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LETTER TO THE EDITORS

NOTE ON GAS MIXING IN ROD BUNDLES

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IN THEIR "shorter communication" on gas mixing in rod bundles, Ingesson and Kjellström [1] discuss our conclusion (Skinner, Freeman and Lyall [2]) that the high rate of transfer of heat or mass through the gaps between the rods is due to secondary flows. They conclude that this is not necessarily the explanation, but that the high rate may, in fact, be due to turbulent diffusion.

In our paper we write that Hanjalic and Launder [3] measured values of v'/u of 18 per cent in a rough duct. Unfortunately this statement was not correct, the 18 per cent applies to $u'/\bar{u}$, the figure for $v'/\bar{u}$ is more like 10 per cent. Thus Ingesson and Kjellström's expression for $(\theta'_i - \theta'_j)$ becomes:

$$(\theta'_i - \theta'_j) = 0{\cdot}15\,(\bar{\theta}_i - \bar{\theta}_j).$$

If we assume that the mixing length in the gap region is set locally, rather than by the larger scale turbulent motions that can occur in the wider parts of the channel, then a reasonable expression to use for l would be $0{\cdot}14\,\hat{y}$ (Schlichting [4]) where $\hat{y}$, the distance to the surface of no shear, is half the gap width. For our geometry this gives an l of about $0{\cdot}02\,\delta_{ij}$, compared with the $0{\cdot}15\,\delta_{ij}$ implied above.

However, more direct evidence of secondary flows in a gap region is now available [5] and was briefly referred to in [2]. In addition, recent unpublished work at this laboratory has shown that in a square duct with all the walls equally roughened, secondary velocities of over 6 per cent of the local primary velocity can occur. Also Jonsson and Sparrow [6] deduced that significant secondary flows were present in some of the configurations of eccentric annuli they tested.

The expression for eddy diffusivity used in the HECTIC programme (even when the obvious misprint in equation (2) of reference [1] is corrected) although good for a pipe, is at least a factor of two too great for an annulus [7] and probably also for a rod cluster. Use of Rapier's expression [8] would double the value of Y obtained by Ingesson and Kjellström showing an even bigger breakdown of the simple turbulent diffusion theory. Of course if a length scale appropriate to the gap region rather than to the cluster as a whole is used in the expression for eddy diffusivity, even larger Y values will be obtained.

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H. G. LYALL

Central Electricity Generating Board
Berkeley Nuclear Laboratories
Gloucestershire
England