DEVELOPMENT OF MINI COLD PLATE APPRATUS

Prepared by: Chan Fwu Shin

ABSTRACT

In Welford Manufacturing (M) Sdn. Bhd., the mass manufactured intravascular catheters (IVC) are delivered to the packing machine where the packages are stamped in vertical motion. This stamping requires a heat-bonding module which operates at 110-120°C. As it is easily accessible, it posed thermal risk to the workers. The objective of this study is to develop an effective liquid cold plate where it will be installed into the heat-bonding module assembly to dissipate the heat for safe contact. This study combined computer modelling simulation, experimental investigation and theoretical parameters calculations. Initially, three prototypes were modelled and compared in heat transfer and pressure drop. The six longitudinal paths model was selected for improvement where its water channel cross-section changed from circular to square, resulted in better heat transfer from the increased of surface contact area. Thereafter, the fabricated cold plate based on the improved model undertook one (1) hour experiment for its actual performance and succeeded in dissipating heat from 120°C to a range of 30.5-38.1°C, complied with safe temperature for human contact which is below 45°C. The following theoretical calculations discovered that Reynolds number is inversely proportional to friction factor whereas water flow rate is linearly proportional to pressure drop. Hence, the system requires pump with higher head to offset the higher pressure drop (increased turbulence) to benefit from higher heat transfer. However, the heat loss through conduction to the surrounding medium was unable to be measured. Finally, the liquid cold plate system required further convection at water reservoir to dissipate the conserved heat from the heat transfers.

Keywords: cold plate, heat transfer, overall heat transfer coefficient, pressure drop, Reynolds number, temperature difference, total thermal resistance, water channel.