

Experimental investigation and theoretical analysis of solar heating and humidification system with desiccant rotor

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Abstract

In this paper, a solar heating system, which combines the technologies of evacuated tube solar air collector and rotary desiccant humidification together, has been configured, tested and modeled. The system mainly includes 15 m² solar air collectors and a desiccant air-conditioning unit. Two operation modes are designed, namely, direct solar heating mode and solar heating with desiccant humidification mode. Performance model of the system has been created in TRNSYS. The objective of this paper is to check the applicability of solar heating and evaluate the feasibility and potential of desiccant humidification for improving indoor thermal comfort. Experimental results show that the solar heating system can convert about 50% of the received solar radiation for space heating on a sunny day in winter and increases indoor temperature by about 10 °C. Compared with direct solar heating mode, solar heating with desiccant humidification can increase the fraction of the time within comfort region from about 10% to 20% for standalone solar heating and from about 30% to 60% for solar heating with auxiliary heater according to seasonal analysis. It is confirmed that solar heating with desiccant humidification is promising and worthwhile being applied to improving indoor thermal comfort in heating season.

Research highlights

► Solar heating system can condition the space to favorable state. ► Solar heating with desiccant humidification can improve indoor thermal comfort. ► Auxiliary heater is advised to be incorporated in practical implementation.

Keywords

- Solar heating;
- Desiccant humidification;
- Thermal comfort;
- Air conditioning;
- TRNSYS