Head pressure reduction

Tasmania and Western Australia

The ‘Watts in Your Business’ project has completed energy audits of 30 packhouses and orchards Australia-wide. This case story of two packing sheds in Tasmania and WA shows where energy use and costs could be reduced.

The J.W. Kirkwood Ticehurst Orchard in Campania, Tasmania, produces and packs around 900 tonnes of cherries, summerfruit and apples per year. It houses four cool store rooms and uses an ammonia suction system controlled by a thermostat and an R404a package unit. From October 2012 to September 2013, the site used over 428,000kWh of electricity, at a cost of over $90,000 (excluding GST). Refrigeration comprised 58% of the business’s total electricity use.

At Newton Brothers packhouse and cold storage in Manjimup, WA, approximately 70% of the business’s total electricity is used for cold storage. The facility produces and packs around 7680 tonnes of apples, pears and stonefruit annually. It has two cold store facilities with 27 individual cold storage rooms. From May 2012 to April 2013, the business consumed over 1.2 million kWh of electricity at a cost of just over $350,000 (excluding GST).

Both businesses could save energy costs by reducing the head pressure in refrigeration units.

Reducing the head pressure of the ammonia compressor at Kirkwood’s could cut energy costs.

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Site savings opportunities

- Reduce head pressure on existing refrigeration systems.
- Save between $2500 to $3500 every year from an initial investment of $5000.
- Payback period of 1 to 2 years.

Head pressure reduction on refrigeration systems

The head pressure or condensing temperature has a direct impact on compressor power consumption.

At cooler ambient temperatures it is easier to liquefy the compressed refrigerant. In these conditions, the head pressure can be lowered to reduce electricity consumption. The extent of head pressure reduction is dependent on condensing temperatures and ambient conditions.

Kirkwood's facility uses ammonia-based refrigeration operating at head pressures between 1000 and 1100kPa. The head pressures could be lowered in appropriate ambient temperature conditions by re- setting the fan cycling pressure switch and modifying the pressure transmitter set points. The condenser fans would activate more frequently than they will operate more efficiently. To ensure success of this, the evaporative condensers would need to be correctly sized and in good working condition and the liquid feed valve from the liquid receiver to the suction accumulator needs to be capable of operating at the reduced pressure differential. A refrigeration contractor could assist with implementing this.

Costs and savings of reducing head pressure on refrigeration units at two sites:

	Annual electricity savings (kWh)	**Annual savings ($)**	**Capital cost ($)**	**Simple period (yrs)**	**Percent reduction use**
Newton brothers					
Franklin Street head pressure reduction	13,100	$3406	$5000	1.5	1.0%

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Graphite Road Head pressure reduction	11,850	$2607	$5000	1.9	0.9%
Kirkwoods					
Head pressure reduction on the ammonia refrigeration system	4850	$1892	$1900	1.1	1.2%

Newton Brothers operates a HCFC-based refrigeration system from a fixed head pressure set-point (at condensing temperatures between 35°C and 40°C), and the condenser fans are cycled to maintain this set-point. A reduction in head pressure is possible during low load periods, and in cold ambient conditions the opportunity exists to reduce compressor power use. Re-setting the condenser fan cycling pressure switch settings means the condenser fans will activate more frequently, but the overall refrigeration system will operate more efficiently.

The thermostatic expansion (TX) valves may limit the potential for head pressure reduction, in which case electronic expansion valves could be installed in place of the TX valves. The costs to implements this (see table above) only consider the associated labour costs in optimising the pressure switch settings and do not consider replacement of the TX valves.

Implementation requirements

- Install on/off data loggers on each compressor for 2 to 3 weeks. Assume a load profile for the other months based on electricity interval data.
- Install on/off data loggers on fan motors.
- Conduct analysis and modelling to quantify energy savings for greater accuracy.
- Conduct preliminary design/equipment selections and project costing. As required, the preferred site contractor can be engaged to assist with accurate project costing.
- Prepare an implementation and measurement/ verification plan for each project.
- Determine energy and cost savings, CO2-e reductions and payback.

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