NATURAL CONVECTION COOLING OF INFRARED SUPPRESSION (IRS) DEVICES

Natural convection heat transfers from Infrared suppression (IRS) devices with different funnel shapes i.e. cylindrical, conical and louvered cylindrical have been studied numerically. For cylindrical and the conical funnels the numerical simulation is carried out with FLUENT 16 by varying the Rayleigh number (Ra) in the range of 10^{10} to 10^{12}.The diameter ratio is varied in the range of 1.02 to 1.3 and the percentage of overlap between -20 to 20.The total heat transfer from the funnels due to natural convection is found to increase with increase in diameter ratio. With increase in diameter ratio, the average Nusselt number for cylindrical funnels increases, attains a peak and then decreases. For conical shaped funnels, with increase in diameter ratio, the average Nusselt number initially increases to a maximum value, then decreases marginally and almost remains constant for larger diameter ratios. The heat transfer rate decreases with increase in percentage of negative overlap for both cylindrical and conical funnels which is mainly due to reduced suction effect. The non-dimensional induced mass flow rate increases with increase in diameter ratio for both cylindrical and conical shaped funnels. For louvered funnels, the dimensionless louver opening (d/D) is varied in the range of 0.025 to 0.2 while the Ra is varied in the range of 10^{10} to 10^{12}. The ratio of heat transferred with louvers to without louvers i.e. Q/Q_0 initially increases up to a value of d/D=0.075 and then decreases. The dimensionless cooling time has been found by assuming the funnels as a lumped system. From the known value of heat transfer coefficient (found from numerical simulation) the temperature-time history of the funnel system have been plotted. For diameter ratio (DR) beyond 1.05, the Nusselt number reduces for cylindrical funnels. Because of this, there is no improvement in cooling of IRS device at higher diameter ratios for cylindrical shaped funnels. For conical shaped funnels, for diameter ratio beyond 1.15, the Nusselt number almost remains constant. Hence, cooling rate of IRS device at higher diameter ratios doesn't change much for conical shaped funnels. For louvered cylindrical funnel set up, the Nusselt number increases till the louver opening (d/D) increases up to 0.1. Thus the cooling is more effective up to d/D=0.1. However, with d/D beyond 0.1 the cooling becomes less effective due to reduction in Nusselt number.