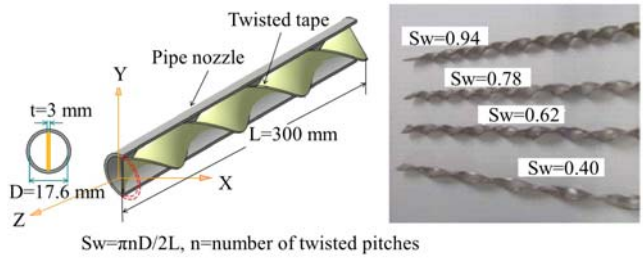

Figure 1. Pipe nozzle with twisted tape

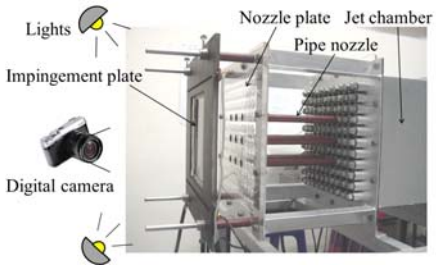

Figure 2. Experimental setup

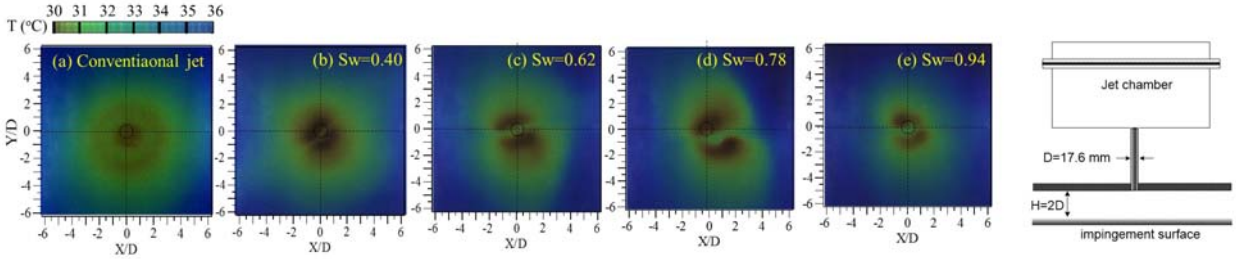

Figure 3. Effect of swirl number on temperature distributions on impingement surface with single swirling jet (H=2D, Re=20,000 and T_j=28.5ºC)

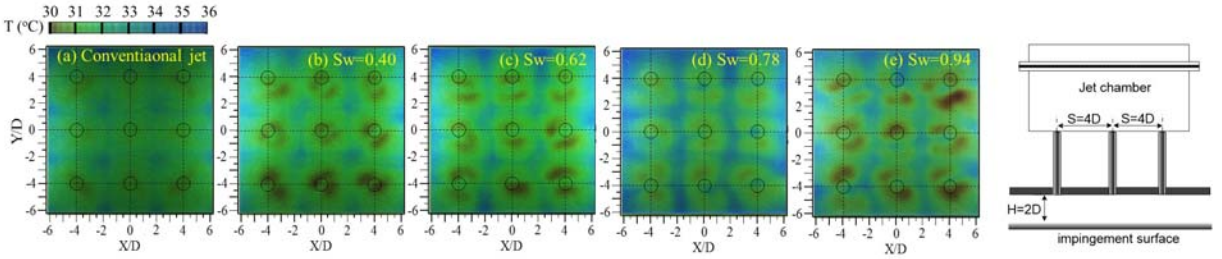

Figure 4. Effect of swirl number on temperature distributions on impingement surface with array of swirling jets (H=2D, Re=20,000 and T_j=28.5ºC)

HEAT TRANSFER CHARACTERISTICS ON IMPINGEMENT SURFACE WITH SWIRLING JETS

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The heat transfer characteristics of swirling jets were investigated for single impinging jet and array of impinging jets. The twisted tapes with different number of twisted pitches were inserted in pipe nozzle as shown in Fig. 1 to generate swirling jet with different Swirl number (*Sw*). In this study, the impingement surface was made of stainless steel foil (30-μm thickness) and heated by DC power supply. Thermochromic Liquid Crystal (TLC) sheet was attached on the opposite side of jet impingement surface as shown in Fig. 2. The impingement surface was cooled with impinging jet and the temperature pattern on the surface was then recorded with a digital camera. Figures 3 and 4 show the heat transfer patterns on impingement surface for single impinging jet and array of impinging jets (3 rows x 3 columns), respectively. The regions with lower temperature are corresponding to the region with higher heat transfer rate. For single swirling jet, the areas of high heat transfer rate were separated in two regions due to effect of inserting twisted tape. The heat transfer rate in region of jet directly impinging seems to be higher than the case of conventional jet. However, the heat transfer rate in wall jet region seems to be lower than the conventional jet. The areas of high heat transfer rate of each impingement region for the case of array of impinging jets are smaller when compare to the case of single impinging jet because of bounding by adjacent impinging jets. The heat transfer rate in each region of jet directly impinging for the case of swirling impinging jet array is higher than conventional impinging jets while the heat transfer rate around impingement region is somewhat higher than the case of conventional impinging jet array in the same locations. For both cases, the heat transfer rate tends to increase with increasing swirl number.