Pumping Efficiency

As with all machinery, pumping systems will decline in efficiency over time, either due to abnormal operating conditions, or through normal wear and tear. To keep the system functioning at peak efficiency it's important to monitor pumping performance on a regular basis, but it can be difficult to pick up gradual declines in performance by observation only. Unless regular checks on the system are made, it's likely the decline in efficiency won't be noticed, until the system fails to the point where there are significant equipment and or crop losses.

Regular testing of operating pressures at the pump, and throughout the irrigation system, is a quick way of checking for reductions in performance and efficiency. Pump efficiency is only one of the factors that will affect pressure within the system, but if the pressure at the pump changes for a given pumping situation, further investigations should be made to determine if the pump efficiency has declined due to any of the following causes.

- Blocked foot valve strainers.
- Undersized foot valve strainers restricting flow.
- Blockages in the suction line.
- Air pockets or air leaks in the suction line.
- Suction lift being too high, e.g. as the water level in the dam decreases the suction lift increases.
- Incomplete priming of the pump.
- Reduced discharge pressure caused by an undersized impeller.
- Blockages of the impeller from inadequate straining of the suction.
- Damage to the impeller caused through cavitation, abrasive sand or normal wear.
- Air leaking into the pump casing.
- Incorrect pump speed.
- The pump not rotating in the right direction – can occur if the motor is not correctly re-connected after repairs.
- Mechanical defects.
- Discharge head too high. At high pressures and low flow rates more cavitation can occur and reduce pump efficiency.
- Blockages within the delivery system
- Leaks within the delivery system.
- Changes to the system, such as adding extra sprinklers to an irrigation layout, without taking into account the extra volume of water and pressure required, and how this will affect pump performance.

The irrigation industry has a method of determining efficiency of a given pump setup, which can then be compared against benchmark figures, and is expressed as kilowatt hours/megalitre/metre head, abbreviated as kWh/ML/m head. If the electricity consumption, pumping rate and operating pressure are known, this figure can be calculated and compared against an industry benchmark, or against the previous performance of the system. It can be quite a challenge to derive these figures in nursery situations, due to the complex nature of many nursery irrigation systems. For example, the efficiency of a pump depends on the flow rate being generated and, in many nursery situations, the flow rate can be quite variable. The best way to compare system efficiency over time would be to have a standard test situation, e.g. do the test when a certain irrigation zone is running. Alternatively, measuring the efficiency of the system when different zones are running, may give information on how the system could be managed better to reduce pumping costs by increasing pump efficiency.

Flow rates can be calculated by measuring the flow from a number of emitters and multiplying emitter flow rate by the number of emitters in the irrigation zone. If the pump has a dedicated electricity meter, the

electricity use can be measured directly, or it may be possible to turn off all other appliances and take a direct meter reading. On small, single phase pumps, cheap meters can be purchased that measure direct electricity use of individual appliances. A pressure gauge on the pump is the best way to measure the operating pressure of the system. To convert kPa to m head divide the kPa reading by 9.8, and to convert psi to m head multiply the psi reading by 1.4.

To calculate kWh/ML/m head, divide the L/hr pumped by 1000000 (this gives the number of hours to pump 1ML), multiply the hours to pump 1ML by the measured kW of electricity the pump uses, and then divide this figure by the pressure in m head to give kWh/ML/m head. For example, 1000000 divided by 3600L/hr flow rate gives 278 hours pumping time, multiplied by 1.0 kW/hr equals 278kwh, divided by 60m head gives 4.6 kWh/ML/m head. The benchmark figure for an efficient pumping system is a calculated value less than 5 kWh/ML/m, but the small pumps commonly used in the nursery industry are notoriously inefficient, and are frequently higher than this benchmark figure. Consequently, in many nursery situations, the aim should be to start with the highest efficiency system achievable and aim to maintain the efficiency as close as possible to the installed efficiency.

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