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Hydrodynamic instabilities and concentration polarization coupled by osmotic pressure in a Taylor-Couette cell DENIS MARTINAND, Aix-Marseille Universit, NILS TILTON, Colorado School of Mines — This study addresses analytically and numerically the coupling between hydrodynamic instabilities and osmotic pressure driven by concentration polarization. The configuration consists of a Taylor-Couette cell filled with a Newtonian fluid carrying a passive scalar. Whereas the concentric inner and outer cylinders are membranes permeable to the solvent, they totally reject the scalar. As a radial in- or outflow of solvent is imposed through both cylinders, a concentration boundary layer develops on the cylinder where the solvent exits, until an equilibrium steady state is reached. In addition, the rotation of the inner cylinder is used to drive centrifugal instabilities in the form of toroidal vortices, which interact with the concentration boundary layer. By means of the osmotic pressure, concentration polarization is found to promote or hinder the hydrodynamic instabilities, depending on capacity of the vortices and diffusion to increase the concentration field at the membrane. The results obtained by analytical stability analysis agree with dedicated Direct Numerical Simulations.

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