Modeling convective dissolution of Carbon dioxide and finger development with the exponential decay and power laws.

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The practice of carbon capture and storage effectively lowers greenhouse gas emissions and mitigates climate change and global warming. To determine whether long-term geological CO2 sequestration is safe and practical, scientists have increasingly relied on model-based predictions of CO2 behaviour beneath the earth's surface in recent years. This investigation aims to grasp the CO2 dissolution trapping process and to develop mathematical models depicting the behaviour of the CO2 convective dissolution process (Fingering) in saline aquifers. This comprehension will eventually help to ensure that the CO2 plume stays inside the designated locations of CO2 storage. The approach involved employing the concept of fractional differentiation by replacing the classical time derivative with the Caputo fractional derivative and the Caputo-Fabrizio derivative. These two differential operators are based on kernels whose properties appear naturally in several real-world problems. We presented some examples of the Bode and phase diagrams to underpin the effect of power law and exponential decay kernel. We used some numerical schemes to derive numerical solutions for each case. Numerical simulations are obtained for various fractional orders.