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Flow in an evaporating sessile drop HASSAN MASOUD, JAMES D. FELSKE, Department of Mechanical and Aerospace Engineering, State University of New York at Buffalo, Buffalo, New York 14260 — Exact analytical solutions are derived for the Stokes flows within evaporating sessile drops of cylindrical and spherical cap shapes. The results are valid for arbitrary contact angle. The field equations, $E^4\psi = 0$ and $\nabla^4\psi = 0$, are solved for the spherical and cylindrical cases, respectively. For the spherical cap, when the contact angle lies in the range $0 \leq \theta_c < \pi/2$, the boundary condition defined by the solution to the vapor phase transport must be modified since it becomes non-physical (singular) at the contact line. Solutions are obtained for any physically meaningful distribution of mass flux along the free surface as long the flux approaches a constant value at the contact line. The vapor phase transport has been written to include the mean flow velocity induced by the mass transfer. This leads to advective transport in the vapor phase in contrast to the simple diffusive transport which has been previously treated. The computed solutions demonstrate that the streamlines for viscous flow lie farther from the substrate than the corresponding streamlines for inviscid flow.

Hassan Masoud
Department of Mechanical and Aerospace Engineering,
State University of New York at Buffalo, Buffalo, New York 14260

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