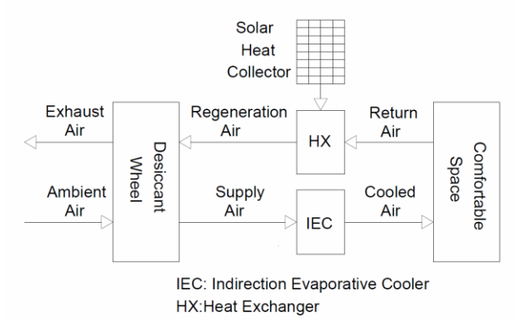
RP1015

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 to develop a new internally cooled desiccant wheel which can use a low temperature regeneration temperature heat source.

This device can be used in air-conditioning systems with the incorporation of indirect evaporative cooling. This can help reduce the energy consumption of the building.



IEC: Indirection Evaporative Cooler
HX:Heat Exchanger

Figure 1: Schematic diagram of a desiccant-IEC air conditioning system

Methodology

A C++ mathematical model which is based on heat and mass conservation will be built. It is mainly used to predict the outlet humidity and temperature of air from desiccant wheel.

Experiments will be implemented to validate the model. After validation the model could be used to find out the best design of the desiccant wheel.

Results

The purpose of current research is to introduce cooled water into the desiccant wheel to reduce the effect of adsorption heat and carry-over heat. By doing this, the dehumidification performance of the desiccant wheel can be improved significantly. At the same time the temperature of the outlet air from the desiccant wheel can also decrease dramatically.

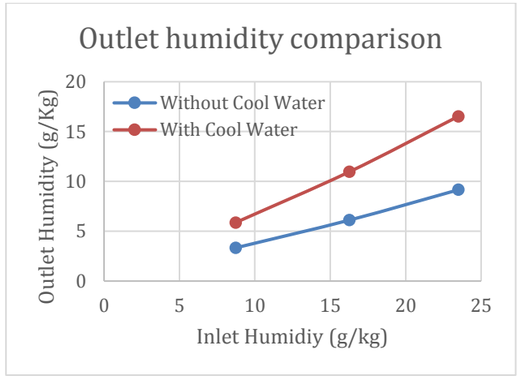


Figure 2: Outlet humidity comparison between a conventional wheel and internally cooled wheel

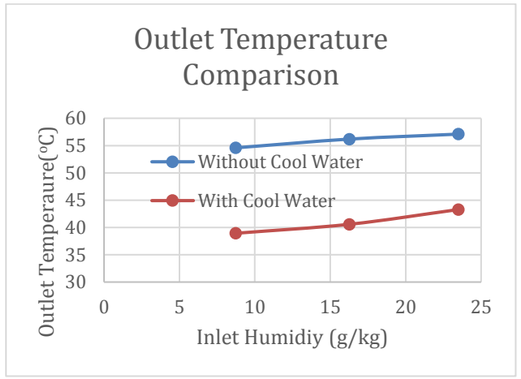


Figure 3: Outlet temperature comparison between conventional wheel and internal cool wheel

Then the new device will be used with an IEC in the air-conditioning system to reduce the electricity consumption further.

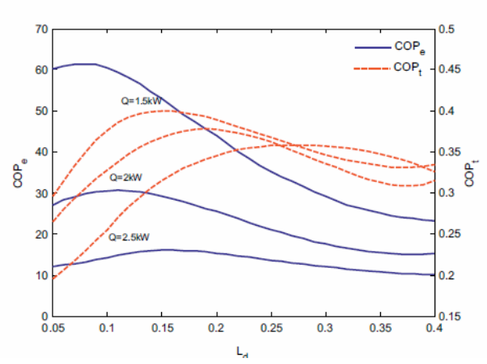


Figure 4: Coefficient of performance (both electricity and thermal) for new air-conditioning system.

The optimized design for the internally cooled desiccant wheel is still under investigation both for its material and structure.

Conclusions

The simulation results from the C++ mathematical model show that in some dry climates, the comfortable climate zone inside the building can be achieved by only using the internally cooled desiccant wheel. For most areas, it must be used with an IEC to produce comfortable indoor condtitions.

However, the electricity saved by this air-conditioning system is considerable.

Anticipated impacts

Conventional air-conditioning systems, not only consume large amounts of electricity but also have a negative influence on the environment which is due to the usage of refrigerants like R22 and R134a.

By replacing it with a desiccant wheel based air-conditioning system, these problems can be solved. Since desiccant wheel based air-conditioning systems can be driven by solar energy and other heat sources instead of using electricity and it does not use damaging refrigerants such a system is much less harmful to the environment.

Key statement about the research project to go into this space.

Different materials which have a low thermal mass will be investigated since it can carry less heat from regeneration area. As a result, cooled water can be used more efficiently and performance of the desiccant wheel can be even better.

Further information

More information could be found in the following website:
http://www.lowcarbonlivingcrc.com.au/research/program-1-integrated-buildingsystems/rp1015-combining-buildingintegrated-pvt-system-low-0

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