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Transient two-phase injection of CO_2 in a wellbore

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Fluid injection in a pipeline is commonly modeled solving the momentum, energy and mass balance equations averaged across the section of the pipe. We propose simplifying this set of complex equations, for cases of moderate velocities, where inertial terms can be neglected. We approximate momentum conservation by generalizing traditional water conduit equations (e.g. Darcy-Weisbach equation, Manning's formula, Hazen-Williams equation) for compressible, variable density and viscosity fluids. Temperature, density and mass fractions are computed using the Span and Wagner equation of state. Viscosity and thermal conductivity are obtained from Vesovic et al and Fenghour et al, respectively.

We test the validity of the proposed formulation using a model of CO_2 injection in a vertical pipe with wall heat transfer. We consider different inflows and temperatures of the injected fluid in order to study optimal and safety conditions in the procedure of the injection. Using boundary conditions, the pipeline model can be coupled to a reservoir model, adding realism to both.

This work will help to design CO_2 injection procedure in the CCS project that will take place in Hontomín (Burgos, Spain).