

Abstract

This work presents an experimental study of the heat transfer characteristics for cross flow air cooled single tube multi passes (smooth and integral low finned tube) and the effect of the integral low fins in enhancement the heat transfer. Two test sections were designed and manufactured from Perspex with dimensions (251´477´370) mm width, height and length, respectively. Each test section has a test tube (single aluminum tube multi passes) with eight or four passes, and the distance between center to center of passes is 55 mm. The first test section used for testing has the smooth aluminum tube of (17, 19) mm inner and outer diameter, respectively, while the second test section for testing has the integral low finned aluminum tube of inner diameter 17 mm, root diameter 19 mm and outer diameter to the tip of fins 22 mm. Each pass has length 251 mm inside the duct with 125 fins (500 fins per meter), the fin height 1.5 mm, thickness 1 mm and pitch 1 mm.

The velocities of air across the test section are (1, 2 and 3) m/sec, and the water flow rates are (3, 4 and 5) l/min. The temperatures of the inlet water to the test tube are (50, 60, 70, 80) oC. The thermal imager technique (IR - fusion camera) was used to measure the surface temperatures of the test tube. A series of experiments was conducted over a wide range of the above mentioned variables with different Reynolds numbers, and all effects of these variables were studied. The experimental results showed that the air side heat transfer coefficient of the integral low finned tube was higher than that of the smooth tube. The enhancement ratio when using the integral low finned tube was (1.86 to 2.38) for eight and four passes. Also, increasing of air velocity will improve the outside heat transfer coefficient.

This work presents empirical correlations for the air side heat transfer coefficient of an integral low finned tube, represented by the empirical correlations for the air side Nussult's number. Sample of these correlations is the following empirical correlation at water flow rate (5 l/min) and inlet water temperature (60 oC):

For eight passes:

$$Nua = 3.8435 (Rea)^{0.3996} Pr^{1/3}$$

For four passes:

$$Nua = 5.3051 (Rea)^{0.3982} Pr^{1/3}$$