DEHUMIDIFICATION: Supermarket Humidity Control Design Guide

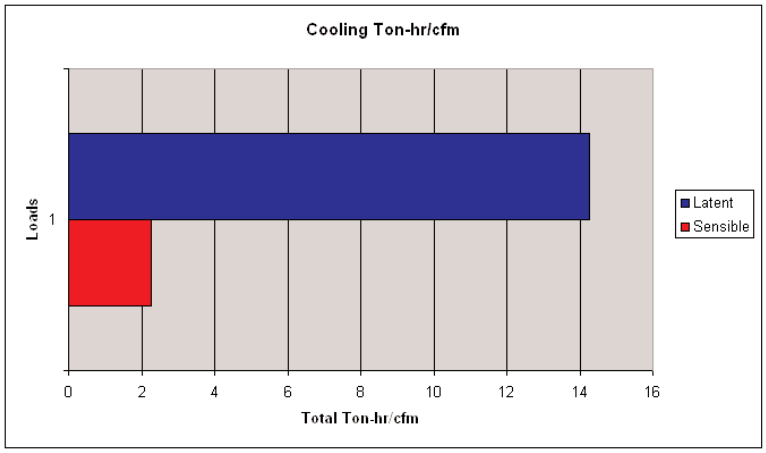
Munters

The Humidity Expert

Supermarket Humidity Control Design Guide

A Supermarket environment is one of the most unique in the commercial arena. The dynamics of temperature and humidity have a strong impact at several levels and offer a challenge to the HVAC designer like no other application. On one side, refrigerated cases provide a steady stream of cool air spilling into aisles, on the other side produce is misted and sprayed to keep the products fresh. Cooking equipment is utilized to provide the convenience of prepared foods. Conventional attempts to control humidity can provide an uncomfortable environment for customers, humidity not controlled can wreak havoc on refrigeration systems not designed to deal with it. The key to attacking this design is to analyze the sensible and latent load independently.

Ventilation air typically represents the largest latent load. With the increased popularity of prepared foods, cooking equipment and indoor cafes, the exhaust volume alone can dictate a large outdoor air intake in order to keep a positive pressure in the space. With this outdoor air comes humidity.



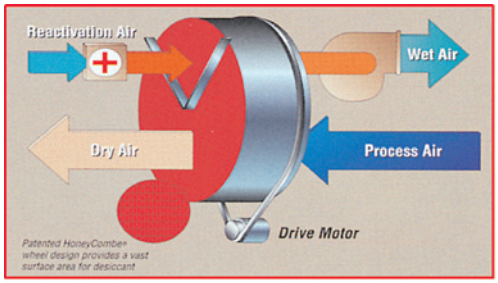
Pre-Condit	Tampa				
		Total			
		Sensible	Cooling	Latent	Cooling
Mid-pts	DB (F)	Hrs	Ton-hr/cfm	Hrs	Ton-hr/cfm
97	96 to 98	3	0.005778	3	0.009351
95	94 to 96	2	0.0036	2	0.004774
93	92 to 94	49	0.080154	49	0.136044
91	90 to 92	189	0.266958	189	0.581045
89	88 to 90	272	0.329247	271	0.834253
87	86 to 88	358	0.372258	354	1.008378
85	84 to 86	420	0.359316	416	1.065075
83	82 to 84	439	0.294057	428	1.086847
81	80 to 82	544	0.271656	522	1.324571
79	78 to 80	591	0.18846	572	1.510356
77	76 to 78	346	0.061335	326	0.851148
75	74 to 76	404	0.031734	743	1.91063
73	72 to 74	Total	2.264553	863	1.837607
71	70 to 72			465	0.801379
69	68 to 70			378	0.502406
67	66 to 68			367	0.362958
65	64 to 66			318	0.255951
63	62 to 64			200	0.118883
61	60 to 62			137	0.050111
59	58 to 60			39	0.009633
57	56 to 58			29	0.005114
55	54 to 56			4	0.000427
53	52 to 54			Total	14.26694
51	50 to 52				
49	48 to 50				

Supermarkets include a large concentration of refrigerated display cases. The cool air spillage (or case credits) needs to be accounted for and a typical Supermarket load profile will show very little internal sensible load due to this effect. The refrigerated display cases are also affected by the humidity in the store. The higher the humidity, the more energy required by the cases to eliminate it.

Therefore, the goal with any supermarket is to reduce the latent load on the refrigerated display cases. Low humidity saves operating costs for display cases by reducing latent refrigeration load, defrost cycles and anti-sweat heater run times. Traditional HVAC systems can keep the temperature constant, but the moisture level creeps up. That means the refrigeration system must work 15% harder than if the humidity was kept low.

Anti-sweat heaters on case edges and doors can consume between 25 and 40 kw per hour. By lowering the humidity and keeping the store dry, those heaters can be cycled off, saving electrical load with no risk of condensation or fogged display doors.

With a conventional air conditioning approach, the only way to reduce the humidity level is via temperature. The colder the leaving air temperature, the lower the dewpoint. Most everyone is familiar with the chill of walking through a supermarket on a mild to warm day. With a desiccant approach, humidity is controlled independently of temperature. An interior space condition of 75 degree F and 40% RH is easily achieved and maintained. A conventional DX system would have to overcool to remove moisture then reheat the air for comfort, utilizing energy in the process.



Warm, dry air from a desiccant approach can be targeted toward the coldest parts of the store so there is no need to use reclaim heat to warm up the aisles. That saves the cost of extra refrigerant piping and most importantly, frees up heat reclaim capacity for producing the hot water needed by the deli and bakery departments.

The following supermarket design practices should be observed to minimize the possibility of humidity problems.

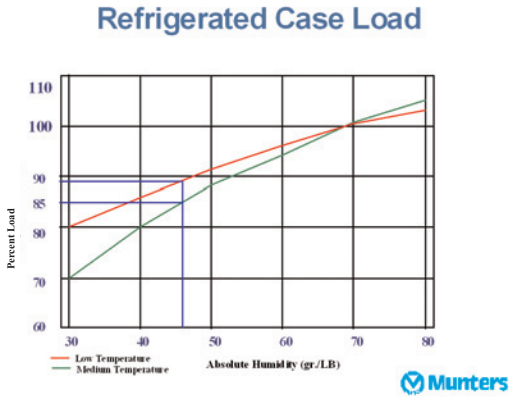
1. Separate sensible and latent loads – Sensible and latent (heat and moisture) loads for a supermarket are different from most retail applications. The effect of the refrigerated display cases impacts both sensible and latent categories to the negative. The designer should account for this to avoid oversizing the HVAC system.

2. Treat the outdoor air before it comes into the store – Outdoor air in most cases will be the major source of moisture. (Refer to ASHRAE Standard 62 guidelines to insure indoor air quality.) The designer also needs to account for the exhaust hood activity and introduce the proper amount of outdoor air to off set. Door openings can be another source of moisture so a positive air pressure is recommended. It is critical for a supermarket that outdoor air is treated before it enters the store. The goal is to reduce the

exposure to the refrigerated cases to as little moisture load as possible. In terms of energy, it is less costly to treat outdoor air with the HVAC system than the refrigeration system.

3. Take advantage of a lower humidity to raise temperature for customer/employee comfort – Maintaining the store at 75 degrees F for customer comfort used to mean that employees were much too hot, which had a negative effect on productivity. But 40% rh allows employees to feel very comfortable at 75 degrees F because at low humidity, normal perspiration is a highly effective cooling mechanism.

4. Maintain 40% RH, reduce defrost cycles – Most major case manufacturers will recommend that the indoor humidity level climb no higher than 55% RH. As the RH level is reduced, case operation is improved.



There are three basic approaches to applying desiccants to supermarkets. They all have their advantages and disadvantages and must be evaluated to meet the needs of the client.

1. Central System – A single unit can meet all the temperature and humidity control needs of a typical supermarket. Dry air is distributed throughout the store, improving the comfort conditions for both customers and employees. Central systems do the work of multiple conventional units in larger stores, so you save on wiring, duct work, rigging and roof work, in addition to reducing your operational costs for the next fifteen years.

2. Target Air Approach – Some stores have a high concentration of refrigerated cases and benefit from the warm dry air directed in that zone. The majority of the stores ventilation air would be processed through this unit, with multiple rooftop packages serving the general merchandise area.

3. Treat Outdoor Air Separately – The third method would be a dedicated outdoor air unit ducted either directly into the space or into a return air duct of either a central system or multiple roof top packages.

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AG 0005 Rev. 02, 02/04