NUMERICAL SIMULATION TO OPTIMIZE THE DESIGN OF DOUBLE GLAZED DOORS FOR CLOSED REFRIGERATED VERTICAL DISPLAY CABINETS

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Abstract

Due to the great awareness of global warming, energy savings should be on the mind of all design engineers. Saving energy in refrigerated vertical display cabinets, which is a major supermarket appliance, is of great importance to users and manufacturers. The aim of this paper is to investigate how to minimize energy usage of refrigerated vertical display cabinets by optimizing the design of its double glazed door. Choosing the gap width can be crucial for optimizing the refrigerator efficiency. The computational fluid dynamics software 'Fluent' is used to predict the heat gain through the double glazed door by solving a steady 2-D model for the natural convection in the air gap including heat transfer due to radiation. The air gap investigated is 1.5m high and assumed to have different width 5, 10, 15, 17, 20, 25, 30 & 35 mm which gives aspect ratios in the range 300–43. Results show that as the gap size increases (i.e. aspect ratio decreases) the heat gain due to natural convection decreases up to a limit and then reaches almost a constant value while the radiation heat transfer shows an opposite trend. However, the total heat transfer gain decreases until it reaches a constant value. These results suggest that increasing the gap width improves the door's efficiency; but only up to a certain limit after which the increase in the gap width does not affect the heat transfer anymore. Results also show that at the small gap width (i.e. high aspect ratio), heat transfer due to convection and radiation is almost equal and as the gap width increases, the radiation component starts to have more dominance. This suggests that the use of a type of glass with lower emittance properties may enhance the thermal effectiveness of the door.