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The Ranz Stretch model and its extensions applied to mixing and reversibility PAVITHRA SUNDARARAJAN, JOSEPH KIRTLAND, DONALD KOCH, ABRAHAM STROOCK, Cornell University — Mixing and separation are central to several chemical systems and are often carried out using microfluidics. Flow in a microfluidic device is usually in the laminar or Stokes regime. So mixing - a combination of stirring and diffusion - is often performed using chaotic flows which stir much faster than non chaotic flows. For separation of solutes of different diffusivities, Heller proposed the principle of Separation by Diffusive Irreversibility (SDI) which combines the reversibility of stirring and irreversibility of diffusion. Fundamental to both mixing and SDI is the interplay of convection and diffusion which is difficult to understand because of the challenging nature of convective coupling of solute concentration and the flow in the governing convective diffusion equation. Our approach is to use the Ranz model which observes the evolution of a single strand of concentration in the local linear flow. While this model captures the qualitative behavior of the chaotic and non chaotic flows, it fails to quantitatively predict the scaling of mixing and separation characteristics. Our goal is to identify a set of parameters that quantify the effects of stretch history and distribution and the presence of islands on mixing and separation. I will present a study of these effects, and the extensions of Ranz model incorporating these effects. I will compare the results from the model to the numerical simulation. The model will improve our understanding of mixing and irreversibility in Stokes flows.

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