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Experimental evaluation of the thermal performance at different environmental conditions of a low temperature display case with built-in compressor and water-cooled condenser

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ABSTRACT

This paper reports the results of experimental tests performed according to ISO 23953 in a vertical closed low temperature display case to evaluate the influence of the environment where it is installed (climatic class) in the energy consumption and thermal performance. The compressor and the condenser are attached to the display case and an external water circuit is used to provide air-chilled water to the condenser. The need for this type of equipment arises from the numerous small stores without air conditioning system and without space for placing a remote cooling rack. Keeping the external environment temperature constant and consequently the refrigerant condensing temperature, changing climatic class n.º 3 ($T_a=25^{\circ}\text{C}$ and $\phi_a=60\%$) to n.º 6 ($T_a=27^{\circ}\text{C}$ and $\phi_a=70\%$), the compressor energy consumption increases 8% to 10% and the highest temperature of the warmest product simulator increases $+3.0^{\circ}\text{C}$. At the same climatic class, the water temperature increases with the external environment temperature. The compressor energy consumption increases 13% and 8% when the refrigerant condensing temperature increases from 40°C to 45°C and from 45°C to 50°C , respectively. Thus, refrigeration equipment with compressor and condenser attached is susceptible to the climatic variation of the internal and external environment. In applications with large climatic amplitude, the components must be designed to meet all the operating situations.

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