PUMPS TECHNOLOGY – the heart of the system

Irrigation systems are carefully designed by specialists to balance the local supply of water with the demand created by operating sprinklers. This balance can be achieved either by increasing water supply at the source; or, by limiting the number of sprinklers or zones of sprinklers applying water at any given moment.

Furthermore, sprinklers are designed to function at specific pressures. The water source must not only deliver an adequate volume of water, but also at the right pressure. This makes on-site pumps essential for proper irrigation on golf courses, parks and other large sites.

Considering golf courses have between 500 and 2,000 sprinkler heads controlled by many field stations, with generally only one pump station, the balancing act is very complicated. Consider further that irrigation must occur in a limited time frame, that the amount of water being applied changes by station and by the irrigation event (with input of evapotranspiration data), and that higher elevation can reduce the water pressure available for sprinklers in higher zones. Now, you can appreciate why experienced engineers are needed to design and install large irrigation systems. Pressure and flow are related. If the flow of water used by sprinkler heads exceeds the supply, pressure will fall. If pressure falls below the design pressure of the head, it won't distribute water to the same rate, distance of uniformity.

One way to achieve balance is by regulating the number and types of heads operating at the same time to match the water output of the pump station. You start with the known output(s) of the pump station and figure out a combination of zones to use this amount of water. You will also need to schedule irrigation so that all combinations of zones have the correct demand. The old way to do this was to pop in valve groups until the pump could just keep up. This is considerably easier today with the advent of computer flow management software and central controllers. Hydrozoning of sprinklers and flow sensors make it possible to create an almost infinite number of sprinkler combinations.

■ New pump technologies – the other way to achieve balance is to regulate the output of the pump station by staging multiple pumps or by changing pump speed with variable frequency drive (VFD). This leads to a debate between pump station manufacturers regarding which is better.

Conventional electric pumps running on alternating current operate at one efficient speed. By staging pumps to come on one after the other as flow demand increases, the specified pressure and flow rate are met. When flow demand decreases, the pumps shut down in reverse order. Generally, a small pump runs constantly to maintain system pressure.

The rough edge of this type of system is the surge in pressure it can generate at start-up and shutdown. When electric current is supplied to each pump, it accelerates quickly to its design speed. The solution is to closely co-ordinate the opening and closing of sprinkler valves with the start-up and shut-down of the pumps in the station. Significant progress has been made getting pump controls to mate with sprinkler valve controls. However, the output is still restricted to the total of the pumps operating at any moment. Unless the irrigation schedule delivers a sprinkler demand that matches these staged outputs, some energy will be wasted.

VFD lets pumps ramp up and down to soften the pulse of pressure in the irrigation system. The speed of these pumps can be changed to reduce or increase their output. While the efficiency of the pump might not be the greatest at lower rpms, some energy is conserved. The real question is when is the higher cost of VFDs returned by energy savings. The longer the irrigation system operates during the year, the more likely a VFD is to make sense.

■ Variable Speed Drive Pumps

The modern approach to pump station efficiency is two-sided. By communicating the pump station controller, a central controller can deliver greater efficiency ad reduced pressure fluctuation. This results in lower energy consumption and fewer blowouts caused by pressure surges. Higher elevation zones can be recognised by the controller to signal the pump station to increase pressure. Since the pressure zones can be controlled to fit sprinkler design specifications, water distribution uniformity by the heads is optimised for the best control over application. Not only is energy saved, so is water.

Operating pressures are also coming down as lower-pressure turf heads are perfected. Older pump stations might need to be retrofitted to deliver less pressure.

Finally, as water supplies are stretched and lower quality water is utilised for large turf irrigation, filters must be engineered into the pump station. The needs of the filters must be met by the pumps, just as the needs of sprinklers have been. Backflushing and other types of filter maintenance must be considered in the irrigation schedule.

From the beginning, pump stations have been a critical component of irrigation system control. This role will continue to grow as water and energy become more precious.

SPRINKLER TECHNOLOGY – THE MUSCLES OF THE SYSTEM

Golf sprinklers have probably one common denominator – they all lay water down in a circular pattern. The basic principle of turf

irrigation is to apply an even application of water over the irrigated area.

■ Valve in Head (VIH) or Block Control?
There are advantages and disadvantages to valve-in-head control. The important point to understand is that certain sites suit VIH sprinklers whilst others do not.

With total individual sprinkler control, maximum water use efficiency can be achieved. This is probably the most important argument for valve in head sprinklers and is the main reason for their development. The most important point to note here is that the system must be operated efficiently, however it is expensive, it is complex and it works well.

■ New Sprinkler Technologies – Low pressure, low precipitation irrigation through nozzle engineering is becoming more popular towards the millennium, offering the following advantages:

a) More efficient profiles are easier to maintain, closer head spacing facilitates lowering of precipitation rates and head operating pressure.

b) Lower head operating pressure saves in energy cost to pump the system:
– saves in the wear and tear on system due to surges and water hammer (heads, valves and plumbing),
– creates larger droplets that fight wind better.

c) Lowering the precipitation rates will conserve water:
– matching application rates to soils infiltration will minimise run-off wastage,
– water stays where applied, reduces compaction, chemical waste and liability,
– better uniformity of water yields better turf appearance and improves playability,
– smaller lateral pipes, swing joints, fewer and smaller automatic valves, fewer stations/control zones and less wire,
– eliminates the need for higher maintenance valve-in-head sprinklers to control application rates.

d) The initial costs savings will be augmented by such long term benefits as extended system life, and lower ongoing maintenance costs, with no valves in the sprinkler heads, live pipework under fairways or playing areas, under lower pressure, all system components will work better and last longer.

■ Metal or Plastic?
At the grocery store it's "paper or plastic?" but with sprinklers the question becomes "metal or plastic?" The conventional wisdom is that metal is more durable than plastic, and therefore is better. Up until the late 1970s metal (usually brass, sometimes zinc) was the standard material from which almost all sprinklers were made. However, times have changed and now plastic is the state-of-the-art material for sprinklers. The primary reason for this change in materials is cost; machined metal parts are more expensive in comparison to injection moulded plastic. Fortunately, most of today's plastic sprinkler heads are very well engineered and will perform as well as a metal sprinkler.

Hybrids: A few companies manufacture plastic sprinkler bodies which accept brass nozzles, which often results in a better water pattern. Other manufacturers claim that plastic nozzles give better performance than brass. I personally haven't noticed any significant difference in performance between most brass and plastic nozzles, although brass nozzles will no doubt last longer.

■ Impact or Gear Drive?
Sprinkler heads are divided into two types based on the method they use to distribute the water.

■ Impact Rotors – the example which most people are familiar with is the "impact" rotor sprinkler which moves back and forth firing bursts of water. You probably know this sprinkler best for the distinct sound it makes when operating – tooka, tooka, tooka, tic, tic, tic, tic, tic, tooka, tooka, tooka, etc... The impact rotors are rapidly being replaced now by gear driven rotors which are very quiet, lower maintenance, and much smaller in size.

■ Gear Drive Rotors – provide a steady, powerful rotation to the sprinkling streams.

Water under pressure enters the base of the head through a diffuser which converts it into high velocity jets. These jets are then impinged against a turbine-like rotor causing it to spin at high speed.

A gear train, driven by the rotor, reduces the high rotational speed and converts it into a powerful turning torque. This torque gives the nozzle assembly the relatively slow rotational speed required for good coverage and precipitation.

Part-circle models incorporate a reciprocating mechanism that slowly drives the nozzle-assembly back and forth over a predetermined arc. Gear trains are usually contained in separate housings to protect the gears from debris in the water.

Which to use, impacts or gear drive? Cost-wise it comes out about the same.