Heat Pipe Benefits

Heat pipes improve the effectiveness of your HVAC system for dehumidifying air. This enhancement to a system will help eliminate the problems associated with humidity in a customers operating environment. Cost benefits are realized when occupants are comfortable at higher thermostat settings due to lower humidity levels. Generally, for each 1°F rise in thermostat setting there is a 7% savings in energy costs.

Advantages

- May reduce or eliminate the need for reheat;
- Allow cost effective manner to accommodate new ventilation standards;
- Requires no mechanical or electrical input;
- Are virtually maintenance free;
- Provide lower operating costs;
- Last a very long time;
- Readily adaptable to new installations and retrofiting existing A/C units; and
- Are environmentally safe.

Prime Heat Pipe Candidates

- Libraries
- Restaurants
- Storage facilities
- Supermarkets
- Applications requiring controlled/reduced humidity
- Applications where reheat or desiccants are used

Case Study

It has only been recently (late 1980's), that commercially affordable heat pipe systems been available for dehumidification enhancements to air conditioners. Heat pipe assisted dehumidification has been successfully applied in thousands of units since then and typically have paybacks of 2 years or less.

Just one example of the effectiveness of heat pipe assisted dehumidification is documented from a demonstration project at a K-Mart store in Mississippi. The project was sponsored by EPRI and two southern utilities. In this project, two identical K-mart stores fifteen miles apart were monitored for humidity levels. In one store, five (5) of the seventeen (17) roof top air conditioning units were retrofited with heat pipes. Each unit was retrofited in about 30 minutes by installing a curb adapter (with heat pipes within). The curb adapters negated the need for any roof repair.

Results showed that the average relative humidity (RH) at the heat pipe store was 35% at 73°F thermostat setting compared to 52%RH at the other store or a difference of 17% relative humidity. K-mart is now enjoying reduced energy bills at the heat pipe store because they can comfortably raise the thermostat setting in their store from 73°F to 76°F due to the lower relative humidity. In fact, they have actually had comments from customers and employees about how cool the store now feels.

Conclusion

Heat pipes can greatly increase the moisture removal capabilities of an air conditioning system typically from 50% to 100%. Savings to your energy bills are realized from eliminating the need to over-cool then reheating the same air and by allowing a rise in the thermostat set point while still maintaining occupant comfort. High humidity levels can effect issues from "sick building syndrome" to excessive frost on freezers in supermarkets. Heat pipes are the economical and environmental technology of choice for efficient dehumidification.

ConserVision℠

Heat Pipes
A Dehumidification Enhancement

VIRGINIA POWER

What are heat pipes?

A heat pipe is a simple device that can quickly transfer heat from one point to another without the need of energy input. The basic make-up of a heat pipe is just a metal tube (usually copper) sealed at both ends, evacuated to a vacuum and charged with a refrigerant (usually HCFC 22).

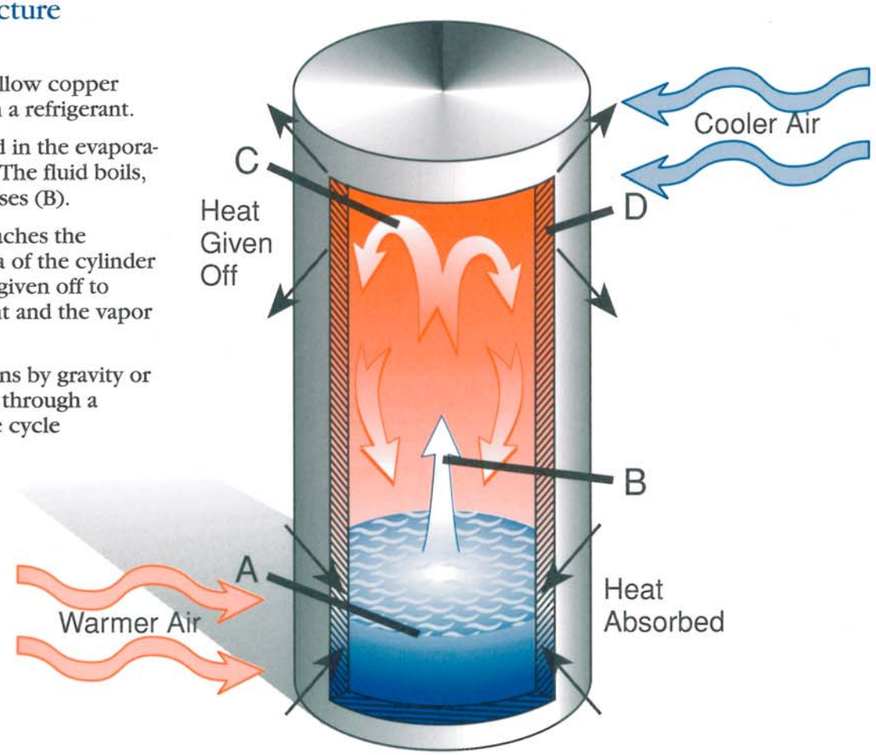
How do they work?

When one end of the pipe is exposed to a warm air stream, the inside refrigerant absorbs heat and evaporates and the vapor moves to the other cooler end. Since the other end of the pipe is exposed to a cooler air stream, the inside refrigerant vapor transfers its heat to the cooler air stream and condenses. After condensing, the refrigerant circulates back to the warmer end by gravity or capillary action, sometimes with the help of an inside "wick".

Heat Pipe Structure Close Up:

A heat pipe is a hollow copper cylinder filled with a refrigerant.

1) Heat is absorbed in the evaporator section (A). The fluid boils, the hot vapor rises (B).
2) As the vapor reaches the condensing area of the cylinder (C), the heat is given off to the environment and the vapor condenses.
3) The liquid returns by gravity or capillary action through a "wick" (D). The cycle then repeats.



Why do heat pipes become an important air conditioning addition?

Heat pipes can increase the **dehumidification** capacity of a system and reduce the energy consumption. By applying a heat pipe system into your air conditioner, you will increase the amount of latent cooling (removal of moisture from the air) while maintaining the sensible cooling (lowering the temperature of the air inside). In circumstances where the need for moisture removal (dehumidification) is high or it is critical to maintain low humidity levels, standard air conditioners may not have the capabilities to effectively deal with these loads. Consequently, a standard cooling system must work longer and harder, possibly without satisfactory results and an increase in energy costs.

Why is humidity control important?

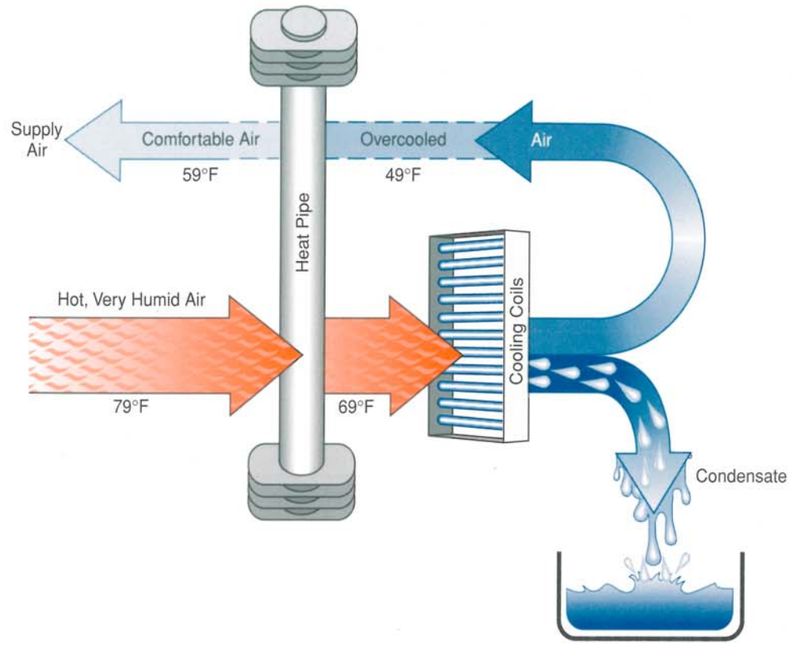
Humidity is the amount of moisture (water vapor) present in air. It is expressed as a percentage (%) in terms of relative humidity (RH). Relative humidity % is the relative measure of present moisture levels in air to the maximum capable levels at a specific air temperature.

Humidity resides within a building from various vehicles such as perspiration from people, processes within building (showering,cooking,...etc) or most commonly from outside air brought into the building for ventilation. It is necessary to control the amount of humidity (or relative humidity levels) in the conditioned space in order to minimize or alleviate various consequences such as:

- *Indoor Air Quality (IAQ)*
  Humidity can be a supporting agent in "sick building syndrome". ASHRAE recommends buildings maintain a relative humidity levels less than 70%.
- *Mold/Mildew*
  Humidity is a key ingredient for the promulgation of mold and mildew in ducts, walls and other interior spaces.
- *Human Comfort*
  High humidity interferes with the human body's natural cooling process of evaporation at the skin surface.
- *Product Quality*
  Humidity can contribute to poor product quality in many manufacturing processes.
- *Equipment Inefficiencies*
  Humidity can contribute to equipment inefficiency of refrigeration systems within a facility - such as open freezers in a supermarket.
- *Preservation*
  Humidity can destroy valuable art work or books in a library.

How are heat pipes applied in air conditioners for dehumidification?

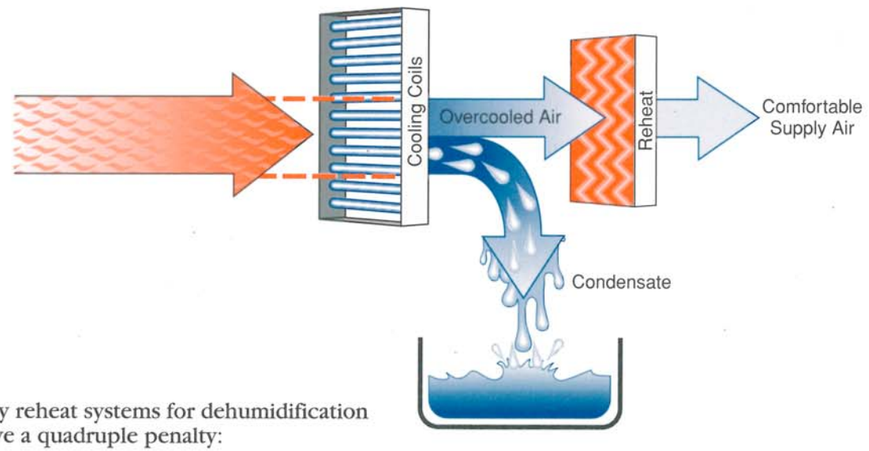
The cooling coil in a conventional air conditioning system provides both the sensible (lowering the temperature) and latent (moisture removal) cooling. When warm air passes thru the cooling coil, its temperature is lowered as it loses heat to the cold coil - sensible cooling. Latent cooling or the removal of moisture from air (dehumidification) is dependent on whether the moisture in the air will leave the air and condense on the cooling coil. Condensation of the water vapor in the air on the cooling coil will take place only if the coil temperature is lower than the dew point of the air passing through. The dew point (DP) is the temperature at which water condenses in air. A conventional air conditioner can use up most of its cooling capacity to cool the air to the dew point (sensible cooling) and have little capacity left for dehumidification or latent cooling.



A heat pipe enhanced air conditioner allows more of the cooling coil's capacity to go towards latent cooling by pre-cooling the air before it gets to the cooling coil. Pre-cooled air means less sensible cooling required at the coil and more capability for latent cooling (dehumidification).

What is the traditional method of dehumidifying for hot, humid conditions?

To remove large amounts of humidity in a hot, humid environment, an air conditioner must operate longer and consume more energy. In order to accommodate the removal of more moisture from the air, the thermostat is lowered and the treated air is over-cooled. Essentially, you are lowering the temperature of the cooling coil to allow more condensation on the coils. The supply air is now too cool for human comfort and it must be reheated before it is delivered to the building spaces. Reheating may also be required to decrease the relative humidity of the over-cooled supply air.



Ordinary reheat systems for dehumidification may have a quadruple penalty:

1) *Increased cooling plant*	The cooling equipment must be increased for overcooling. This additional air conditioning tonnage increases first cost of cooling equipment;
2) *First cost of reheat plant*	The reheat coil requires increased electrical equipment and/or heating distribution piping;
3) *Annual cooling costs*	The owner pays the extra energy costs for overcooling of the air;
4) *Annual reheat energy cost*	The owner pays the annual energy costs of reheating the same air.