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Letter to the Editor

Comments on "Bulk mean temperature in porous medium analysis"

Jang et al. [1] introduced what they call the bulk mean temperature in a porous medium, a quantity they defined (their Eq. (1)) as the average, over what is effectively (though the authors are not explicit about this) a representative elementary volume (REV), of the intrinsic temperature weighted by the intrinsic velocity. They claimed that it was because it is very difficult to calculate this quantity that many investigators, including the present writer (they cite [2]), have used a bulk mean temperature defined as the REV average of the REV averaged temperature weighted with the REV averaged velocity (Darcy velocity) (their Eq. (2)). This is a faulty representation of the work of those previous investigators in two respects. First, the bulk temperature defined in [2] and in similar papers, in connection with forced convection in a channel, is an average not over an REV but over the cross-section of the channel. That means that it represents something completely different—a truly bulk average rather than just a local average. Second, it is true that it is a Darcy-velocity weighted average of an REV temperature that is used, but this is done for a very good reason. It is done because the Nusselt number, defined in terms of a bulk temperature defined in this way, is compatible with the Nusselt number derived from the REV temperature distribution. (This distribution is in turn obtained from the governing differential equations, expressed in terms of the REV velocity and the REV temperature, that are appropriate for the analysis of the physical problem.) In other words, the traditional analysis would be inconsistent if any other definition of the bulk mean temperature were to be employed. Thus the refinement introduced in [1] is not relevant to the traditional physical problems with which the present writer is familiar.

References

[1] S.P. Jang, S.J. Kim, S.U.S. Choi, Bulk mean temperature in porous medium analysis, Int. J. Heat Mass Transfer 47 (2004) 5603–5607.
[2] D.A. Nield, A.V. Kuznetsov, Local thermal nonequilibrium effects in forced convection in a porous medium channel: a conjugate problem, Int. J. Heat Mass Transfer 42 (1999) 3245–3252.

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