IAN FRIGAARD, UBC

Visco-plastic fluid displacements in horizontal narrow eccentric annuli: stratification and traveling wave solutions

We consider laminar displacement flows in narrow eccentric annuli, oriented horizontally, between 2 fluids of Herschel–Bulkley type, (*i.e.*, including Newtonian, power law and Bingham models). This situation is modeled via a Hele–Shaw approach. Whereas slumping and stratification would be expected in the absence of any imposed flow rate, for a displacement flow we show that there are often steady state traveling wave solutions in this displacement. Surprisingly these may exist even at large eccentricities and for large density differences between the fluids. When heavy fluids displace light fluids, annular eccentricity opposes buoyancy and steady states are more prevalent than when light fluids displace heavy fluids. For large ratios of buoyancy forces to viscous forces we derive a lubrication-style displacement model. This simplification allows us to find necessary and sufficient conditions under which a displacement can be steady, which can be expressed conveniently in terms of a consistency ratio. It is interesting that buoyancy does not appear in the critical conditions for a horizontal well. Instead a competition between fluid rheologies and eccentricity is the determining factor. Buoyancy acts only to determine the axial length of the steady state profile.

This is joint work with M. Carrasco-Teja, B. Seymour and S. Storey.