Improving Irrigation Energy Efficiency

Nursery irrigation systems are often overlooked as major users of electricity. A survey of production nurseries showed on average 26% of energy costs were associated with pumping, and 42% of total energy costs were attributed to irrigation. With predicted price rises, energy costs of irrigation are an area that should be regularly reviewed to reduce the cost of this basic but vital input of nursery production.

The following suggestions can help to reduce energy costs in pumping installations.

***Quantify pumping system requirements,** and seek professional advice on changes that can be made. When assessing potential energy savings, a simple rule to remember is that 1 unit of energy saved at the pump saves 3.3 units at the motor. Many nurseries have started with pumping systems that were able to supply the demands of the nursery at the time. As the business has grown the same pumping system is expected to cope with the extra demand, and in many cases isn't suited to the changed pump duty. The hydraulic requirements of an irrigation system can be analysed, and compared to the performance characteristics of the existing pump to determine if they are a satisfactory match and, if not, what a suitable replacement would be.*

***Operate pumps near their Best Efficiency Point (BEP) and ensure no cavitation occurs**. To improve the efficiency of oversized pumps, install Variable Frequency Drives (VFD's), downsize/ replace or trim impellers, or replace the pump with a smaller pump. Controlling flow by speed regulation is always more energy efficient than using a control valve. Valves reduce the flow, but not the energy used by the pump. For example, you can reduce energy costs by 80 percent if you halve the motor speed. This reduction in energy use is due to the pump affinity laws, which state halving the pump speed will halve the flow rate, decrease operating pressure by 4 times, and decrease power consumption by 8 times. This is why VFD's are more energy efficient in situations where there are significant variations in flow, as halving the speed of the pump will result in the motor only using 1/8th of the power required at full speed i.e. a small reduction in speed will result in a large reduction in power consumption. While VFD's add to the cost of a pumping system, energy savings of up to 50 percent a year can be achieved, giving payback periods of as little as 2.5 years depending the on the range of pump duties likely to be encountered in normal pumping. It should be noted prolonged use of an oversized motor with a VFD at low speeds can reduce the life of the motor due to overheating, and there are also situations where VFD pumps do not work efficiently e.g. where there are large changes in elevation.*

***Impellers can be trimmed if they have a constant flow rate, have a partially closed discharge valve, and no system changes are planned.** If a pump is continuously throttled to 10 percent less than its BEP, trim the impeller to reduce the energy demand by up to 25 percent.*

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To reduce energy lost due to friction, minimise the number of bends and valves in pipe work and ensure pipes are sized to minimise friction losses. *Increasing pipe diameter by 15 percent will halve pressure losses due to friction. Reducing pressure requirements at the pump will also reduce energy use.*

High Efficiency Motors (HEM) *are about two to four percent more efficient than standard electric motors, and offer lower operating costs and reduced energy consumption. The initial investment will be greater than installing standard efficiency motor, but this will be recouped by the additional savings in energy costs over time. HEM maintain efficiency over a wider range of loads, and have greater thermal tolerance, but It's important to match the HEM to its application, as these motors operate at a slightly higher full-load speed than standard motors. This may mean replacing an existing motor with a smaller one, trimming impellers on pumps or changing gear or pulley ratios.*

Check for motors that are running hot *(60°C or higher), as this can be a sign of excessive energy use.*

Replace a motor rather than rewinding it. *Efficiency is reduced by up to three percent each time a motor is rewound. If a motor burns out, the best solution is to review load requirements and purchase a high-efficiency motor to match that load.*

Establish a regular maintenance programme for pumps to prevent dirt and dust build-up. *Ensure the availability of basic instruments at pumps, such as pressure gauges and flow meters, to help with performance monitoring. Replace worn seals and pump impellers as required. Use low friction coatings on internal surfaces of pumps to improve efficiency, and ensure drive belts are in good condition, evenly matched and correctly aligned.*

Investigate how the irrigation is scheduled, and how different growing areas are managed. *If it's possible to combine irrigation zones without impacting on operating pressures and system efficiency, the length of time the pump runs for can be reduced, thus reducing overall energy consumption. Care needs to be taken with this approach that the pump is still operating close to or at its BEP. Aligning irrigation scheduling to plant water use may also reduce overall energy use by only applying the amount of water the plants require.*

Consider total lifetime costs when buying a new pump. *Industry figures quote energy costs as being 85% of the lifetime cost of a pump, with maintenance being 10% and initial cost 5%. This shows how replacing an inefficient pump may be cost effective in the long term, as the savings in energy will outweigh the initial cost of the more efficient pump.*

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