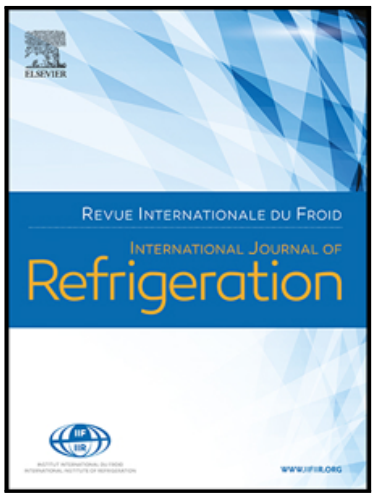

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Study on dynamic thermal performance and optimization of hybrid systems with capillary mat cooling and displacement ventilation

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ABSTRACT

In this paper, the thermal performance of capillary mat cooling systems is evaluated through actual measurements under different ventilation rates. The results showed that the indoor air temperature drop rates of the ceiling, wall and floor cooling are 1.42 - 2.44 ° C / h, 0.69 - 1.11 ° C / h, 0.29 - 0.58 ° C / h respectively in the response phase, which can provide a reference for predictive control strategy of radiant system. Then the cooling capacity of the capillary mat is validated. The radiant heat transfer coefficient of the cooling capillary mat is about 5.80 W/m^2·k. When the supply water temperature dropped from 20℃ to 16℃, the total heat flux can experience an increase of 10%-30%. The heat flux for cooling ceilings is the largest, followed by cooling walls, which is 7%-17% lower; and cooling floors, which is 75%-90% lower. Orthogonal experiments illustrated that the water supply temperature and air supply volume have a significant influence on the indoor thermal environment of the hybrid systems, followed by the air supply temperature. In general, the dynamic performance of the radiant cooling system in the response phase can provide an effective reference for different control strategy considering the significant thermal inertia.

Keywords: Response time; Hybrid system; Capillary mat; Displacement ventilation; Orthogonal experiment; Heat transfer coefficient

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