

Variable speed drive application (VSD)

[February 2010]

LinkPlas reduces cooling fan costs with VSD

LinkPlas Ltd, manufacturer of PET containers based in Albany North Harbour, uses an injection stretch blow moulding process to make containers for the industrial, food and beverage, personal care and healthcare markets.

The company needs reliable cooling water to cool injection moulding machine hydraulic-systems. In seeking a process to establish a more stable cooling water temperature, an opportunity for electricity savings was identified.

Controlling the fan speed with a temperature sensor and VSD prevents over cooling during periods of low air temperature and humidity.

Not only is the cooling control improved, the VSD saves energy for this 24 hour per day, 5 day a week operation.

"Our cooling tower fan now uses the same amount of electricity as a standard light bulb," said Steve Morrison of LinkPlas.



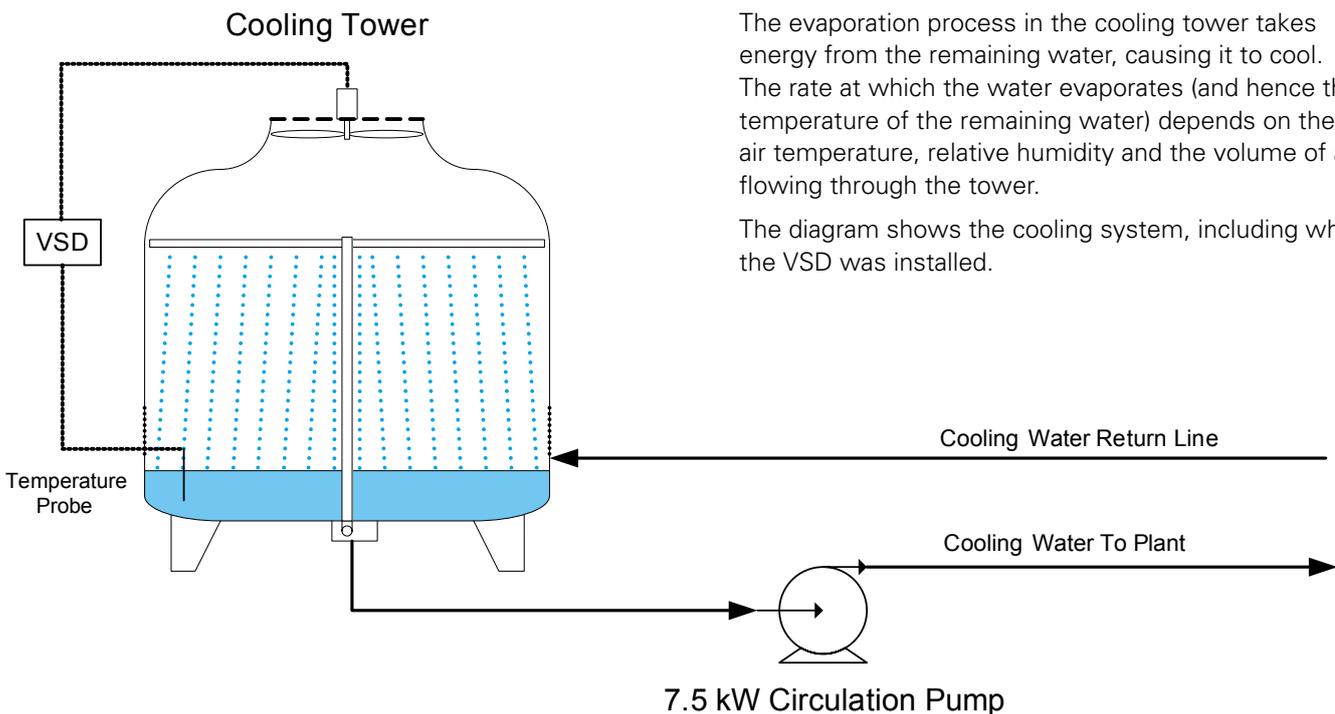
The cooling water system

At LinkPlas, cooling water is pumped through a cooling loop, picking up heat from the moulding machines being cooled. The heat is then rejected outside via an evaporative cooling tower.

The heated cooling water enters the cooling tower through spray nozzles at the top of the tower. As the spray droplets fall into the basin, some of the water evaporates into an air stream created by the cooling tower fan.

The evaporation process in the cooling tower takes energy from the remaining water, causing it to cool. The rate at which the water evaporates (and hence the temperature of the remaining water) depends on the air temperature, relative humidity and the volume of air flowing through the tower.

The diagram shows the cooling system, including where the VSD was installed.



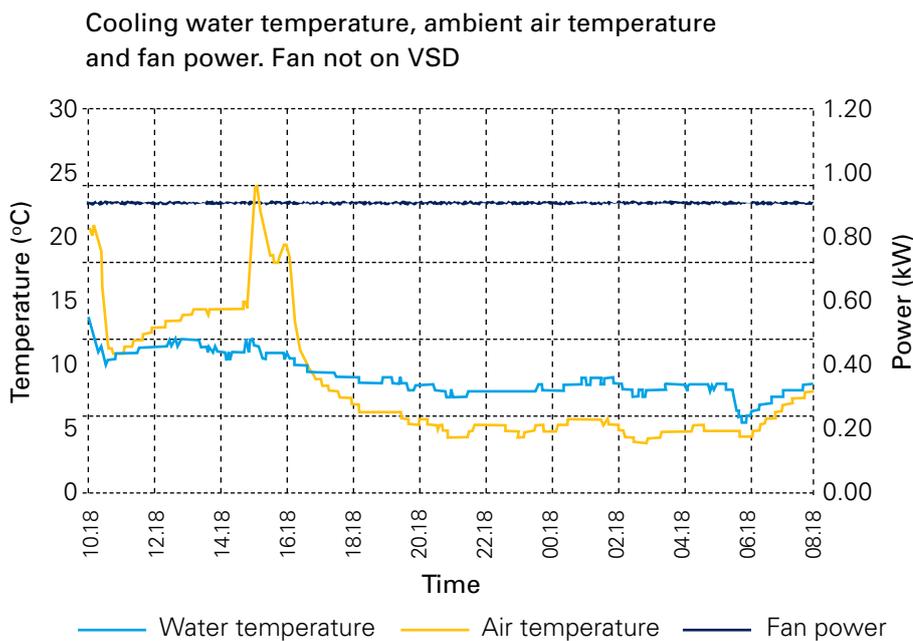
The problem – excessive cooling, wasted energy

Because the cooling tower is sized to achieve the required cooling duty on the hottest days of the year, the rest of the time, its cooling ability far exceeds the required capacity.

Prior to the VSD being installed, the fan ran continuously at a fixed speed, even though at low temperature and humidity the volume of air delivered far exceeded what was required to effect the necessary cooling of the water.

This resulted in needlessly low water temperatures and excessive fan power consumption.

The graph below shows a typical 24 hour (production day) profile of the cooling tower's water temperature, ambient temperature and fan power, prior to the installation of the temperature probe and VSD.



It can be seen from the graph that the water temperature in the cooling tower varied from 6°C to 14°C, a range of 8°C over the day. The fan's power demand was constant at 0.95 kW during this time.

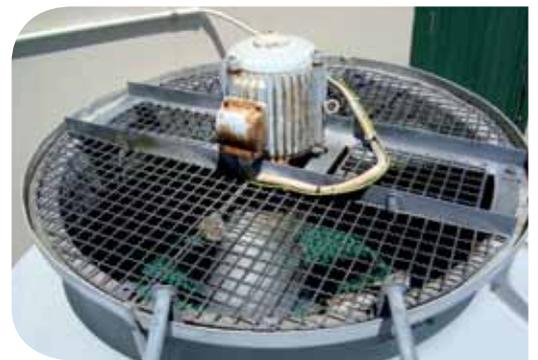
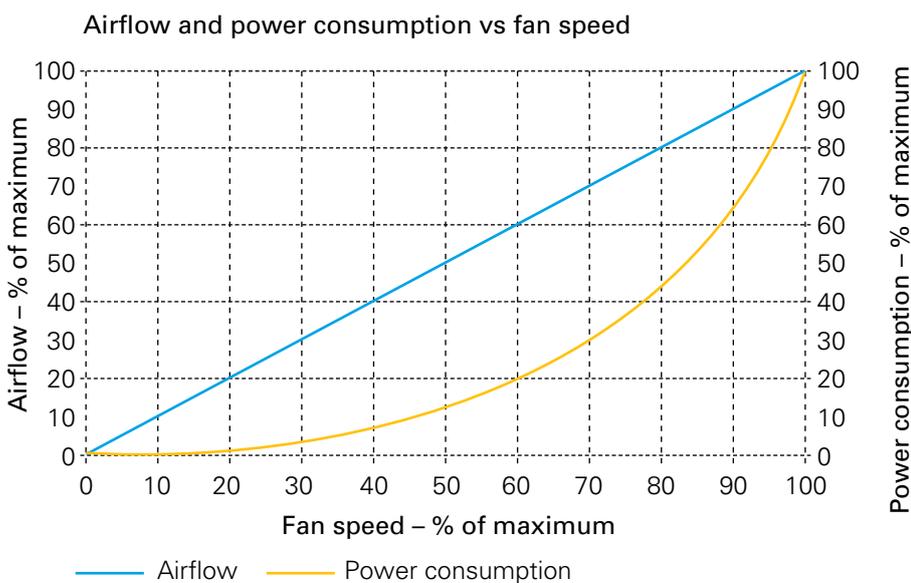
“ The volume of air delivered far exceeded what was required to effect the necessary cooling of the water ”

The opportunity – appropriate cooling, cost savings

The opportunity was to establish a more stable cooling water temperature, by not over-cooling during periods of low air temperature and humidity, and simultaneously reduce energy costs.

The lower limit of water temperature that can be achieved by the cooling tower is determined by the wet bulb air temperature at the time. On days with a very low wet bulb temperature (e.g. a cold, dry, winter day), only a small fraction of the maximum airflow capability of the fan will be required to achieve sufficient cooling to maintain the required temperature.

A fan's airflow has a linear relationship with fan speed, but a fan's power consumption has a cubic relationship with fan speed. This means the power consumption drops off rapidly as the fan slows down.



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The solution – VSD on cooling fan

The solution links the speed of the fan with the temperature of the water in the cooling tower basin. Hence, the installation of a temperature sensor in the water linked to a VSD controlling the fan speed.

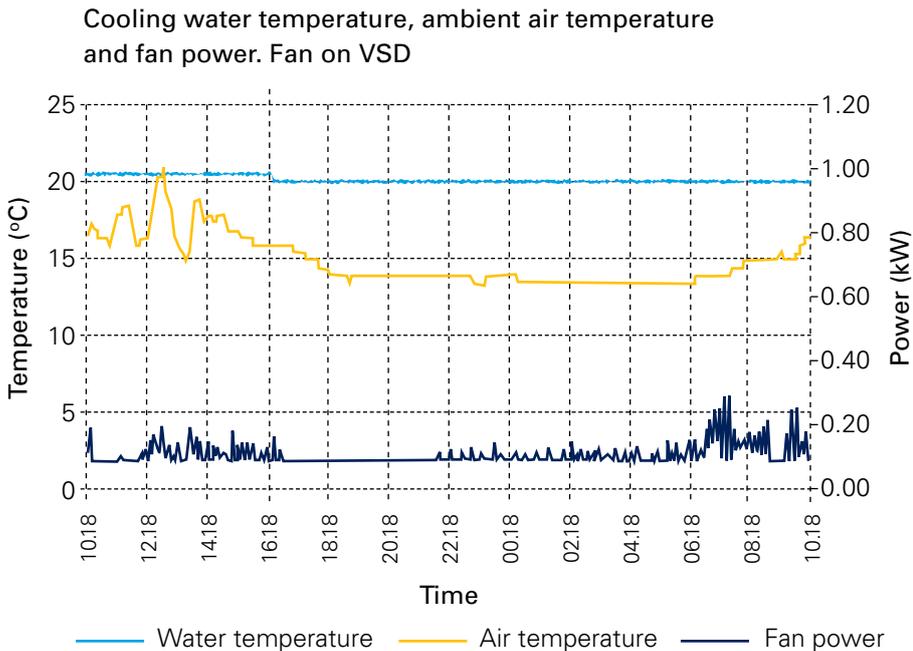
A temperature setpoint is used for the VSD to control the speed of the cooling tower fan according to the temperature of the water in the basin. Fan speed is increased as the water temperature rises or exceeds the set point and conversely slows down as the temperature cools or goes below the setpoint.

A further benefit from this solution is the reduction in fan noise. In cases where a plant is adjacent to a residential area, controlling the fan speed with a VSD can provide for improved neighbourhood relations. Compared to constant on or on/off control of a fan running at maximum speed, a VSD controlled system will be much quieter.

At night, when the potential for noise disruption is highest, the VSD controlled fans are quieter because air temperature is generally lower.

The result

The graph below shows a production day profile of water temperature, air temperature and fan power after the temperature probe and VSD were installed, with the temperature setpoint set at 20°C.



Depending on the ambient air temperature, the fan's power demand varied between 90 Watts and 300 Watts, while the water temperature ranges between 20°C and 21°C.

The peak power demand of 300 Watts is 30% of the previous constant load, and the minimum demand of 90 Watts was determined by a minimum fan speed setting of 16 Hz (to maintain a minimum airflow through the cooling tower).

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Conclusion

Overall, the large water temperature fluctuations were avoided and the annual electricity savings from the fan are estimated at 8,296 kWh or \$1,296.

With an installation cost of \$2,120 for the VSD and temperature probe, LinkPlas has a payback period of 1.6 years for this investment.

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