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Gravity Induced Mixing of Miscible Fluids in Vertical and Inclined Tubes

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Gravity induced mixing of two miscible fluids in a long tube is studied as a function of the tube tilt angle from vertical θ and of the density contrast characterized by the Atwood number At. At high At values and/or low θvalues, the relative concentration of the two fluids follows a macroscopic diffusion law characterized by a diffusion coefficient D increasing strongly with the tube tilting (by a factor of 100 between 0 and 70^o). At higher θ values and/or for low density contrasts, a segregation of the two fluids in the tube section is induced by gravity resulting in a stable counterflow with little mixing at the interface. The Atwood number corresponding to the transition between the diffusive and counterflow regimes increases strongly with the deviation angle from $At = 10^{-4}$ for $\theta = 0^\circ$ to $At = 5 \times 10^{-2}$ for $\theta = 80^\circ$.

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