World Academy of Science, Engineering and Technology
International Journal of Industrial and Manufacturing Engineering
Vol:11, No:01, 2017

Design of Tube Expanders with Groove Shapes to Reduce Deformation of Tube Inner Grooves in Copper Tube Expansion

Authors : I. Sin, H. Kim, S. Park

Abstract : Fin-tube heat exchangers have grooves inside tubes to improve heat exchange performance. However, during the tube expansion process, heat exchange efficiency is decreased due to large deformation of tube inner grooves. Therefore, the objective of this study is to design a tube expander with groove shapes on its outer surface to minimize deformation of the inner grooves in copper tube expansion for fin-tube heat exchangers. In order to achieve this goal, first, we have tried to calculate tube inner groove deformation by the currently used tube expander without groove shapes on its surface. The tube inner groove deformation was acquired by elastoplastic finite element analysis from the boundary conditions with one tube end fixed and friction between the tube and tube expander (friction coefficient: 0.15). The tube expansion process was simulated by inserting the tube expander into the tube with a speed of 90 mm/s. The analysis results showed that tube inner groove heights were decreased by approximately 8 % from 0.15 mm to 0.138 mm with stress concentrations observed at the groove end, consistent with experimental results. Based on the current results, we are trying to design a novel shape of the tube expander with grooves to further reduce deformation tube inner grooves in copper tube expansion. For this, we will select major design variables of tube expander groove shapes by conducting sensitivity analysis and then optimize the design variables using the Taguchi method.

Keywords : tube expansion, tube expander, heat exchanger, finite element
Conference Title : ICMPI 2017 : International Conference on Manufacturing and Process Innovations
Conference Location : Singapore, Singapore
Conference Dates : January 08-09, 2017