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ENERGY case study

Pump evaluation pays off

A pump efficiency trial at Goondiwindi has highlighted the importance of testing individual pumping set-ups to identify the optimum operating point to achieve maximum efficiency.

Hamish Johnstone of "Macintyre Downs" Goondiwindi thought he was burning a fair bit of diesel at his lift pump.

His rough dip stick measures of his fuel tank showed he was using up to 55 to 60 litres of diesel per hour, which adds up when you are pumping water for a large number of hours (eg 10 pumping events over eight days, 24 hours a day – or about 1920 hours) over a season.

The pump specifications might tell you not to run your engine at more than 1800 RPM and at these revs you should be pumping about 135 ML/day, but these specs do not take into account varying conditions.

What an irrigator thinks he is pumping may be quite different in reality.

The pump in question moves tail water into the storage or lifts it up into the main supply channel for recirculation. Both pumping efforts are very different. As well, the pumping conditions change as the storage fills.

In order to get some accurate data on his diesel consumption, Hamish agreed to trial a Pump Efficiency Monitor (PEM) which was developed by the National Centre of Engineering in Agriculture (NCEA). The testing was undertaken by NCEA's Phil Szabo (pictured below) and NSW DPI's Janelle Montgomery who is also the CottonInfo Water Use Efficiency technical specialist for NSW.

The PEM continuously logs water flow, diesel consumption and hydraulic head, parameters that are needed to examine pump performance. This data can then be used to determine a combined efficiency of the pump and diesel engine.

"You will never really know if you never measure - remember the old adage 'measure to manage'," Phil says.

Best Practice

Water flow, total dynamic head and diesel consumption data were collected with the PEM unit (Figure 1) during a single pumping event that aimed to fill an empty 1800ML ring tank as quickly as possible after a significant rainfall event.

“The combined engine and pump efficiency is also shown on Figure 1 and is much lower than what you would expect if examining pump efficiency on its own,” Phil said.

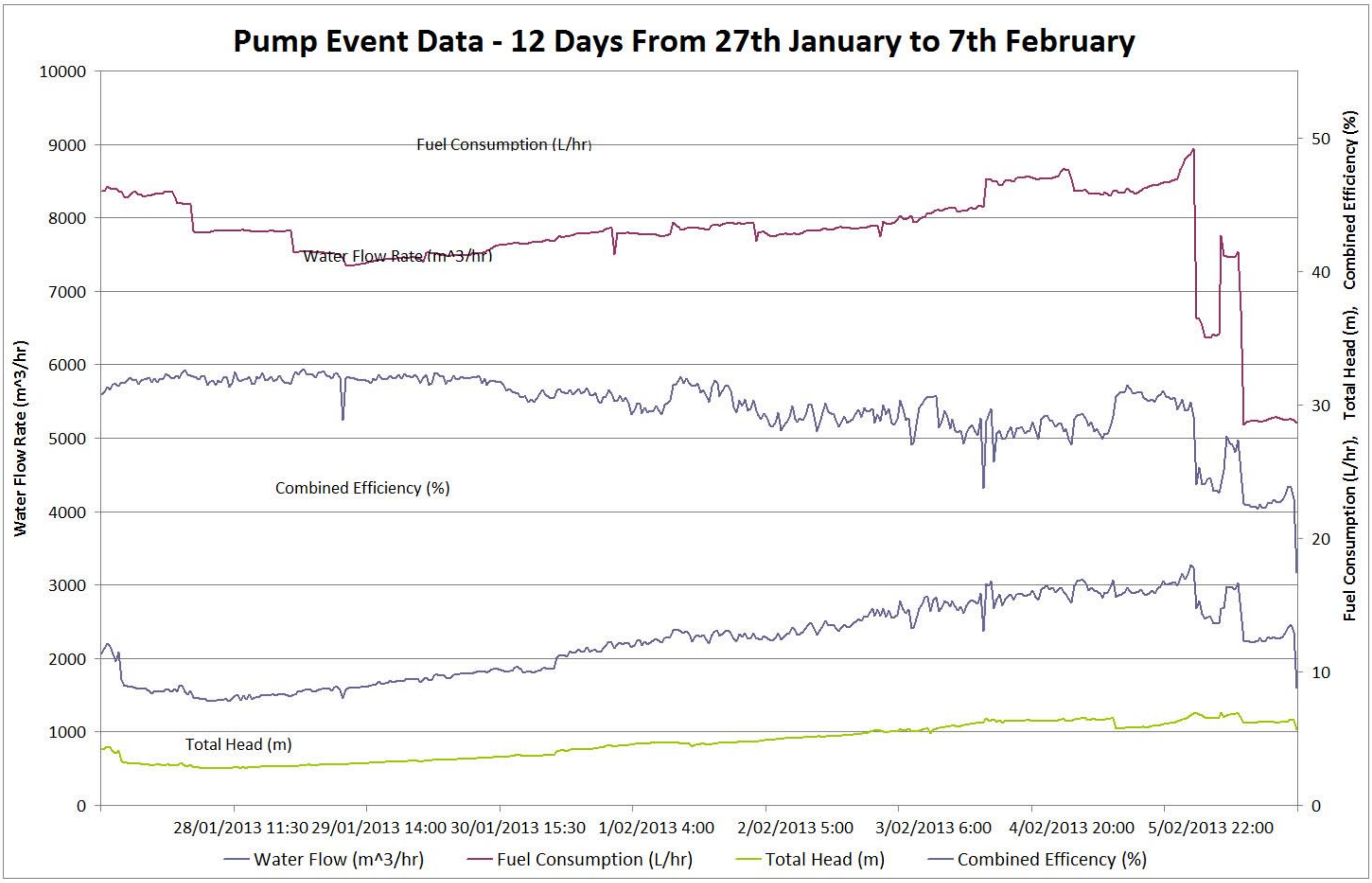
“Unfortunately with diesel engines it is difficult to determine the actual pump efficiency, as the amount of power that the engine delivers to the pump cannot be measured with any accuracy,” Phil said.

“Pump efficiency is defined as energy output/ energy input. Any losses of energy in the system through worn out impellers, cavitation, leaks, poor maintenance etcetera will reduce the pump efficiency.”

During the test, at the start of pumping with the engine speed set to 1800 RPM (pump 630 RPM) and only three metres total dynamic head (TDH) (as the on-farm water storage was empty) the pump was achieving a flow rate of 138 ML/day with fuel consumption of 45 L/hr.

This duty point is off the pump curve resulting in severe cavitation.

Figure 1:



The pump was run at 1800 RPM for the entire pumping event. As the TDH increased as the storage filled, to a maximum seven metres, the flow rate reduced to 120 ML/day.

However, this same water flow rate (120ML/day) could have been achieved with the engine running at 1550 RPM (pump 550 RPM), resulting in significantly decreased fuel consumption. A spot check at 1550 RPM determined fuel consumption to be 25L/hr. That's a saving of at least 20L/hr.

From the data gathered over the entire pumping event, fuel consumption per megalitre per metre of head decreased from a maximum of 2.7L/ML/m at the start of pumping to a minimum of 1.04L/ML/m at the end of the pumping event as shown in Figure 2.

For more information on pump efficiency trials, contact:

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Figure 2: Over the monitored full irrigation event, it could be seen that when combined efficiency increases, fuel costs decrease.