Nursery & Garden Industry Queensland

Designing an Efficient Pumping System

When considering options for improving pump efficiency, the option of designing a new system should always be investigated. It may be, over time, this will result in greater cost savings than upgrading an existing system. If a pumping system is being designed for a new development, it's critical that the system be carefully designed to ensure it meets the required capacity, while being the most efficient system possible.

Good system design considers all the elements within the pumping system, including how to minimise the need for pumping. Many of the principles used to improve the efficiency of an existing system can be applied to designing a new system, with enhanced opportunities for improving energy efficiency.

Assess production requirements and minimise needs:
Determine the amount of water required and over what period the water needs to be applied. Always use the worst case scenario in calculating pumping requirements. Minimise pumping through more efficient irrigation layouts, as well as accurate irrigation scheduling. Where possible, reduce operating pressures and reduce vertical and horizontal distances from the pump to the delivery point to minimise pressure losses.

Use a whole of system approach:
Ensure a whole of system approach is used, considering the following:
- *Energy prices*
- *Layout of pipes*
- *Layout of the pumping station*
- *Maximum/minimum flows*
- *Variation in flow rates*
- *Pump control systems*
- *Metering and monitoring*
- *Optimising the design*

Minimise pumping demand by:
- *Reducing pumping needs through system design and use.*
- *Reducing leaks.*
- *Lowering pumping system flow rate.*
- *Lowering the operating pressure if possible.*
- *Choosing efficient pumping components.*
- *Using the latest energy prices and tariffs in the calculation of operating costs.*

Design efficient pumping stations:
If there are multiple pumps in a pumping station, ensure they aren't working against each other, and controls are set for the pumps to work as designed. Ensure the pumps have been sized correctly for the flow rates of the system, and if combinations of fixed and variable speed pumps are used, that they are configured correctly.

Select efficient components:
Consider all elements of the system
- *Pipes - pressure losses from friction*
- *Valves - pressure losses from friction*
- *Pumps - efficiency - pump and impeller sizing and pump efficiency*
- *Pump drives - efficiency and sizing*
- *Controllers*

Flow rates and pressures required at the emitter are determined, then head losses due to friction calculated before deciding on the pump and motor requirements. Correctly designed piping systems will also provide benefits in reduced maintenance.

Pipe design:
- *Minimise pipe lengths between the pump and delivery point. Move the pump closer to the delivery point.*

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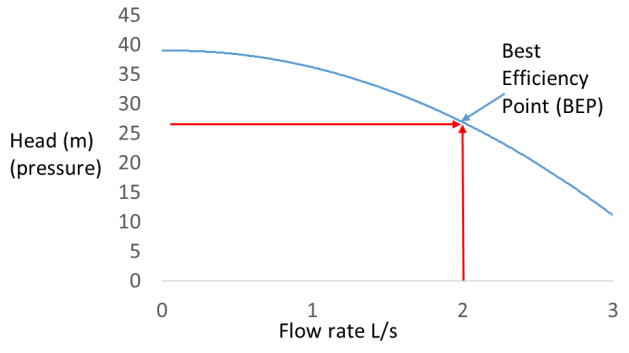
- *Minimise the number of fittings and bends to minimise pressure losses. Use long radius bends and minimise valves.*
- *Minimise the height water has to be pumped.*
- *Correctly size pipes and select piping material to minimise friction losses without excessive capital expenditure. Consider alternative pipe materials. Maximise pipe diameter and design pipe layouts to minimise pressure loss.*

Select the correct pump:

The pump selected must be able to meet flow and pressure requirements without being oversized. Other considerations are efficiency, duty point, suction inlet conditions, operating life, maintenance requirements, water quality and water source e.g. bore versus surface water.

Centrifugal pumps are the most common pumps used in nurseries and have the advantages of good performance, low cost, low maintenance and long operating lives. These pumps come in single stage and multistage configurations. Energy supply options to be considered are single or three phase electricity, solar and in rare cases fuel (petrol/ diesel). High efficiency pumps and motors should be selected, and attention paid to correct impeller sizing.

Pump characteristic curves provide a graphical representation of the performance of a pump, and are used to select the most efficient pump for a given situation i.e. the flow rate and pressure the pump has to operate at (duty point). Select a pump that has the duty point as close as possible to the Best Efficiency Point (BEP).



In nursery situations, pumps may need to cover a range of duty points due to variations in pressure and flow requirements for different irrigation zones. The duration of operation at each of the duty points should be considered in deciding if a particular pump is the most efficient for the system. Consider variable speed drives or multiple size pumps for varying flows. Pump manufacturers also have online software that can be used to assist in selecting the most efficient pump for a given situation.

Controls and operation:

- *Consider variable-speed drives for flow management rather than throttling valves or flow bypass.*
- *Record system use data.*
- *Provide metering of components (flows, pressures and energy).*
- *Ensure compatibility with variable-speed drives.*
- *Design for easy maintenance.*
- *Put a maintenance schedule in place.*
- *Select a service provider who understands energy efficiency and helps you with solutions.*

Improve the design:

Don't assume the first attempt at designing the system is the most efficient outcome. Go over the design again and review the trade-offs and see further improvements can be made. Some efficiency options may have a quicker payback than others.

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