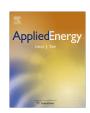


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A review of physical modelling and numerical simulation of long-term geological storage of CO₂

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ABSTRACT

Numerical simulations are essential to the understanding of the long-term geological storage of CO_2 . Physical modelling of geological storage of CO_2 has been based on Darcy's law, together with the equations of conservation of mass and energy. Modelling and simulations can be used to predict where CO_2 is likely to flow, to interpret the volume and spatial distribution of CO_2 under storage conditions, and to optimise injection operations. The state of the art of physical modelling and numerical simulation of CO_2 dispersion is briefly reviewed in this paper, which calls for more accurate and more efficient modelling approaches. A systematic evaluation of the numerical methods used and a comparison between the streamline based methods and the grid based methods would be valuable. Multi-scale modelling may prove to be of great value in predicting the long-term geological storage of CO_2 , while highly accurate numerical methods such as high-order schemes may be employed in numerical simulations of CO_2 dispersion for local transport calculations.

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1. Introduction

The potential role of carbon abatement technologies in reducing greenhouse gas emissions has gained much increased recognition and importance internationally in recent years [1–4]. Early rapid deployment of carbon dioxide (CO₂) capture and storage (CCS) technologies is now recognised as an important issue in meeting climate change mitigation targets and providing a serious option worldwide. The development and deployment of CCS technology can have a profound impact on the energy sector including energy

policies [5–7]. The geological storage of CO_2 currently represents the best and likely the only short-to-medium term option for significantly enhancing CO_2 sinks, thus reducing net carbon emissions into the atmosphere [8]. CCS can be effectively integrated into various energy systems. For instance, a liquefied energy chain for transport and utilisation of natural gas for power production with CCS was investigated [9–12]. Other investigations included integration of carbon capture onto electric power generation for offshore operations [13], power generation combining solid oxide fuel cell and oxy-fuel combustion for carbon capture [14], as well as an industrial test and techno-economic analysis of carbon capture in a coal-fired power station [15]. As it stands, CCS is the only industrial scale process capable of capturing large quantities of CO_2 at source and burying it beneath the earth's surface.

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