Int. J. Heat Mass Transfer. Vol. 27, No. 3, p. 463, 1984
Printed in Great Britain

0017–9310/84 $3.00 + 0.00
Pergamon Press Ltd.

TECHNICAL NOTES

THE SENFTLEBEN EFFECT IN CROSS-FLOW HEAT EXCHANGE AND THE PART PLAYED BY ELECTRONIC CONDUCTION

P. COOPER and P. H. G. ALLEN
Department of Electrical Engineering, Imperial College of Science and Technology, Exhibition Road, London SW7 2BT, U.K.

(*Received* 10 *February* 1983)

THE ABOVE paper was published in *PhysicoChemical Hydrodynamics* 4(2), 85–101 (1983). It describes the effect of electric stress on heat transfer to and from the oil side of an elementary oil/water shell/tube heat exchanger. Figure 1 shows a section through the experimental duct which has a length of 127 mm perpendicular to the plane of the diagram.

The effect on enhancement/inhibition of electrode polarity with respect to the earthed tubes, of oil velocity and gas content and of thermal flux are demonstrated (see Fig. 2). Due to the part played by electronic conduction in the generation of electrophoretic forces and to its variation with temperature and other factors, there are difficulties in applying existing non-dimensional groupings to the correlation of such results. The problems are discussed and suggestions made for yet further improvement. For zero electric stress conditions, good agreement is shown when heat transfer is correlated with Zukauskas's results for cross-flow in tube banks [1].

REFERENCE

1. A. Zukauskas, Heat transfer from tubes in cross-flow, *Adv. Heat Transfer* **8**, 93–160 (1972).

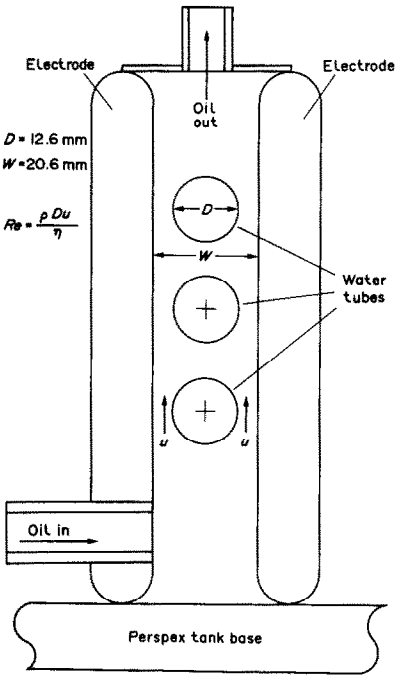

FIG. 1. Experimental duct.

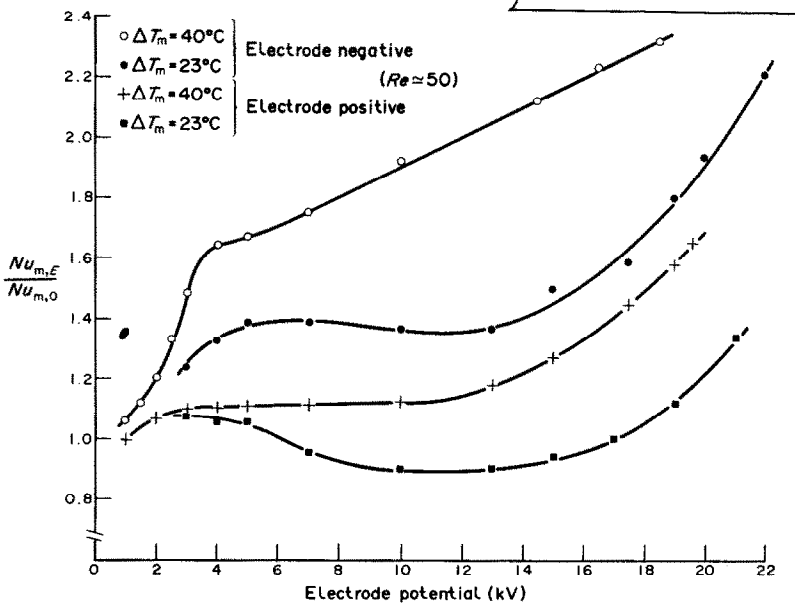

FIG. 2. Ratio of oil-side Nusselt numbers to zero stress values as a function of electric field polarity/magnitude and oil–water temperature difference. $Nu_{m,0}$, mean oil-side Nusselt number with zero applied field; $Nu_{m,E}$, mean oil-side Nusselt number (under identical thermal and hydrodynamic conditions) with applied electric field; and ΔT_m, difference of mean inlet/outlet temperatures for oil and water.