

FAN ENERGY SAVINGS IN CARCASS CHILLERS & FREEZERS



Figure 1: Fan Coil Unit (FCU) Source – Guntner GmbH



Figure 2: VSDs. Source – Danfoss

As much as 30% of electricity consumption from refrigeration systems at red meat processing facilities results from the inefficient operation of evaporators or fan coil units (FCUs). Fan speed control of evaporators or FCUs in carcass chillers and freezer rooms are two examples of areas where fan speed control can provide an attractive return on investment.

Evaporators or FCUs (shown in Figure 1) are present in all generally run at full speed or cycle on/off as required however, more often than not, their operation is not matched to the cooling requirement in a room which results in unnecessary energy use. Additionally, their operation adds to the cooling load in the space (and therefore additional load on the refrigeration plant) as heat is generated as the electrical energy entering the fan is converted into mechanical energy.

ENERGY SAVINGS OPPORTUNITY

Fan speeds can be varied through the use of a variable speed drive (VSD), to match the cooling load in a space, and thereby significant energy savings are possible with very attractive payback periods. However, specific care must be given to the control logic which varies the fan speed over time, so that production and meat quality is not compromised.

Fan power consumption is directly proportional to the cube of fan speed, meaning that a reduction in fan speed results in an even greater reduction in power consumption. This relationship can be observed in Figure 3. A 20% reduction in fan speed equates to a 50% reduction in power consumption and a 40% reduction in fan speed equates to a 75% reduction in power consumption.

These power consumption savings are applicable to all types and sizes of refrigeration systems; from smaller Freon refrigeration plants to large industrial Ammonia refrigeration plants.

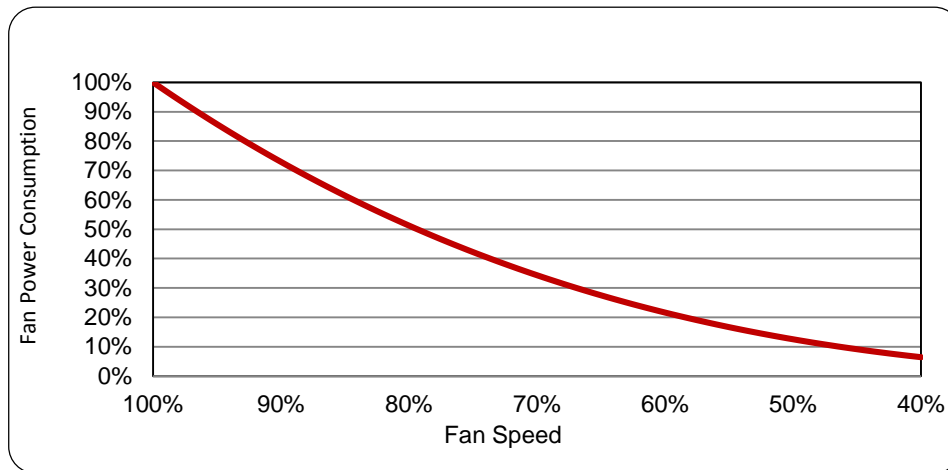


Figure 3: Fan power consumption vs fan speed. Source – Minus 40

WHERE CAN THIS WORK ON YOUR SITE?

The energy efficiency benefits associated with implementing fan speed control on evaporators or FCUs will vary depending upon the following factors:

- The cooling load profile for a specific room;
- Ongoing production and meat quality;
- Air distribution throughout the room.

Freezer rooms and carcass chillers are two excellent examples where the application of fan speed control can provide significant energy savings. Example 1 outlines in detail such a scenario, in which fan speeds could be reduced over the weekend and during the night throughout the week.

Example 1: Energy saving calculation for a single beef chiller

POWER CONSUMPTION	Week Days			Weekend	
	Night	Day	Peak	ALL	Peak
Speed	100%	100%	100%	100%	100%
Hours	9	9	4	18	4
Daily Power Consumption [kWh]	60.48	60.48	26.88	120.96	26.88
Sub Total [kWh] per annum	38,438			15,376	
Total [kWh], per annum	53,814				
SPEED-CONTROLLED POWER CONSUMPTION	Week Days			Weekend	
	Night	Day	Peak	ALL	Peak
Speed	50%	100%	100%	50%	100%
Hours	9	9	4	18	4
Daily Power Consumption [kWh]	7.56	60.48	26.88	15.12	26.88
Sub Total [kWh], per annum	24,680			4,368	
Total [kWh], per annum	29,048				
Nett Annual Saving [kWh]	24,766				
Cost saving @ 10c/kWh = \$2,476 /annum					

This example shows the process for calculating the savings resulting from the installation of evaporator fan speed controls (EFSCs) on a beef carcass chiller with two evaporators and two fans per evaporator. The total fan power is 6.72 kW.

The typical cooling load profile in a carcass chiller can be seen in Figure 3. The exact load profile will be dependent on the carcass size, air flow and temperature, time of load in/out, meat characteristics, etc, and thereby the cooling load varies significantly throughout the operational cycle. As a result, implementing a speed control logic that matches the cooling load can yield significant energy savings. It can be seen from Figure 3 that there is a substantial period after carcass chilling, before the product is removed from the room in which there is a substantially reduced load (i.e., during the night). Implementing fan speed control during these times would maximize energy savings.

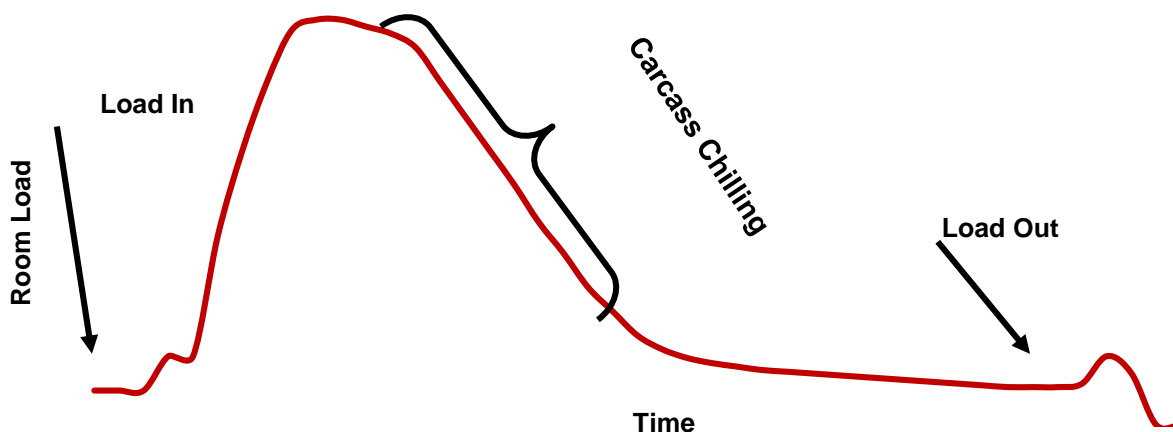


Figure 4: Typical cooling load profile of a carcass chiller. Source – Minus40

Implementing speed control has the following benefits:

- Considerable reduction in fan power;
- Reduced heat introduction into the space to be cooled, therefore reducing the load on the refrigeration plant;
- Improved control of room temperature at low load as opposed to fans cycling on and off. A similar observation can be made for holding freezers which operate under low load conditions outside of operational hours.

Implementation of fan speed control on evaporators or FCUs requires the following equipment:

- VSDs on the fans – typically one VSD per evaporator or FCU, allowing the VSD to control all fans of that unit;
- Sufficient programming capability in the control system to facilitate effective speed control logic.

Example 1: Energy saving calculation for a single beef chiller

	Average Daily Kill	EFSC implemented on	Capital Cost (\$)	Energy Cost Savings (\$)	Payback Period (Yrs)
Meat Processor 1	1,200 lambs	5 carcass chillers, 1 freezer room	190,000	183,000	1.04
Meat Processor 2	900 cattle	20 carcass chillers	200,000	168,000	1.20