

Thermo-Hydraulic Performance of Horizontal Circumferentially Ribbed Double Pipe Heat Exchanger

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Abstract

Heat transfer coefficient and pressure drop for water flow inside circumferential ribbed tubes with different rib dimensions have been determined experimentally. The data of ribbed tubes were compared with that of a plain tube. The experimental test section is a horizontal counter flow concentric tube heat exchanger with circumferentially ribbed inner tube. The ribbed tubes tested in this investigation have the ranges: circumferential depth from 0.5 to 1.5 mm and axial pitch distance from 5 to 15 mm. Water was used as the working fluid, where hot water flows in the inner tube and cold water flows in the annulus. The test runs are done at water flow rates ranging between 0.1 and 1.0 m³/h. The inlet cold and hot water temperatures are between 20 and 30 °C and between 40 and 60 °C, respectively. Comparison of experimental data of circumferentially ribbed tubes with smooth tube have shown that the heat transfer coefficient and pressure drop, quantified by means of Nusselt number and friction factor, are around 1.92 to 5.61 and 1.25 to 3.41 times higher than smooth tube depending on the circumferential geometric parameters and mass velocity of the working fluid. New correlations based on the data gathered during this work for predicting Nusselt number and friction factor for the circumferential ribbed tube heat exchanger have been proposed. The proposed correlations can predict the experimental data with average relative error of $\pm 6\%$ for Nusselt number and $\pm 5\%$ for friction factor.

Keywords: Circumferentially ribbed tube; double pipe; Heat exchanger.

الأداء الحراري-الهيدروليكي لمبادل حراري أفقي مزدوج الأنابيب مضلع بشكل محيطي

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الخلاصة:

تم حساب معامل انتقال الحرارة و هبوط الضغط لتدفق الماء داخل الانابيب المضلعة بشكل محيطي وبأبعاد تضليع مختلفة تجريبيا. بيانات الانابيب المضلعة تم مقارنتها مع تلك الخاصة بالانابيب الناعم. ان مقطع الاختبار التجريبي هو عبارة عن مبادل حراري أفقي متركز الانبوب ومتعكس الجريان مع انبوب داخلي مضلع بشكل محيطي. الانابيب