

# RP1015

# GROUND COUPLED PHOTOVOLTAIC THERMAL (PV/T) DESICCANT COOLING

## Research Question (50 words)

As cooling loads generally peak with solar irradiation, solar cooling can be a good alternative to conventional vapour compression cooling. This project investigates the utilisation of PV/T collectors with ground coupled desiccant cooling that provides air conditioning and generates electricity.

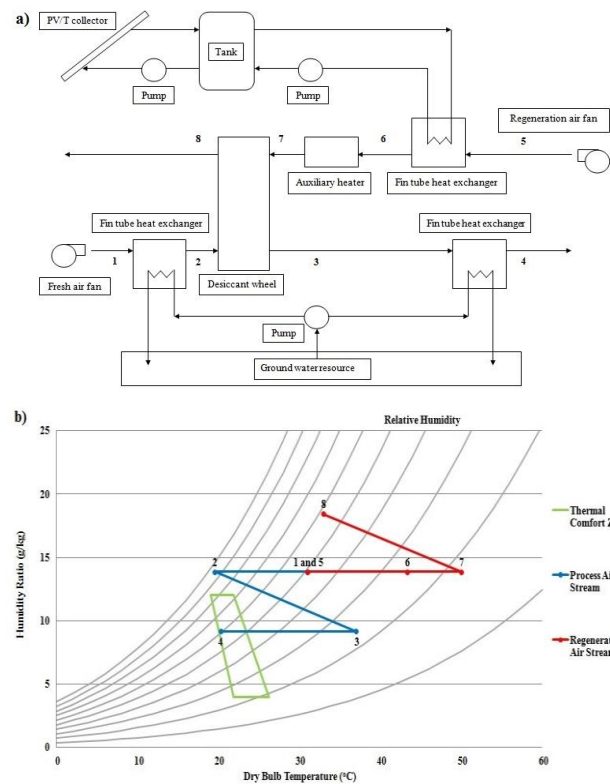


Fig. 1: a) Schematic of the ground coupled PV/T desiccant cooling system and b) psychrometric process for a typical summer day in Sydney

## Methodology (75 words)

To analyse the overall performance of a ground coupled PV/T desiccant cooling cycle, using TRNSYS, as shown in Fig. 1. Detailed models for key components such as PV/T collectors, desiccant wheel, heat exchangers and ground source heat sinks were validated. Parasitic

components such as pumps and fans were calibrated according to product specifications. The system was simulated under a temperate climate (Sydney). The model is equivalent to a physical dehumidification and cooling unit with 100% fresh air ventilation.

## Results (225 words)

One of the main challenges to use PV/T collectors for desiccant cooling is that the heat source temperature recovered is not high enough to recharge the desiccant. Hence, pre-cooling of the inlet air to the desiccant wheel was used to effectively enhance the dehumidification and reduce the required temperature for regeneration, as shown in Fig. 2.

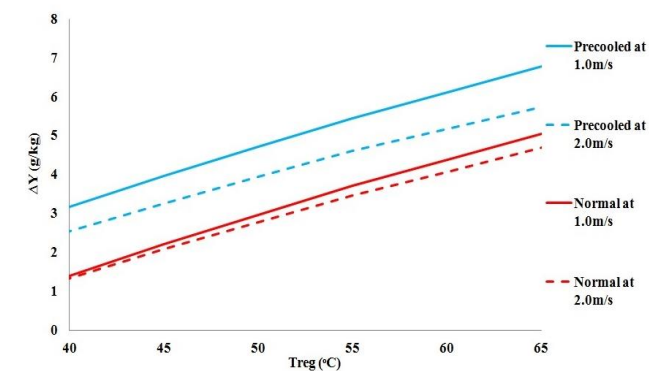


Fig. 2: Air dehumidification by ground coupled desiccant cooling cycle with and without pre-cooling under various regeneration temperatures

Results (Fig. 3) show that the ground coupled desiccant cooling process can supply air within the comfort zones with temperatures between 20°C-22°C and a humidity ratio of 4-12 g/kg during the dehumidification and cooling operation.

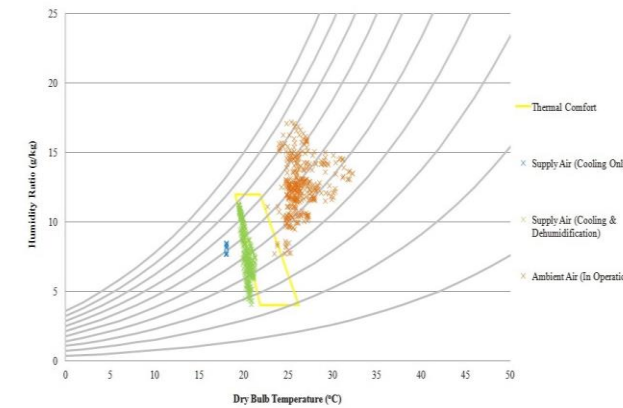


Fig. 3: Ambient and supply air conditions in annual operation of the ground coupled PV/T desiccant cooling system

For example, the cogeneration of thermal heat and electricity by a 5 m<sup>2</sup> glazed PV/T collector can offset all the energy consumption, including parasitic components (like fans and pumps) as well as a small amount of auxiliary heating (Fig. 4). The total energy generated by the ground coupled PV/T desiccant cooling system is greater than the energy consumed during a year, with a calculated annual coefficient of performance (COP) of 11.6.

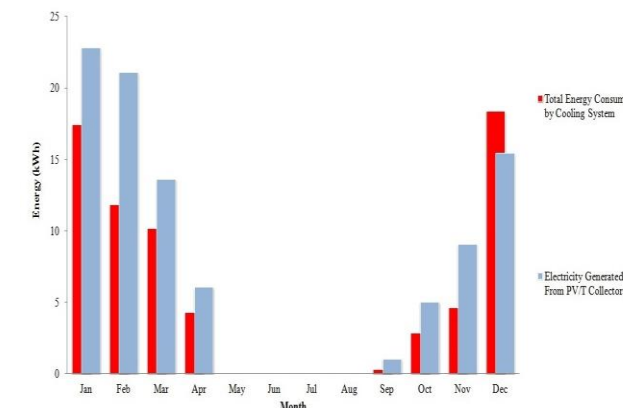


Fig. 4: Monthly electricity generated and energy consumed by the ground coupled PV/T desiccant cooling system

## Conclusions (50 words)

The proposed ground coupled PV/T desiccant air cooling process can achieve comfortable air conditions for a temperate climate like Sydney. The pre-cooling enhances dehumidification and allows the operation of the system at low heat source temperature. This maximises the use of PV/T collectors to offset the energy consumption and improve system performance.

## Anticipated Impacts (50 words)

The ground coupled PV/T desiccant cooling can be used to effectively control indoor conditions in both residential and commercial buildings. The use of solar energy can provide important energy savings. It is also environmentally friendly as water acts as the refrigerant.

Key statement about the research project to go into this space (what is the key message?).

Solar cooling can be a more sustainable and energy efficient solution. Using recovered heat from a PV/T system for desiccant cooling coupled with ground cooling presents a good opportunity to provide space cooling.

## Further Information

### Contact

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