Analysis of variables affecting atmospheric water generation using vapor compression refrigeration

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Abstract

This research investigated the effects of temperature, relative humidity, and air flow rate on water generation using vapor-compression refrigeration. The Atmospheric Water Generation systems (AWG) consisted of five cross-flow heat exchangers arranged in series and installed inside a 0.35 × 0.35m tunnel. The system operated with a cooling capacity of 12,283 BTU/h using R-22 refrigerant. Experimental parameters were evaluated across an air temperature range of 20–40°C, relative humidity of 50–90%, and air flow rates of 6–16 m³/min. The results revealed that temperature, relative humidity, and air flow rate significantly and directly influenced water condensation, with relative humidity identified as the most dominant factor, followed by air temperature and air flow rate, respectively. At an optimal operating condition of 90% relative humidity, 40°C temperature, and a 14.5 m³/min air flow rate, the system was achieved a maximum water collection rate of 5.95 kg/h. This experimental yield was of 8.6–41.8% lower than the values predicted by the mathematical model, while the specific energy consumption of the system ranged between 0.29 and 3.30 kWh/kg.

Keywords: Air, Water, Humidity, Atmospheric water generation, Vapor compression refrigeration