

78. A Theoretical Study on the Optimum Refrigerant Charge in a Vapor-Compression Air-Conditioner

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A theoretical model for the transient performance of vapor-compression air-conditioning system has been developed to evaluate the influence of the refrigerant charge on the system performance. A set of mass and energy equations for a simulation of the heat exchangers and the capillary tube and a polytropic compression model for the compressor are used. For a system charged with 0.75 kg of R-22 refrigerant and for indoor air of 27°C and outdoor air of 35°C, the present model successfully predicts the transient behavior of the vapor-compression air-conditioner from the startup. As the refrigerant charge is increased, both the evaporating and condensing pressures increase gradually, but the cooling rate and the COP show a maximum in the range of 0.75-0.8 kg of refrigerant charge. This amount of refrigerant mass is determined to be the optimum charge of the model system. Also, the effect of outdoor air temperature on the optimum refrigerant charge is discussed.

