

SOLAR AIR CONDITIONING

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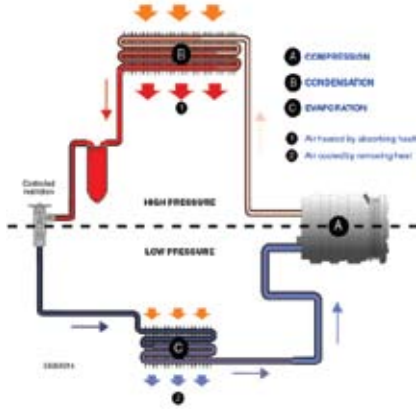


Motivation

- Create a solar air conditioner to be used in home.
- Harness environment friendly source of energy.

Typical System Operation

- A typical air conditioning system consists of a refrigerant passing through a condenser where heat is dissipated.



- Refrigerant vapor at low pressure enters the evaporator which absorbs heat from the surroundings.
- Heat is removed through the compression and condensing leading to cooling the desired environment.

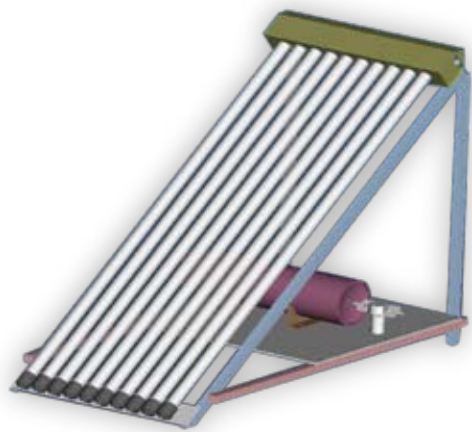
Solar System Operation

Air Cycle:

- The solar A/c system does not have a compression cycle which reduces energy consumption.
- It is also a more environmental friendly system, since no ozone layer harming refrigerants are used. Instead, water and water vapor from the air are manipulated.
- Outside air is processed through a desiccant wheel which removes the moisture from air. This process reduces the air's enthalpy and wet bulb temperature.
- This air with a reduced relative humidity is passed through a humidification cycle that cools the air further and increases the humidity to a comfortable level.
- To recover the absorptive properties of the desiccant wheel, solar heated water goes through a water to air heat exchanger to dry away moisture.

Solar Collector Heating

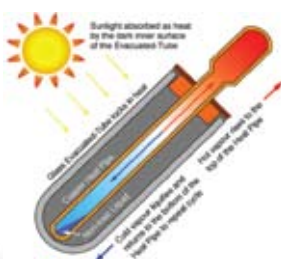
- Sun Maxx 10 evacuated tube solar collector system.
- Can deliver 18,000 BTU of heating a day.
- Capture light from all angles.
- Larger aperture area results in higher solar efficiency.



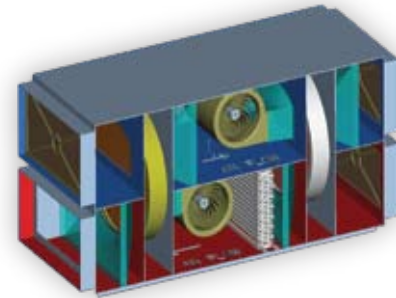
Cooling

- We choose the open cycle desiccant cooling method for A/c.
- This includes dehumidification of hot air by a desiccant.
- Desiccant cooling is an open heat driven cycle, which uses a desiccant (mainly Silica Gel) wheel and thermal wheel in tandem to achieve both cooling and dehumidification.

- A typical desiccant wheel is shown in figure below.



- Proposed design of cooling system modeled on Pro-E is below. It is based on Adsorption chiller system.



- The desiccant wheel dries out the air to increase efficiency. Air is cooled in the heat reclamation wheel.
- Heat is transferred through contact between the air and rotor material. It is cooled further through evaporation humidification.
- Solar power is used to heat the air to dry out the desiccant wheel.

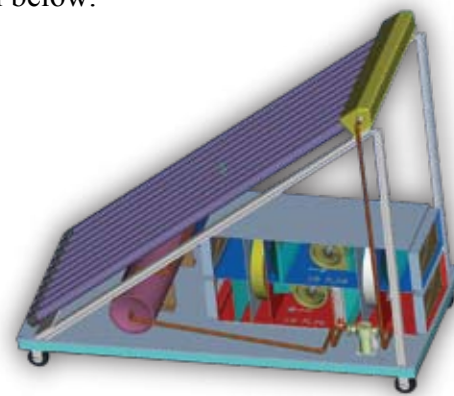
Preliminary Results

Using software supplied by NovelAire Technologies, we came up with following observations:

- Moist air at 30°C and 13.7 g/kg moisture content is drawn through the desiccant wheel so that it comes off at; say 36°C and 6.3 g/kg moisture content. The supply air stream then passes through the thermal wheel where it is cooled to 24°C.
- On the extract air side, air from the room at, 17.5°C and 10.8 g/kg moisture content passes through the thermal wheel; it is heated to approximately 47°C. The air stream is then heated up to approximately 80°C in order to regenerate the desiccant wheel.

Final Design and Conclusion

- The Final model for the Air conditioning system is shown below.



- It includes the heating and cooling systems in one assembly.
- Stress analysis for the wooden frame has been performed.
- All CAD drawings are completed and the team will start the construction soon.

