World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

An Experimental Study on Heat and Flow Characteristics of Water Flow in Microtube

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Abstract : In the current research, the single phase fluid flow and heat transfer characteristics are experimentally investigated. The experiments are conducted to cover transition zone for the Reynolds numbers ranging from 100 to 4800 by fused silica and stainless steel microtubes having diameters of 103-180 μm. The applicability of the Logarithmic Mean Temperature Difference (LMTD) method is revealed and an experimental method is developed to calculate the heat transfer coefficient. Heat transfer is supplied by a water jacket surrounding the microtubes and heat transfer coefficients are obtained by LMTD method. The results are compared with data obtained by the correlations available in the literature in the study. The experimental results indicate that the Nusselt numbers of microtube flows do not accord with the conventional results when the Reynolds number is lower than 1000. After that, the Nusselt number approaches the conventional theory prediction. Moreover, the scaling effects in micro scale such as axial conduction, viscous heating and entrance effects are discussed. On the aspect of fluid characteristics, the friction factor is well predicted with conventional theory and the conventional friction prediction is valid for water flow through microtube with a relative surface roughness less than about 4 %.

Keywords : microtube, laminar flow, friction factor, heat transfer, LMTD method
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020