Theoretical study on volatile organic compound removal and energy performance of a novel heat pump assisted solid desiccant cooling system

A theoretical model was established for predicting the volatile organic compound (VOC) removal and energy performance of a novel heat pump assisted solid desiccant cooling system (HP-SDC). The HP-SDC was proposed based on the combination of desiccant rotor with heat pump, and was designed for cooling, dehumidification and indoor air cleaning in normal office, commercial or residential buildings. The desiccant rotor was used for dehumidification and indoor air cleaning; the heat pump provided sensible cooling and regeneration heat for the desiccant rotor. The theoretical model consisted of two sub-models. One sub-model was used to simulate the heat, moisture and VOC transfer in the desiccant rotor; the other sub-model was used to predict the energy performance of the heat pump. Combining the two sub-models, the energy performance and VOC removal effect of the HP-SDC could be simulated and predicted. The theoretical model was validated by experimental data. Validating results showed that the model could be used to predict the performance of HP-SDC. The results also showed that the HP-SDC could clean air borne contaminants effectively and could provide an energy efficient choice for ventilation.