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Can a Clean-Air Heat Pump (CAHP) maintain air purification capability when using polluted air for regeneration?

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Abstract

Clean Air Heat Pump (CAHP) was one type of rotary desiccant cooling system which combined a silica gel rotor with a heat pump to achieve air cleaning, dehumidifying and cooling in buildings. Using exhaust air from the conditioned room for regeneration of the silica gel rotor might have an advantage on reducing the regeneration air temperature and further improving the energy performance of the CAHP. However, the exhaust air carried a lot of indoor air pollutants. Whether using exhaust air for the regeneration of the silica gel rotor had an impact on the air cleaning performance of the CAHP was experimentally studied. The results showed that using the air contained acetone or toluene for regeneration reduced the pollutants removal capability of CAHP with a reduction of approx. 10% in air cleaning efficiency. The energy performance of the CAHP when using exhaust air for regeneration was also evaluated compared with the CAHP with outdoor air for regeneration by means of numerical simulation. The simulated results showed that the energy saving of the CAHP was obvious when using exhaust air for regeneration, regardless of the degradation of indoor air quality. If the same indoor air quality level as that when using outdoor air for regeneration was expected to be maintained, increasing the intake of outdoor air was one possible way but would increase the energy consumption. The increased energy counteracted the reduced energy of using exhaust air for regeneration, and consequently the energy of CAHP was not saved.

Keywords: desiccant wheel; air cleaning; polluted regeneration air

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