White Paper

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Using Adaptive Defrost Control Technology to Improve Energy Savings in the Food Service Industry.

Brian Lamberty
Marketing Manager, HVAC/R
Intermatic Incorporated

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Executive Summary

Running unnecessary defrost cycles in commercial walk-in coolers and freezers can increase a commercial food service operator's utility bills and impose undue strain on refrigeration components. In a competitive industry with razor-thin profit margins, ensuring commercial freezer and refrigeration units operate efficiently helps preserve a business owner's investment and provides an opportunity for savings. This paper describes how hybrid adaptive defrost control technology from Intermatic can reduce defrost cycles up to 40% or more per day.

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Abstract

Running unnecessary defrost cycles in commercial walk-in coolers and freezers is impacting the utility bills of commercial food service businesses.

Some facilities have installed intelligent evaporator efficiency controllers; however, these are very expensive and can be difficult to install and program.

Grässlin by Intermatic has developed a new adaptive defrost module for refrigerated walk-in freezers and coolers called the ICUBE™ Adaptive Defrost Module. The ICUBE™ uses adaptive defrost control algorithms to continuously monitor the conditions of the evaporator coil so it only defrosts when necessary at the next programmed interval. It installs simply and easily into an existing DTAV40 timer.

"Adaptive" or "demand" defrost are both essentially defined as a defrost control system that reduces defrost frequency by initiating defrosts or adjusting the number of defrosts per day in response to operating conditions, such as the frost load on the evaporator coil or moisture levels in the refrigerated space. This differentiates them from a time-initiated system that defrosts strictly based on compressor run time or clock time.

In an industry that operates on paper-thin margins, the ICUBE™ can provide some much-needed relief. The ICUBE™ is easy for contractors to install and program, making it an affordable solution that will deliver a fast ROI.

Situation analysis: What's in the field now?

Ice buildup on a refrigeration unit's evaporator coils decreases system capacity by reducing evaporator coil heat absorption. A defrost cycle counterbalances this effect by melting ice buildup. Although time-interval defrost switches have traditionally been relied upon to control defrost cycles, modern commercial designs utilize new strategies, such as temperature-initiated defrost methodologies, for more efficiency.

When using adaptive (demand) defrost as a method to defrost evaporator coils, defrost cycles initiate only when there is frost buildup. However, during heavy use, doors are continually opened and shut in a short time frame, causing the refrigeration unit to work harder to maintain its temperature setpoint and promoting conditions for frost buildup. As a result, defrost cycles may be triggered during these heavy usage periods – and at other unwanted times – for extended periods each day.

Intelligent evaporator efficiency controllers are another option; however, their complexity tends to necessitate a longer contractor visit for proper retrofitting and programming.

Reducing defrost frequency with a time/temperature hybrid approach

Time scheduling is especially important during busy periods in food service, such as the lunchtime rush. Intermatic has developed a new adaptive defrost module for its Grässlin refrigeration line, called the ICUBE™ Adaptive Defrost Module. When paired with a Grässlin DTAV40 Defrost Timer, the ICUBE™ module creates a time/temperature hybrid approach to maintain the timer's scheduling. In effect, this temporarily delays a defrost cycle and initiates it at an optimal, low usage time.

When comparing time-initiated defrost controls to temperature-initiated (adaptive or demand), both have their advantages and disadvantages based on conditional circumstances. Including a timer within a defrost controller is essential since there are times when a defrost cycle should be delayed, for example, during typical periods of loading product into the controlled cabinet area. A frost load condition could occur at a more rapid rate during this type of circumstance due to the exterior ambient air infiltrating the box and making contact with the evaporator coil. A temperature-initiate only approach could, in effect, initiate additional defrost occurrences versus a typical time initiated control.

By introducing a time/temperature hybrid type methodology, such as pairing a Grässlin DTAV40 Defrost Timer with an ICUBE™ module, the time scheduling aspect of the control would in effect temporarily delay a defrost to initiate at an optimal low usage time. During this type of circumstance, a temperature initiate only approach would also create longer compressor run times to pull the box down to the set temperature because it is defrosting during a high capacity period.
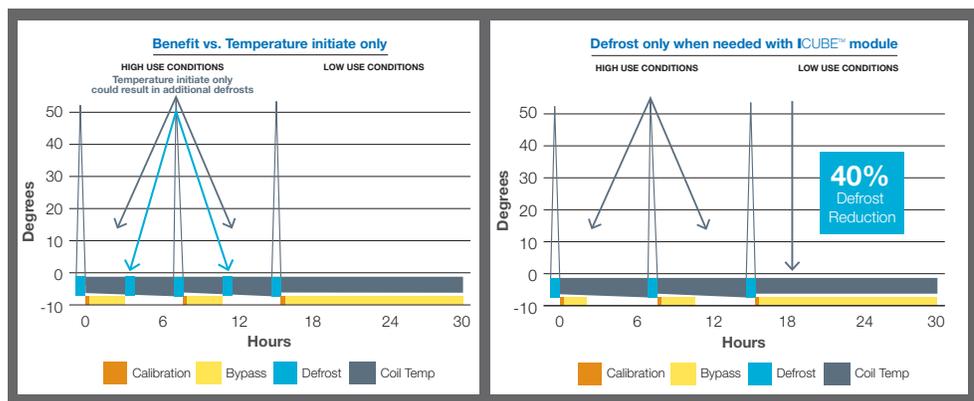
An affordable retrofit solution

Many full service and fast food restaurants; hospitals and health care facilities; and food processing and storage facilities are currently using Intermatic's Grässlin brand DTAV40 Electromechanical Defrost Timer. The ICUBE™ module installs simply and easily into the DTAV40 timer. Other than running the sensing wire from the module, no changes need to be made to the existing wiring. Since the sensing wire is non-isolated, it can route through the existing line voltage wire conduit or raceways.

Fail safe control and frost accumulation factors

If there is no thermistor probe attached, or a probe failure occurs, the ICUBE™ module operates solely off of the defrost timer and does not enter efficiency mode. If there is concern about frost accumulation factors between overridden successive timed defrosts, and no need to delay a scheduled defrost event during a high usage condition, simply add more time initiate schedules to the clock. The ICUBE™ module will override a defrost cycle anyway if the evaporator coil condition does not require defrosting.

Major energy savings

A comparison of the kilowatt hours (kWh) at two restaurants is revealing. Both locations use two evaporators with 1500 watt electric defrost heaters that run 365-days. With the ICUBE™ module, average usage per day decreases (per hour) and kW hours are reduced. In this example, kilowatts decrease by 876-hours, generating a $150 annual cost savings and an ROI of just over 1-year.

Restaurant 1 with Defrost Timer	
Calculate Kilowatt Hours	
Watts	3,000.00
Average usage per day (in hours)	2.00
Number of days used	365.00
Cost per KWH	0.17
Output	
Kilowatt hours	2,190.00
COST	$372.30

Restaurant 2 with Defrost Timer and ICUBE™ Module	
Calculate Kilowatt Hours	
Watts	3,000.00
Average usage per day (in hours)	1.20
Number of days used	365.00
Cost per KWH	0.17
Output	
Kilowatt hours	1,314.00
COST	$223.38

Reducing the strain on HVAC/R equipment; minimizing the risk of spoilage

The Care and Share Food Bank, in Colorado Springs, CO, is a major non-profit food bank. In 2015, they distributed over 21,000,000 pounds of food to 31 Southern Colorado counties. Operators at Care and Share are always seeking new ways to minimize operating costs so they can focus on their core mission: supplying Coloradoans who are at risk of hunger with enough healthy and nutritious food to thrive.

Their HVAC/R contractor, Bill Brown, owner of Cooling Cubed, LLC, proposed the idea of retrofitting ICUBE™ modules into their Grässlin DTAV40 defrost clocks that were controlling evaporator defrosting at the pantry's 9,000 sq. ft. cold storage facility. "This facility has long been plagued with evaporator coils that were freezing up from all of the heavy door opening. Relative humidity levels were averaging 68%. The frozen coils then hurt the box temperatures and were costly to defrost," said Bill.

They installed the ICUBE™ modules to ensure defrost cycles are based on evaporator coil conditions and help better manage the number of defrost cycles needed per day. With the time and temperature hybrid approach, the strain on freezer components has been alleviated. Overall energy use is expected to decrease from 237.07 kWh/d to 161.56 kWh/d, representing a 75.51 kWh/d reduction, or 32%, totaling 27,558 kWh annually. An annual savings of $2,755.75 is estimated for the entire facility (five systems). "Since the ICUBE™ module will only defrost when it needs to, or skip a defrost because one isn't needed, we can now schedule more defrost events per day without stressing the system," stated Bill.

Conclusion

Intermatic developed the adaptive defrost module to create a time and temperature hybrid approach for controlling refrigeration equipment. The **I**CUBE™ Adaptive Defrost Module is an easy-to-install solution that snaps onto the existing DTAV40 timer. There's no need to change any system wiring. Its versatility can add benefits to facilities of varying square footages, by either reducing the number of defrosts, or scheduling defrosts during later times, when kW prices are lower and at times more optimum to facility operations. It can also ease the strain on HVAC/R systems.

Innovative adaptive defrost control technology introduces a new way to save energy by reducing defrost cycles by up to 40% or more per day, helping alleviate utility bills and extending refrigeration equipment component life.

As an industry leader in defrost timers and energy-efficient controls, Intermatic and its Grässlin brand of controls can help contractors build greater profitability while saving their food service industry customers money.

Lighting Controls │ Surge Protection │ Weatherproof │ Photocontrols │ Timers │ Defrost/Refrigeration Controls

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