Case Study

WHAT IS THAT THROTTLING VALVE COSTING YOU?

There are many reasons to use a valve in an irrigation system including on-off control, flow rate control, prevention of back flow, reducing pressure or as a safety device. When the flow is reduced or controlled by means of a regulating device such as a throttling or control valve there is a subsequent energy loss. By reducing the flow and pressure to an irrigation system with a valve, the energy that was used to generate that flow and pressure is lost. The question is how much is the energy loss at the valve costing you?

Generally, manually operated valves are called throttling valves and automatically operated valves are called control valves. Based on the irrigation system assessments conducted on farms in the Mareeba and Dimbulah region, throttling and control valves contribute to energy inefficiency and increased pumping costs. The details for one such farm are outlined below, along with the figures used to calculate the cost of the energy loss. The purpose of this valve is to throttle back the pressure and flow of an oversized pump. This problem is all too common in an area where many large pumps originally used in tobacco production are still in use and poorly matched to the current irrigation systems.

The pump itself actually operates efficiently at 4.98 kWh/ML/m and approximately 60 per cent efficiency. The inefficiency occurs after the discharge where a valve restricts flow and reduces the pressure by 400 kPa. The irrigated area is below the pump and water source allowing some blocks to be gravity fed with no pumping required. In blocks where gravity feed is not sufficient to meet the micro-sprinkler operating pressure, the pump is operated as a booster to deliver approximately 180 kPa.

PUMP EVALUATION	HYDRO-TITAN 125X100-250, 55KW
rpm	2950
Discharge pressure	583 kPa
Pressure after throttled valve	180 kPa
Tariff 62 operated during peak cost	35.828 c/kWh
Flow rate	52 L/s
Energy/volume/m	4.98k Wh/ML/m
Pump efficiency	59.44 per cent

The pressure, flow rate and total dynamic head have been recorded as part of the pump evaluation, along with the kWh/ML/m. Using an ultrasonic flow meter the flow rate was measured at 52 L/s for this irrigation shift. The discharge pressure at the pump and pressure after the valve show a reduction of 40 m head pressure. These figures may be used to calculate the cost of the energy loss at the valve.

The pump evaluation found at the given flow rate and total dynamic head the pump operates at 4.98 kWh/ML/m. When multiplied by the 40 m head loss the result is a loss of 199 kWh/ML at the valve. To put this into a monetary value, 199 kWh/ML is then multiplied by the electricity tariff (0.35828 $/kWh) with the result being $71.37 / ML loss across the valve.

Pressure loss at valve	583 kPa - 180 kPa = 403 kPa = 40 m head
Calculated kWh/ML/m multiplied by m of head loss	40 m x 4.98 kWh/ML/m = 199 kWh/ML
Multiplied by the electricity tariff (0.35828 $/kWh)	199 kWh/ML x 0.35828 $/kWh = $71.37 / ML
Measured flow rate 52 L/s	52 L/s x 3600 = 18 720 L/h
Multiplied by 20 hrs of irrigation per week	187 200 x 20 = 3.74 ML/wk
Multiplied by $71.37 / ML	= $267.20 / wk = $3473.72 / quarter

Using the measured flow rate multiplied by the hours of irrigation per week, the quarterly energy loss has been calculated at a value of $3473.72.

If the grower was to spend $4000 on a replacement pump that efficiently delivered the required 52 L/s flow rate and 20 m of head, the savings from the energy loss at the valve would recoup the pump replacement costs in less than four months. Following this the grower could expect a continued cost saving of $71 / ML on subsequent pumping. Pump selection charts show there are small pumps capable of meeting the required duty point at 15 kWh which indicates a significant reduction in electricity costs when compared to the existing unit that draws 56 kWh.

Using a throttling or control valve to restrict an oversized pump to meet irrigation system requirements may at first glance appear a viable option to utilise an existing pump. However, the resultant energy loss at the valve, together with inefficient pump operation leads to a significantly increased pump operating cost. Once the energy loss has been quantified it becomes apparent the cost of a suitably matched pump would be quickly recouped. In addition, there are ongoing savings associated with efficient pump operation that further justify investing in a pump that is suitably matched to the irrigation system.

For more information, contact the Growcom Land and Water Field Officer on 07 3620 3844.

A Growcom project conducted in collaboration with the Department of Natural Resources and Mines with funding provided by the Queensland Government's Rural Water Use Efficiency Initiative – Irrigation Futures (RWUEI-IF).

Queensland Government

RURAL WATER USE EFFICIENCY INITIATIVE

WATERFORPROFIT

growcom