DEHUMIDIFICATION: Restaurant Humidity Control Design Guide

Munters

The Humidity Expert

Restaurant Humidity Control Design Guide

Introduction

High humidity is the cause of many common problems encountered in today's restaurants. Diffusers dripping water on the floor and on customers, and condensation on glass doors and windows are obvious signs of high humidity. Floors that sweat or take a long time to dry after mopping also indicate humidity problems. The staff complains about being too hot and wants the thermostat turned down at the same time the customers are complaining about being too cold and wants the thermostat to be turned up; that's a humidity problem too. Many restaurant owners and designers find themselves wondering why they have these problems now when they didn't in the past. The short answer is that restaurant designs have changed and the systems used to condition them have not.

Most restaurants use packaged direct expansion AC equipment to air condition their dining rooms and kitchens. Typically the AC equipment delivers a constant air volume to the space and the compressors cycle on and off as required by the space thermostat to maintain the temperature setting in the space. The outdoor make up air required by code for ventilation in the dining room is pulled in through the DX equipment upstream of the cooling coil and the fan and ductwork distributes the outdoor air throughout the building. Make-up air for the kitchen exhaust hoods is introduced through a dedicated make-up air fan in the kitchen. Humidity control is ignored because it is assumed that the thermostat will call for compressor operation frequent enough to control the humidity and the problems it causes. Now that things have changed, designers must take a look at the best way to condition restaurants.

In the 1980's AC equipment was designed so that about 25% of it's total cooling capacity was used for controlling humidity of the air crossing its cooling coil (latent cooling) and about 75% was used lowering the temperature of the air (sensible cooling). Today this ratio is much different as equipment designers realized they could increase the published efficiency of equipment by reducing its latent capacity and increasing its sensible capacity. As a result today most commercial AC equipment has high SEER's, but is designed to dehumidify with only 10 or 15% of its capacity. Ironically, the higher the efficiency of the air conditioner the lower its dehumidification capability

While the ability of the equipment to dehumidify has been going down, the need for the equipment to dehumidify has been going up. In the last 10 years two trends in air conditioning loads have contributed significantly to humidity problems in restaurants. First, building codes have steadily increased the amount of outdoor air required in the dining room, raising the percentage of latent cooling needed from the air conditioner. Secondly, the sensible load imposed on those cooling coils has been going down due to energy saving changes made to buildings. Changes like lower lighting loads from high efficiency lighting, lower transmission loads from better insulation and better glass, and lower infiltration loads from tighter construction all reduce the amount of sensible cooling required with little or no reduction in the latent cooling required. This also raises the percentage of latent cooling needed.

The result of these two trends is that in today's restaurant a much higher percentage of the work that needs to be done by the cooling coil is humidity reduction rather than temperature reduction. Equipment designed to do 85% cooling and 15% dehumidification is now asked to do 60% cooling and 40% dehumidification.

A look at a typical restaurant load profile in Table 1 illustrates the problem. The restaurant seats about 200 people and requires 3,000 cfm of outdoor air. The air conditioning loads were run using a popular load program available from a large manufacturer of packaged air condition equipment. Like most load programs it only considers humidity load at peak dry bulb conditions.

Table 1. Typical Restaurant Load Profile

Load	BTUH	% of Total
Roof	11,454	2.1%
Solar	20,922	3.8%
Glass	6,199	1.1%
Wall	8,222	1.5%
Partison	0	0.0%
Envelope	**46,797**	**8.5%**
Lights	38,031	6.9%
People	113,350	20.5%
Misc	117,769	21.2%
Internal	**269,150**	**48.5%**
Outdoor Air	**206,862**	**37.4%**
Supply Fan Heat	**16,137**	**2.9%**
Duct Heat Pick-up	**14,756**	**2.7%**
Total	**553,702**	**100.0%**

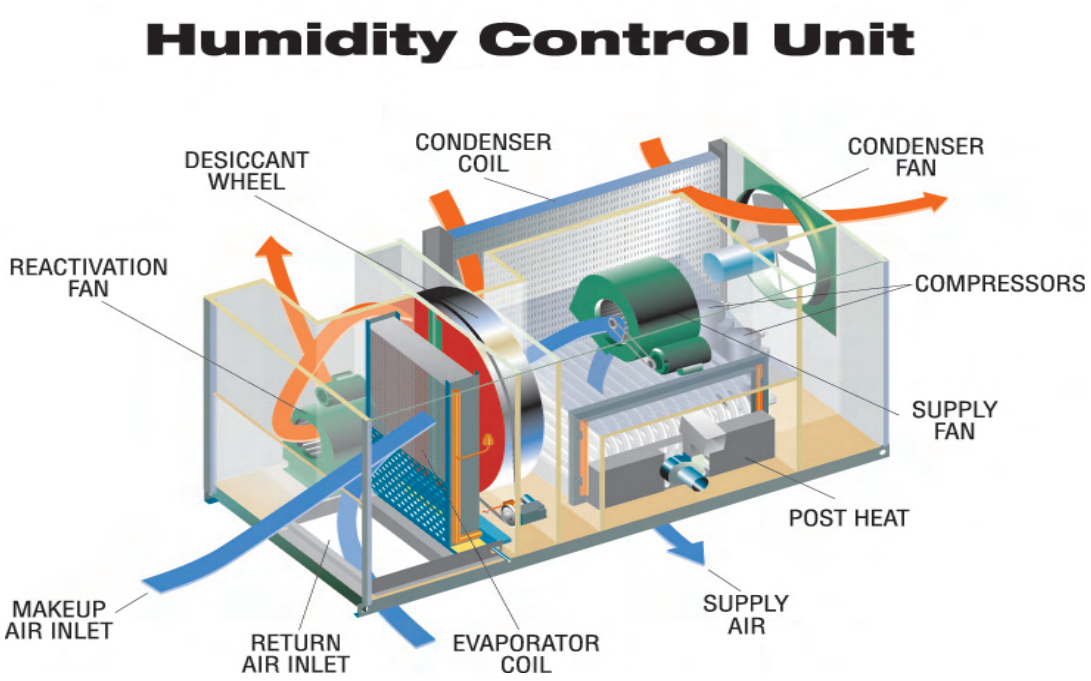
Equipment

Because of load profiles like the one in Table 1, more and more restaurant owners & designers are reaching the conclusion that separate control for humidity must be added to their buildings. The easiest way to control humidity is with conventional A/C equipment- just turn on the heat when humidity is too high. All that is needed is to add a few controls that will allow heating and cooling to run at the same time. When the space is too humid the controls bring on the heat. This raises the room temperature so that the thermostat brings on the air conditioning. While the cooling system is fighting the heating system to maintain the room temperature set point, the cooling coil removes the humidity from the room. This is a very effective but, unfortunately, the most energy consuming means of humidity control. It is so energy consuming that most energy codes prohibit its use.

A viable option to control humidity without running afoul of the code authorities is to add a piece of equipment dedicated to dehumidifying the outdoor air. The dedicated dehumidifier works in conjunction with standard off the shelf AC equipment. The dehumidifier controls humidity via a space humidistat while the AC unit controls space temperature via a space thermostat.

In the past there were two primary ways to dehumidify air (1) either mechanically cool the humid air below the humidity level that you want to maintain in the space or, (2) use a desiccant to draw moisture out of the air to reduce it to the desired humidity level. Individually each approach has drawbacks that keep it from being an ideal solution to the humidity problem. Mechanical cooling is least expensive when controlling to high humidity levels and the reheat is free while desiccants are least expensive when controlling to low humidity levels. By using both technologies in one product Munters increased the dehumidification capacity and efficiency compared to using either technology by itself, while maintaining the low cost of the mechanical system. Munters calls this product the "Humidity Control Unit" (HCU). The HCU is a stand alone unit, which means that one package provides heating, cooling, and humidity control. The HCU is the most efficient method of dehumidifying outdoor air on the market today and is available in standard sizes from 1,000 to 12,000 CFM.

The HCU is also one of the least expensive technologies available. Up until this point, the least expensive way to treat outdoor air has been to modify standard AC equipment by adding hot gas bypass and hot gas reheat. The Munters HCU costs the same or less. Plus, the HCU accomplishes the task using up to 40% less energy. Talk to your Munters representative for more information on the HCU.



Building Design

It is important to note that the ability to control humidity depends in a large part on the integrity of the building envelope. Humidity load calculations are based on reasonably tight building with a minimum of air leaks. If the building leaks air badly it may not be possible to control humidity within a tight range. The architects plans and specifications normally call for a tight building. On new construction jobs, in most cases, the issue is enforcement of existing standards rather than changing existing standards. On new buildings coordinating this at early stages can insure successful humidity control. When adding humidity control to an existing space, give some attention to the building structure. Plugging and caulking seams and gaps in the building structure can dramatically reduce the humidity load and minimize the size and price of dehumidifier required.

Following these recommendations, successful humidity control can be achieved.

Use ducted return air rather than ceiling plenum return. Plenum returns put the area where the wall meets the roof under constant negative pressure. The joint where these two building members meet is difficult to seal and is a common avenue for moist air to leak into a building. Ducted returns in general have fewer humidity problems because the ductwork is much easier to seal than the building structure.

Keep the restaurant positively pressurized relative to the outdoors. Humidity control is impossible if the restaurant is under negative pressure. The restaurant dining room should be positive to the outdoors and it should be positive compared to the kitchen area to prevent cooking odors from entering the dining room. This is best accomplished by not exhausting air from the dining room. Exhaust the air from the kitchen and the bathrooms instead.

Dehumidify the outdoor air before it enters the restaurant. On humid days, two thirds of the restaurants humidity load is concentrated in the ventilation air brought into the building. Humidity control is most effective by removing the moisture from the air before it enters the building. The remaining one-third of the humidity load not concentrated in the make-up air can be handled by the AC system during its normal cooling cycle.

Use dry ventilation air twice. Many designers treat the kitchen and the dining room as isolated entities. A make-up air system is installed in the kitchen to bring in outdoor air so that it can be exhausted by the kitchen hoods. The make up air for

the hoods is usually heated, but not cooled. This can make for very uncomfortable kitchens in southern climates and cooling make-up air just so it can be exhausted is an expensive undertaking. Meanwhile in the dining room a large amount of already conditioned air is being exhausted outdoors to no benefit. Rather than throw away this conditioned air in the dining room transfer it to the kitchen where it can help cool & dry that area before it's exhausted. This saves energy by downsizing or eliminating all together, the make-up air system for the kitchen.

Even in very humid areas there are thousands of hours each year when the outdoor conditions are dry enough that the AC unit is perfectly capable of maintaining humidity control with no help from the dehumidifier. If the dehumidifier can be bypassed during these hours the cost of running the dehumidifiers fan can be eliminated. To bypass the dehumidifier during these hours include an isolation damper on the dehumidifier so that the air can be bypassed when humidity control is not needed. When the humidistat calls for dehumidification the outdoor air dampers close, and the air is brought in through the dehumidifier, which runs until space humidity set point is achieved. When there is no call for dehumidification in the space the dehumidifier shuts down and the unit only runs to cool the space.

Maintain humidity control 24 hours a day, seven days a week. Many restaurants raise the cooling temperature set point when the building is unoccupied to save energy. This can lead to humidity problems unless you can maintain humidity control during unoccupied hours. The HCU can be furnished with return air and outdoor air dampers for off-hours humidity control. During occupied hours, the HCU dehumidifies the outdoor air. Relative humidity is generally highest at night and that humidity naturally infiltrates into buildings when their A/C system is shut down. The next morning at start-up all that additional humidity has to be removed from the building before the DX cooling system can reduce the space temperature to the occupied set point. When using an HCU for humidity control the better strategy is to add a return duct to the HCU. During night setback the HCU's outdoor air dampers close and its return air dampers open. The HCU dehumidifies at night running in this recirculation mode, maintaining low humidity at all times. This is very helpful in controlling humidity.

Acknowledgements; This application guide is based primarily on recommendations discussed in "Humidity Control Design Guide For Commercial And Institutional Buildings" published by ASHRAE.

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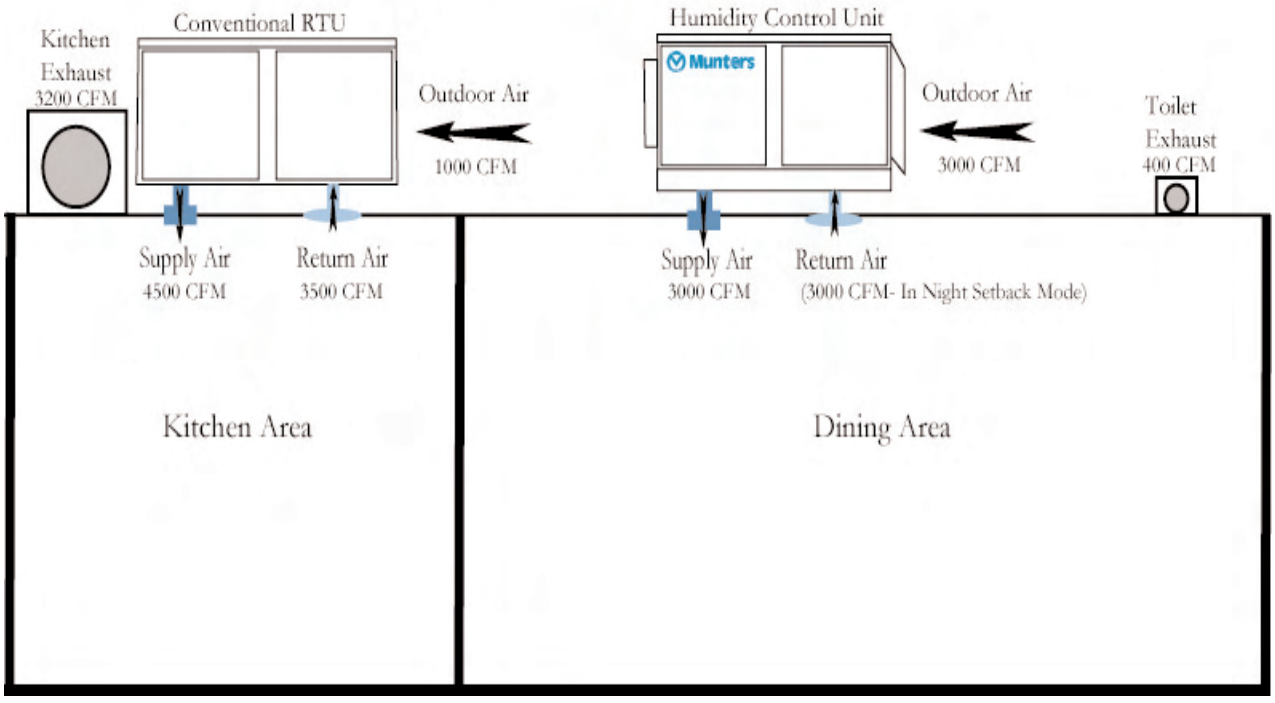

Munters is the world leader in humidity control with products and services for dehumidification, humidification and cooling of air. Customers are found in a wide range of segments, the most important being insurance-, utilities-, food-, pharma- and electronics- industries.

Manufacturing and sales are carried out via the Group's own companies in more than 25 countries in Europe, Americas, and Asia. The Group has 2,900 employees and net sales of SEK 4,100 million. Munters is listed on Stockholmsbörsen, the Stockholm Stock Exchange. For more information see www.munters.us

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