*Transport in Porous Media* **32:** 237, 1998.



*Letter to the Editor*

# Closure on Free Surface Transport in Response to Nield's Note

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Equation (9) of Chen, S.C. and Vafai, K., *Numerical Heat Transfer J. A* **31** (1997), 235–254, is applied based on the macroscopic point of view of the free surface. We are very well aware of the complexity of the microscopic point of view for the free surface. However, as the abstract, introduction and conclusions make it abundantly clear, this paper was intended to address non-Darcian effects which were mostly ignored in previous studies for these types of applications. More and more applications are geared towards higher Reynolds number flows as mentioned in the paper. The statement of 'For Darcy's model . . . ' is based on the macroscopic point of view instead of the microscopic point of view for the free surface. More importantly, as stated on p. 253, the surface tension effect on the free surface momentum transport is significant only for low Re flows. For higher Reynolds number flow applications, as the paper is intended for, the effect becomes insignificant. It is obvious that the pore-level curvature of the free surface is important; however, our approach is consistent with the modeling done based on macroscopic field equations and lack of detailed data at the pore-level. It should be noted that the solution presented by Nield is, as noted by him, essentially a subset of the solution given by us in an earlier work.

In essence the point raised by Nield is a non-issue. Of course, it is good to take the complexity of the microscopic point of view for the free surface into account; it is also good to take the molecular spacing into account! When we are modeling the process at the macroscopic level then we cannot solve for these at each individual pore level. This is understood.