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Transition to vortex shedding and its impact on heat and solute transport in membrane filtration systems[1] JINCHENG LOU, JACOB JOHNSTON, NILS TILTON, Colorado School of Mines, DR. TILTON'S RESEARCH LAB TEAM — We perform direct numerical simulations (DNS) to investigate the hydrodynamic stability of flow over a cylinder confined in a planar channel with a permeable wall. More specifically, we investigate how cylinder configuration influences transition to laminar vortex shedding, and how this impacts thermal and concentration boundary layers forming on the permeable wall. This flow plays an important role in modern desalination processes that use permeable membranes to remove solutes from feed solutions. The efficiency of these processes are reduced by the formation of thermal and solute boundary layers on the membrane surfaces. This has motivated considerable interest in disrupting these layers using nearby obstacles that generate vortex shedding. We show that while vortex shedding can indeed increase system efficiency by increasing transmembrane flow, it also generates recirculation zones on the membrane surface that lead to solute accumulation and precipitation. Such precipitation is known to damage membranes when treating complex feed solutions. The coupled momentum, energy, and mass transport equations are solved using a finite-volume method with recent advances in immersed boundary methods to enforce no-slip and no-flux conditions to second order spatial and temporal accuracy.

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