FLORIDA SOLAR ENERGY CENTER®

Heat Pipe Application Program

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Fact Sheet

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Public Information Office

Heat Pipe Application Program

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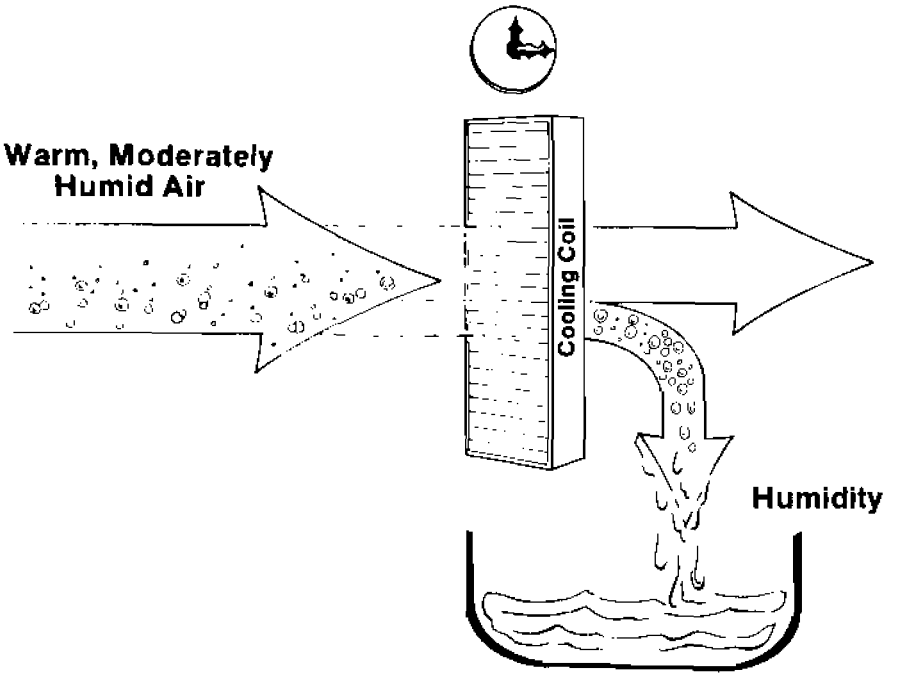
The Florida Solar Energy Center has begun a project to develop a high efficiency airconditioner/dehumidifier using heat pipes between the warm return and cold supply air streams. Such systems will save energy in hot, humid climates.

Air conditioners generally use less than 35% of their capacity in dehumidification and the rest in cooling. If more dehumidification is required (say 50%), the air must be overcooled to remove moisture. It then must be reheated. This has the following disadvantages:

- Energy is required for overcooling.
- Energy is required for reheating.
- Equipment must be oversized to overcool.
- Maintenance costs are increased.
- Power demand is increased.

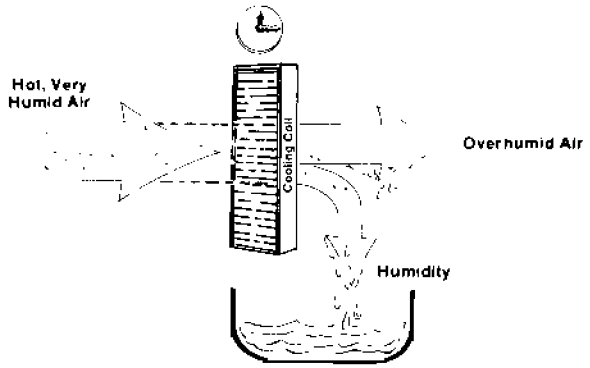
The use of heat pipes can reduce or eliminate overcooling and reheating. This offers tremendous cost savings in lessened energy consumption, lower equipment investment, and reduced maintenance and demand charges.

The following illustrations describe the problem and present a solution that employs the NASA-developed heat pipe technology. A prototype system has been designed by Dinh Co., Inc.



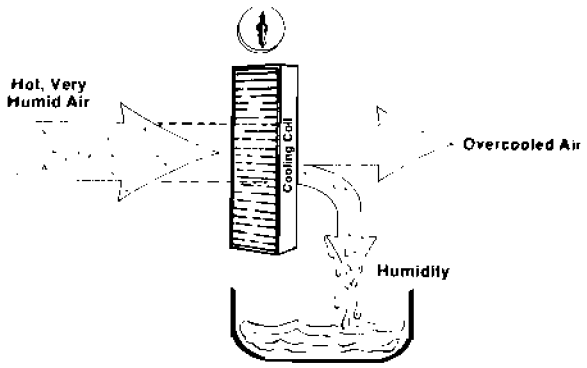
A. Air conditioning in a moderate climate.

In a warm, moderately humid environment, a typical air conditioner efficiently removes humidity and cools the air with normal cooling-coil operation.



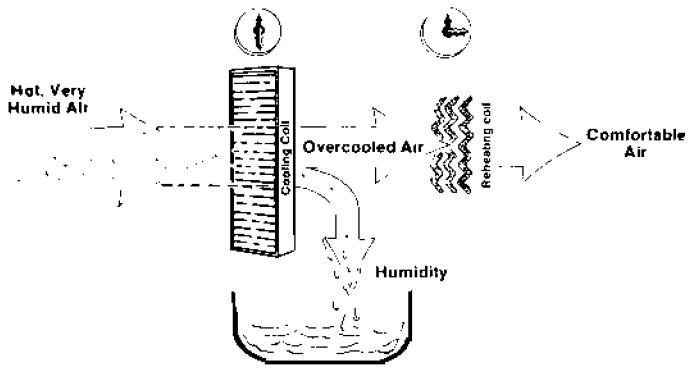
B. Air conditioning in a hot, humid climate.

In a hot, highly humid environment, a typical air conditioner removes only a portion of the humidity during normal cooling-coil operation. Resulting room air is overly humid.



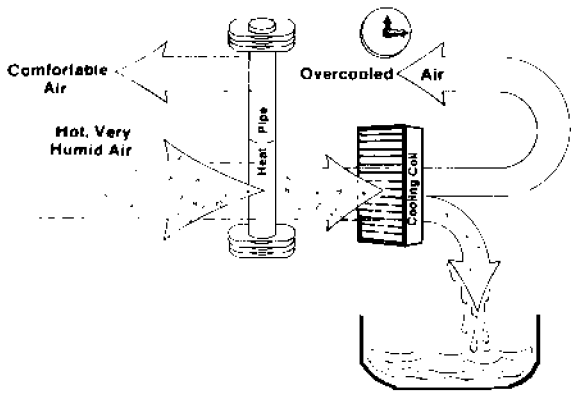
C. Air conditioning and dehumidifying in a hot, humid climate.

To remove large amounts of humidity in a hot, humid environment, an air conditioner must operate longer and consume more energy. The humidity is removed, but the air is overcooled.



D. Reheating overcooled air.

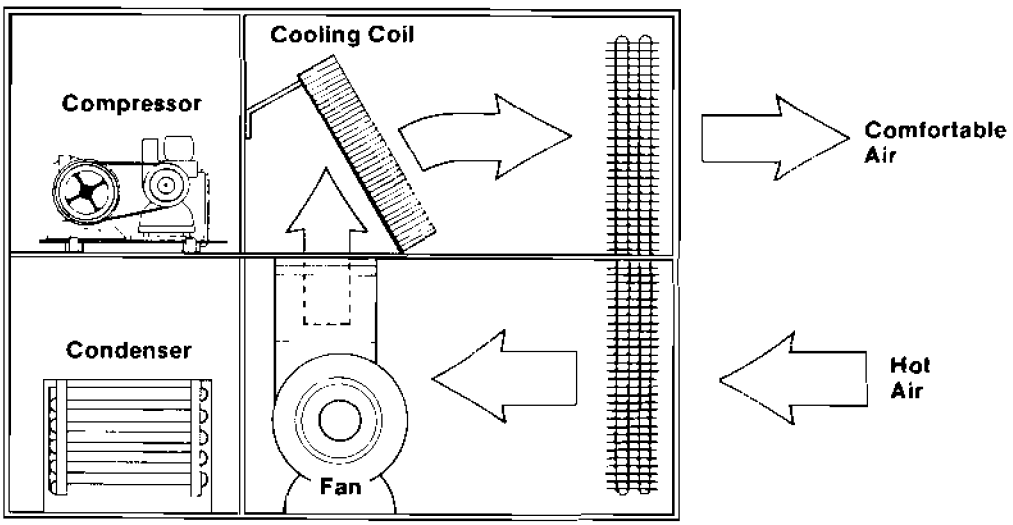
The overcooled air that results when excess humidity is removed must be reheated to be comfortable. The reheating consumes additional energy.



E. Using heat pipes to improve efficiency.

When heat pipes are used in an air conditioner, they cool the air before it reaches the cooling coil. The cooling coil removes the remaining heat and humidity. The overcooled air is then reheated to a comfortable temperature by the heat pipes. The cooling coil operates for only the standard time period, and no reheating is required.

A High-Efficiency Air Conditioner/ Dehumidifier Using Heat Pipes



Heat pipe heat exchanger

Psychrometric Process

Overcooling and Reheating to Remove Moisture

1 Room air
1-2 Air-conditioner cooling
2 Overcooled air
2-3 Reheating
3-4 Room heat pickup
4-1 Room moisture pickup

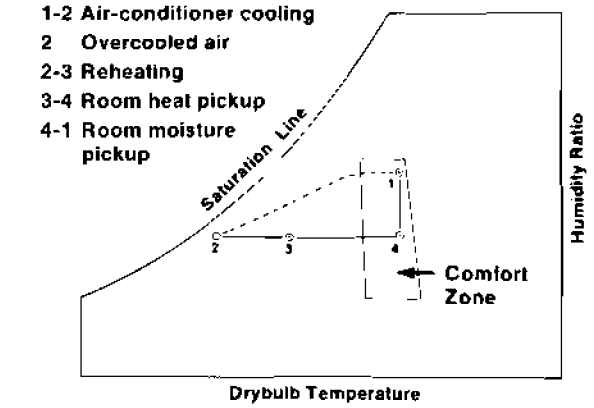


Figure A

Figures A and B illustrate the differences between the conventional air-conditioner overcool/reheat process (A) and the novel heat pipe dehumification process (B).

Heat Pipe Application Avoids Overcooling and Reheating

1 Room air
1-2 Heat pipe precooling
2-3 Air-conditioning cooling
3 Overcooled air
3-4 Heat pipe heating
4-5 Room heat pickup
5-1 Room moisture pickup

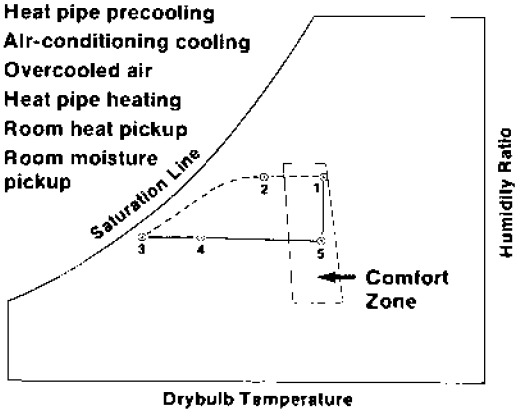


Figure B

The heat pipe application reduces the work of the air conditioner (2 to 3 in Figure B versus 1 to 2 in Figure A) and does not require reheating.

Example Economics of Heat Pipe Application

Need:	10-ton air conditioner (AC) with 50% dehumidification capacity (DC)
Conventional System:	14-ton AC with 35% DC and air reheat.
Heat Pipe System:	10-ton AC with 35% DC and heat pipes.

Economic Analysis

	Conventional System		Heat Pipe System
	Electric Reheat	Waste Heat Recovery	
Investment			
• AC	$14,000	$14,000	$10,000
• Waste heat recovery	-0-	$ 1,000	-0-
• Heat pipe	-0-	-0-	$ 2,100
Total	$14,000	$15,000	$12,100
Required Energy Costs *			
• AC	$ 2,363	$ 2,422	$ 1,772
• Reheat	$ 1,688	-0-	-0-
Total	$ 4,051	$ 2,422	$ 1,772
Power Demand (kW)	19.25 kW	5.8 kW	4.2 kW

* @ 1500 hours full load/year @ $ 08/kWh Figures include additional fan power requirement.

Project accomplishments

- Experiments proved technical feasibility.
- Cost effectiveness determined to be very favorable.
- Different heat pipe designs and configurations studied.
- Preliminary design and performance data obtained.
- Transferring technology to air-conditioner manufacturers.

Current activities

- Technology demonstration at a candy warehouse in Georgia.
- Develop application methodology for heat pipe selection.
- Study new heat pipe geometries.

Applications

Most suitable where:

- Low humidity level necessary
- Humidity control required
- Air reheated after cooling in traditional HVAC system
- Large quantities of ventilation air needed

Some examples are:

- Electronic component production, assembly and storage
- Film drying, processing and storage
- Drug, chemical and paper manufacturing and storage
- Candy, chocolate processing and storage
- Swimming pool enclosures
- Hospital operating rooms
- Grocery stores
- Telephone exchanges, relay stations, clean rooms
- Underground silos

Other Heat Pipe Applications

Heat pipes have been used for many applications:

- Remote heat rejection from a concentrated source (e.g. computer chip)
- Obtain uniform temperature
- Efficient heat exchangers

For more information on dehumidification application, or other applications, please contact:

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