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Humidity removal in supermarkets

In an air conditioning system, the evaporator removes moisture from the air. Therefore, it would seem reasonable that if the efficiency of the evaporator were increased, more moisture could be removed. As air is passed through an air conditioner's evaporator, it reaches dew point and condenses into a liquid. The liquid is then removed as condensate. This process is called dehumidification.

Another part of the conditioning process is reheating the air as it comes out of the evaporator, causing the air to become warmer and expand. This warmer, expanded air now has more ability to hold moisture and thus will have a lower relative humidity. The air is said to be less dense per cubic foot or have a higher specific volume. The trick is to reheat the air efficiently to an acceptable delivery level with the proper amount of warmth and relative humidity. Accomplishing both of these functions greatly enhances the desired operation.

Fig. 1 shows a system that reheats the air being discharged by the evaporator's air handler. The air actually comes in contact with a liquid subcooling coil connected to the discharge of a liquid pressure amplification (LPA) pump. The liquid subcooling coil is located downstream of the liquid receiver. Depending on the size of the coil, the liquid can be subcooled to within 8° F of the air temperature leaving the evaporator. With 60° F leaving air temperature, the liquid should be subcooled to approximately 68° F. The more subcooling there is, the closer the liquid temperature comes to the evaporating temperature. This increases the net refrigeration effect (NRE).

This subcooling coil allows liquid in the coil to be further subcooled by the colder air being discharged by the evaporator's air handler, while at the same time providing reheat to the air leaving the evaporator. Thus, the percent relative humidity (%RH) of the discharged air is lowered, the liquid in the subcooling coil is being subcooled further, and the air is being reheated to an acceptable level for the occupants.

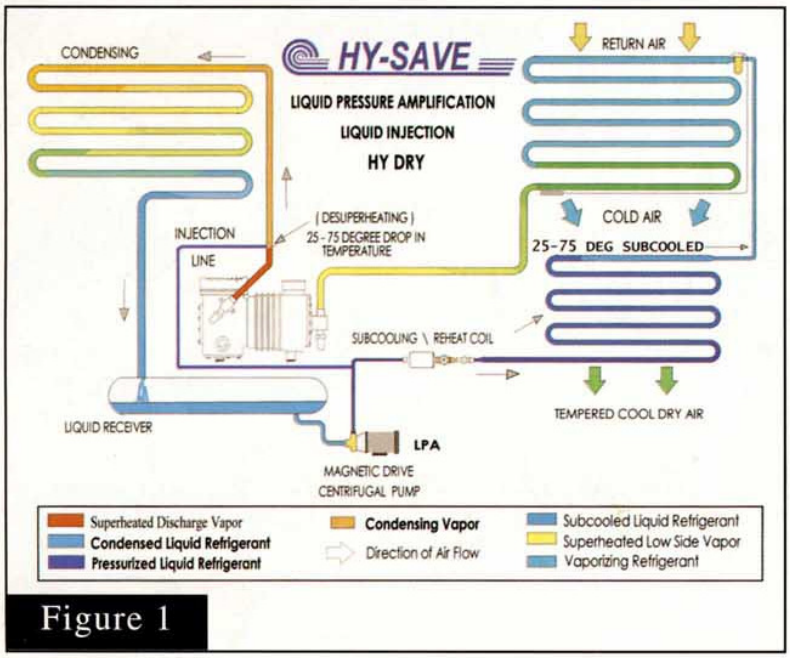

Figure 1

Supermarket savings

Reducing the humidity in supermarkets will reduce the latent heat loads on the store's refrigeration and air conditioning equipment. Actual installations have proven energy savings as much as 13% of energy used. High humidity situations in supermarkets will cause excessive frost on evaporator coils in the refrigeration cases. This frost build up reduces heat transfer and efficiency of the system. Not only does the frost build up consume energy, but it takes energy to get rid of the frost by longer defrost periods. Even mullion heater loads can be reduced with lowered relative humidity in the supermarket. Mullion heaters simply keep the surfaces of the refrigeration cases above dew point so condensate will not form. Equipment for this moisture control has been expensive to buy and to maintain. This system will reduce the energy usage on both the air conditioning and refrigeration systems.

One of the key benefits of this system is the use of the internal energy of the system to accomplish reheating the air. No external heat, gas, or liquid is used for reheat. Subcooling is also accomplished without any external energy source. □