
Heat transfer intensification in helium plant assemblies

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Russian cryogenic helium plants feature helical-coil heat exchangers made of copper tubes ribbed with copper wire, so that the heat exchanger surface becomes statistically homogeneous. This structure the right conditions to distribute the flow evenly in the heat exchange annulus. Low parallel flow pressure in KGU-5000/4,5 and a related decrease in heat transfer coefficient in the annulus made us search for possible ways of intensifying heat transfer in the pipe without increasing the size and mass of heat exchangers. We analysed the works of R. Koch and E.K. Kalinin, which lead us to selecting intensifier shape and dimensions so that they look like smoothly outlined ridges. Studies of four test heat exchangers made of wire-ribbed tubes manufactured with and without intensifiers confirmed the technological feasibility of producing a tube-based helical-coil heat exchanger out of tubes ribbed with wire, with internal intensifiers in the shape of smoothly outlined ring-shaped ridges. We determined that the heat transfer coefficient inside tubes with intensifiers is approximately twice as high as that in a smooth tube under comparable conditions. We managed to decrease the size and dimensions of these heat exchangers to install them in a large helium plant.

Keywords: heat exchanger, tube, wire ribbing, heat transfer intensification, heat transfer coefficient, ring-shaped diaphragm ridges, cryogenic helium plant, statistically homogeneous structure

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