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LETTERS TO THE EDITORS

IMPROVED HEAT-TRANSFER PERFORMANCE WITH BOUNDARY-LAYER TURBULENCE PROMOTERS

IN THIS paper [1] are presented the results of a series of experiments on roughened rod cluster performance. The tests have obviously been very carefully carried out, and provide useful data on the performance of that type of surface. However we feel that the statement that "Wilkie's results show a substantial relative roughness effect which was not apparent in either Sheriff and Gumley or in Sutherland's investigation" needs further elaboration. For instance, we would ask whether Wilkie's results are directly comparable with the other two bearing in mind that the former were carried out on integral square ribs, whereas the latter were both done on wire wound surfaces. It seems to us that a wire-wound surface can be correctly referred to as a turbulent promoter, since the uncertain contact of the wire with the rod would make any direct contribution of the roughness to the rod performance unlikely. But this is certainly not the case with integral ribs where not only is there a significant change in surface area over the range of surfaces tested by Wilkie (143–251 in^2/ft) but there is also a relatively high heat-transfer coefficient on top of the rib [2]. It appears to us therefore that the performance of an integrally ribbed surface can be influenced considerably by the shape and dimensions of the rib and in fact results of work which we are carrying out at the present time support this argument, although not perhaps to the extent indicated by Wilkie's results. Thus we suggest that it is most important to emphasise that Sutherland's conclusion "once fully rough conditions have been established, the heat-transfer performance is the same for all promoter sizes" has, in his paper, only been demonstrated for wire winding and does not apply to integral ribs.

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IMPROVED HEAT-TRANSFER PERFORMANCE WITH BOUNDARY-LAYER TURBULENCE PROMOTERS

THE PAPER by Sutherland [1] is very relevant to our own heat-transfer investigations in connection with roughened rod cluster fuel elements for gas-cooled nuclear reactors, and we have studied it with interest but some difficulty. The difficulty perhaps arises from over-compression and a certain looseness of definition which leave a number of points obscure even after reference to an earlier paper by Sutherland and Kays [2]. For example:

(a) On p. 1590 it is stated that "Finally, we are limiting our scope to fully developed flow so that the results may be used with the superposition technique to handle the non-uniformly heated rod array". Subject to reservations to be made later, the data given will handle a non-uniformly heated array, i.e. non-uniform *across* the array. They will also handle non-uniformity of heat flux in the *axial* direction provided the starting-point for heating is not in the hydrodynamic entry region. Superposition is also applicable to the hydrodynamic entry region provided experiments have been carried out to establish the basic solutions for a step-change in heat flux starting at various points in the hydrodynamic entry region. The overall experimental programme would of course be very much larger than that reported by Sutherland.
(b) When measurements were made for "uniformly heating the array" did that include the ring of partial rods?