault Zone	49
6.4 Problem No. 4 (*rwaf*) - Migration of a CO ₂ Plume in a Sloping Aquifer, Intersected by a Fault	61
7. CONCLUDING REMARKS	71
ACKNOWLEDGEMENT	72
REFERENCES	73

APPENDIX A. Three-Phase Relative Permeabilities	77
APPENDIX B. Three-Phase Capillary Pressures	81
APPENDIX C. Notation for Mass Fractions	83

LIST OF FIGURES

Figure 1.	Possible phase combinations in the system water-CO ₂	4
Figure 2.	Phase states of CO ₂	4
Figure 3.	Dissolved CO ₂ mass fractions at T = 30 °C for pure water (0m) and 4-molar NaCl brine	9
Figure 4.	H ₂ O mass fractions in gas at T = 30 °C for pure water (0m) and 4-molar NaCl brine	10
Figure 5.	Concentration of water in gas and CO ₂ in the liquid (aqueous) phase for salinities ranging from zero to fully saturated	10
Figure 6.	CO ₂ phase partitioning in the system H ₂ O - NaCl - CO ₂	11
Figure 7.	Schematic of the temperature-pressure tabulation of CO ₂ properties	19
Figure 8.	Model for converging-diverging pore channels	33
Figure 9.	Porosity-permeability relationship for tubes-in-series model	34
Figure 10.	TOUGH2/ECO2M input file for sample problem 1	41
Figure 11.	Primary variables internally used in ECO2M for the INCON data given in Fig. 10	43
Figure 12.	Output data for sample problem 1	43
Figure 13.	Schematic of sample problem 2 - radial flow from a CO ₂ injection well	44
Figure 14.	TOUGH2 input file for grid generation for radial injection problem	45
Figure 15.	Modified MESH file for radial injection problem	45
Figure 16.	TOUGH2/ECO2M input file for radial injection problem	46
Figure 17.	Part of printed output for radial flow problem	47
Figure 18.	Part of printed output for radial flow problem with permeability reduction from solids precipitation	48
Figure 19.	T,P-diagram of a typical geothermal-hydrostatic profile	49
Figure 20.	TOUGH2 input file for generating a 1-D vertical grid for a fault zone	50
Figure 21.	Modified MESH file for 1-D vertical fault leakage problem	51

Figure 22.	Input file for generating a static geothermal-hydrostatic profile	52
Figure 23.	Part of printed output for obtaining a geothermal-hydrostatic profile	53
Figure 24.	Input file for CO ₂ migration along a fault zone	54
Figure 25.	Part of printed output for fault leakage problem	56
Figure 26.	Part of printed output for continuation run of fault leakage problem	57
Figure 27.	Saturation and temperature profiles at different times	59
Figure 28.	Time dependence of water and CO ₂ outflow at the landsurface, and temperatures at two different depths	59
Figure 29.	Water and CO ₂ fluxes as shown in Fig. 28, with the heavy superposed lines indicating the top and bottom of three-phase conditions, respectively	60
Figure 30.	Temperature-pressure profiles at different times	60
Figure 31.	Geometric dimensions of the 2-D rectangular domain modeled	61
Figure 32.	Computational grid showing the entire aquifer (top) and a zoom into the region with refined gridding (bottom)	62
Figure 33.	TOUGH2/ECO2M input file for a problem of CO ₂ plume migration in a sloping aquifer that is intersected by a vertical fault	65
Figure 34.	Part of printout of primary variables at beginning of run	66
Figure 35.	Part of printed output for CO ₂ plume migration and leakage problem	67
Figure 36.	Water fluxes at the top and bottom of the fault	68
Figure 37.	CO ₂ fluxes at the top and bottom of the fault	69
Figure 38.	Advancement of the plume over time	69
Figure 39.	CO ₂ plume at t = 178.6 yr, for a case without a leaky fault present, simulated with TOUGH2/ECO2N	70

LIST OF TABLES

Table 1.	Fluid components in ECO2M	3
Table 2.	Primary thermodynamic variables used for multiphase mixtures of brine and CO ₂	7
Table 3.	Molecular weights in the system H ₂ O–NaCl–CO ₂	17
Table 4.	Parameters for molar volume of dissolved CO ₂	20
Table 5.	Dissolved aqueous CO ₂ mass fractions along the CO ₂ saturation line	24
Table 6.	ECO2N-style primary variables	29

