This study investigates the heat transfer and pressure drop characteristics of jet array impingement in two distinct parts. In the first part, the performance of a uniform array of jets on both a flat and a large radius curved target surface are compared. This comparison was done at average jet Reynolds number ranging from 55,000 to 125,000. In the second part, the characteristics of a non-uniform array of jets, more typical of geometries used in actual gas turbine combustors, are investigated, including the effects of the removal of downstream rows and the placement of rib features onto the target surface. The non-uniform configurations studied have varying hole diameters and geometric spacing for spatial tuning of the heat transfer behavior. First row jet Reynolds numbers ranging from 50,000 to 160,000 are reported. For all configurations, spent air is drawn out in a single direction which is tangential to the target plate curvature. Alongside the experimental work, CFD simulations were performed utilizing the $v^2$-$f$ eddy viscosity turbulence model.

The results from the uniform array impingement onto a curved surface comparison show that the large radius curvature of the current geometry has little to no effect on the flow distribution and heat transfer of the array. The non-uniform array results illustrate the applicability of tuning a jet impingement array using varying jet diameters and spacing. However, there are some difficulties in obtaining streamwise pitch resolved heat transfer predictions for non-uniform arrays as current open literature correlations for uniform arrays are shown to be not applicable. The computational results from this study show that simulations can be used to obtain initial predictions, with streamwise pitch averaged Nu values found to be within 20% of experimental results. The use of ribs downstream in place of several jet rows was shown to yield similar heat transfer results at lower pressure drop levels.

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The public is welcome to attend.