ISBN: 978-1-912532-05-6

CO_2 injection in liquid state as an efficient storage concept for reducing greenhouse gas emissions

Victor Vilarrasa
Institute of Environmental Assessment and Water Research, Spanish National Research Council (IDAEA-CSIC)
Associated Unit: Hydrogeology Group (UPC-CSIC)
c/ Jordi Girona 18-26
08034 Barcelona, Spain

victor.vilarrasa@idaea.csic.es

Talk Abstract

Deep geological formations have a great potential to significantly reduce carbon dioxide (CO_2) emissions to the atmosphere through both geologic carbon storage and geothermal energy. Geologic carbon storage permits storing large amounts of CO_2, in the order of tens of millions of tons of CO_2 per storage site. However, it may be argued that the economic costs are excessively high and that a CO_2 should be utilized somehow to make injection profitable. A promising solution is to use CO_2 as circulating fluid to produce geothermal energy because CO_2 is more efficient than water. We propose to inject CO_2 in liquid state, rather than in supercritical conditions, which are the conditions at which CO_2 will stay once it equilibrates with the pressure and temperature of storage formations. Liquid CO_2 has a higher density than supercritical CO_2, which significantly reduces the required compression energy at the wellhead because CO_2 flows downwards mainly by gravity. If liquid CO_2 injection is combined with production of supercritical CO_2 from the storage formation a thermosiphon is created, which permits circulating CO_2 at a minimum operational costs and generate carbon-free geothermal energy. The potential downside of liquid CO_2 injection is that the rock around the injection well is cooled down, which generates contraction and thermal stress reduction, which eventually could reactivate fractures or even promote hydraulic fractures. We assess the geomechanical stability of the caprock as a result of this cooling and find that a stress redistribution occurs around the cooled region, which tightens the caprock. Overall, liquid CO_2 injection is an energetically efficient injection concept that can permit both reducing CO_2 emissions to the atmosphere and to generate geothermal energy. The targeted audience are scientists and engineers interested in geothermal energy and coupled processes occurring in the subsurface.

Keywords
Geologic carbon storage, geothermal energy, CO_2 injection, cooling, geomechanics.

Short biography

Victor Vilarrasa is a researcher at the Institute of Environmental Assessment and Water Research, Spanish National Research Council (IDAEA-CSIC). His research deals with dimensional analysis and modeling of coupled thermo-hydro-mechanical-chemical (THMC) processes related to geo-energy and geo-engineering applications. One of his main interests is to understand the effects of fluid injection in

ISBN: 978-1-912532-05-6

the subsurface. Fluid injection results in pressure buildup and cooling that brings the stress state closer to failure conditions, which may induce seismic events. He applies his research to several geo-energy applications, including CO_2 storage, geological nuclear waste disposal and enhanced geothermal systems.

DOI: http://dx.doi.org/10.17501..