RP1015

COMBINING A BUILDING INTEGRATED PVT SYSTEM WITH A LOW TEMPERATURE DESICCANT COOLER TO DRIVE AFFORDABLE SOLAR COOLING

Research Question

The fundamental question of my research is how to reduce the energy consumption for space cooling/heating without reducing the comfort level.

Can cooling in summer and heating in winter be achieved utilising solar thermal energy from a PV/T and a desiccant air system?

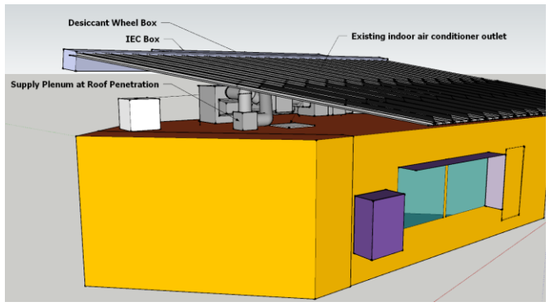

Figure 1: Final design of the PV/T desiccant wheel cooling system

Methodology

A TRNSYS model including the building (monitoring room 401), PV/T, desiccant wheel and internal evaporative cooler (IEC) has been established for determining each parameter of the system and simulation. With partners CSIRO and BlueScope, a prototype system consisting of a PV/T air array, a desiccant wheel cooling system has been designed, and will be installed and operated on the roof of Tyree Energy Technologies Building (TETB), UNSW in the following year. This system can provide us with the required data to experimentally investigate whether the PV/T and desiccant system can meet the cooling and heating requirements for the room.

Results

Current research is focussed on final design of the experimental system and developing a simulation model for the solar thermal cooling system. The solar array will consist of 2 PV laminates forming the PV/T section of the solar air collector in series with a covered solar thermal air collector. This design achieves a balance between electricity and heat generation to meet the requirements of the system.

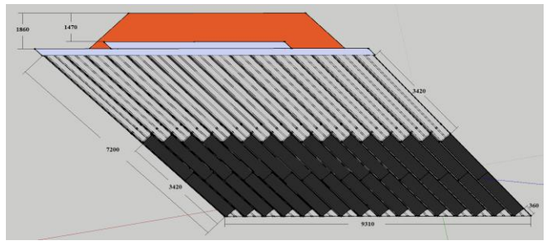

Figure 2: Top-down view of the PV/T and Solar Thermal System Design.

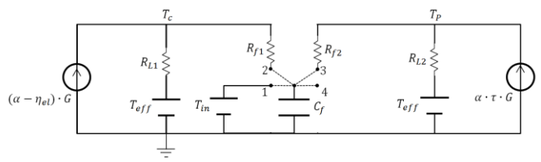

Figure 3: Equivalent thermal circuit of the PV/T and solar thermal air collectors established for the detailed analysis.

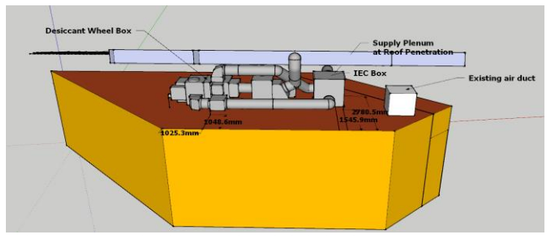

Figure 4: Back view of the finial design.

Finial duct design		
DIA (mm)	**Item**	**Pressure drop (Pa)**
300	Air duct to hot air filter	2.16
300	Desiccant Wheel Box to IEC	4.23
250	IEC to Roof Penetration	1.18
300	Desiccant Wheel to Roof Penetration	2.51
Total Pressure Drop		**10.08**

Table 1: Summary of the pressure drop due to the air duct

The advantages of this system are the low pressure drop with moderately sized ducts.

The frequency of building temperature in both winter and summer during working hours from 8:00 to 17:00, Monday to Friday have been shown in the following figures.

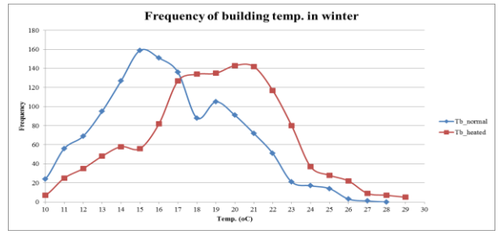

Figure 5: Frequency of building temperature in winter (hourly, 1 degree bins).

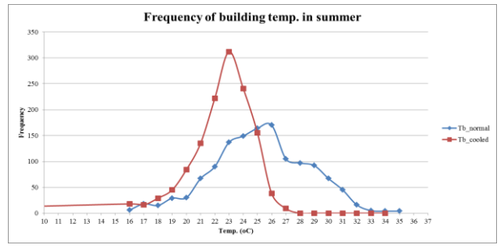

Figure 6: Frequency of building temperature in summer (hourly, 1 degree bins).

Conclusions

The design of the whole solar thermal desiccant wheel cooling system with IEC has been finished. By the simulation results, it does show a good cooling performance in summer. From the research motivation's point of view, this design can meet the requirement quite well to achieve the balance of between cost and performance.

This project focuses on further providing cooling in summer when maximum solar radiation is available and heating in winter when required.

Anticipated impacts

Since space cooling and heating is one of the highest energy consuming loads in modern society and the energy crisis is looming ahead, with this novel technology we can enjoy the indoor comfort, with the same time, be environmentally friendly and potentially lower the cost of air-conditioning. Our next generation system will assist sustainable development through this energy efficiency technology.

Further information

More information could be found in the following website:

http://www.lowcarbonlivingcrc.com.au/research/program-1-integrated-building-systems/rp1015-combining-building-integrated-pvt-system-low-0

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