Pool Energy Usage & Management

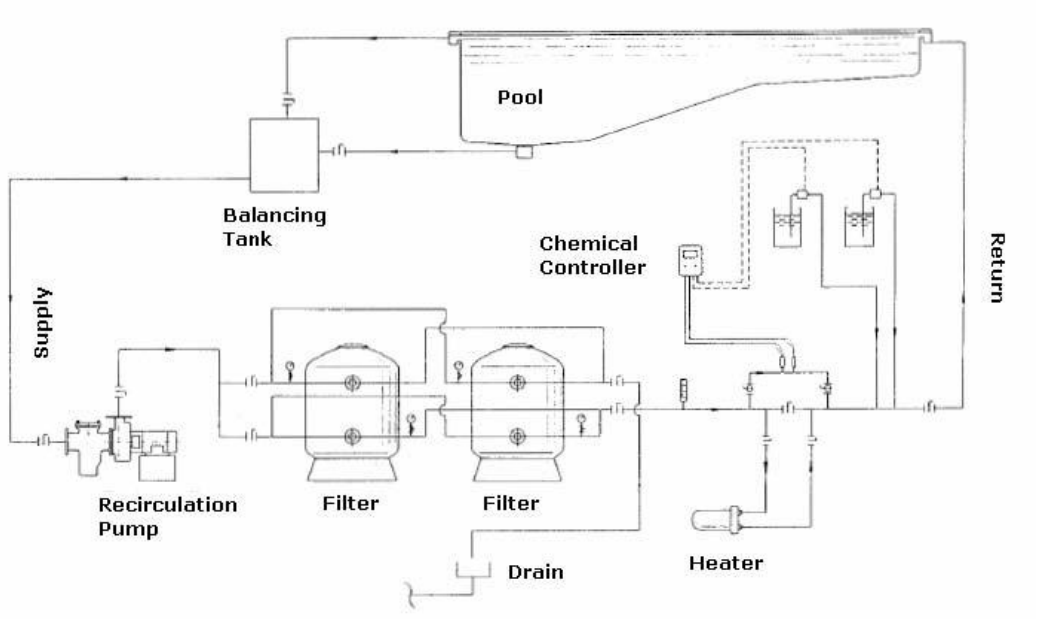
Pool Recirculation System

Filtration equipment for swimming pools is part of the overall pool recirculation system (Figure 4). This system generally comprises of a pool, balancing tank, strainer, recirculation pump, filters, heater and some form of water disinfection and treatment equipment (chlorine, ozone, pH control, etc).

Swimming pools are subject to constant contamination from foreign matter brought in by swimmers, sourcewater and articles used in and about the water. Such contamination includes particles of dirt, organic matter, bacteria, algae, hair, makeup, suntan and body oils, leaves, mi neral residue from chemicals and other debris.

Filtration is the mechanical process of removing this insoluble matter from swimming pool and spa water. Pool water carrying particulate matter, solids and debris is passed through filtering media that allow the water to return to the pool clear. Water clarity is important for appearanc e, hygiene, safety and risk management.

Figure 4: Typical Pool Recirculation System



3. TURNOVER RATES

When the total volume of a pool is filtered within a 24-hour period, the pool is described as having one turnover per day. As the returning clean filtered water is mixed with the pool water, it is diluted, making it less turbid.

Dirt is constantly brought into swimming pools, and it is generally assumed that a rate of 3 to 4 turnovers per day is typically required to maintain clear water. For example, in Ontario the accepted code standard is currently a 6-hour turnover (4 per day) for public pools, 30 minutes for spas and 2-4 hours for wading pools, water parks and specialty pools.

Table 1: Typical Turnover Codes for Aquatic Facilities

Facility	Turnover	Turnover Rate
Public	4 hr	6
Spas	30 min	48
Wading Pools	2-4 hrs	12-6
Water Parks	2-4 hrs	12-6

4. POOL PUMP AFFINITY LAWS

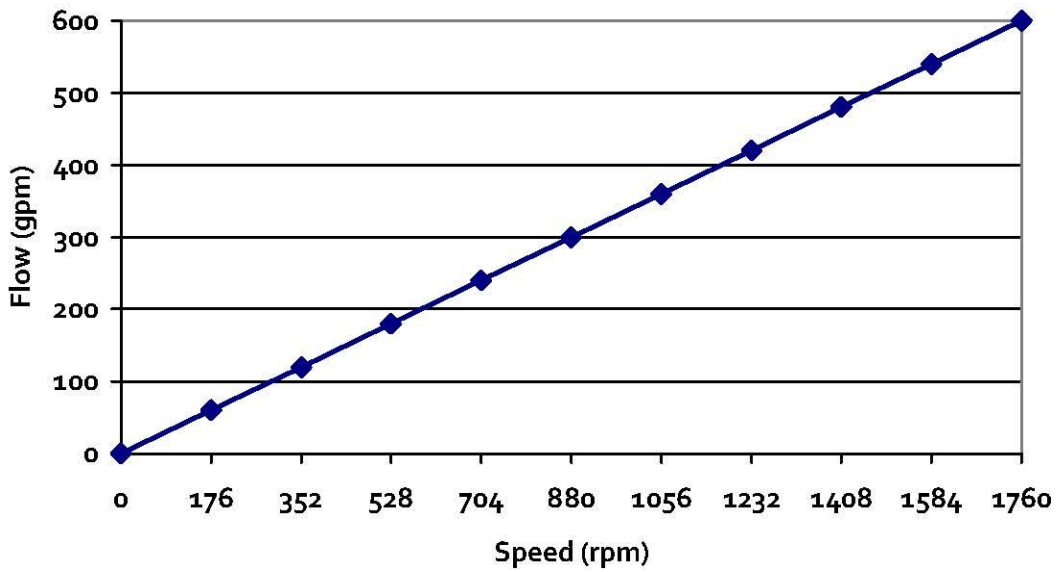
Presently, the recirculation pump of a pool operates continuously at a constant design flow rate (600 gpm) and maximum power (13.3 kW), even though the actual pool bather load and resulting water clarity will vary from design conditions.

The number of bathers, performance and condition of the filters, water chemistry, time of day and actual amount of debris introduced into the pool each day will affect the pool clarity

It is interesting to see what would happen if it were possible to vary the flow rate of the recirculation pump in direct response to changing water clarity conditions, while still maintaining the present turnover code requirements.

For a centrifugal pool pump, as the speed (rpm) of the pump decreases the flow rate (gpm) of the pump decreases proportionally. This unique relationship between pump speed and flow is referred to as one of the Centrifugal Pump Affinity Laws and is illustrated in Figure 5.

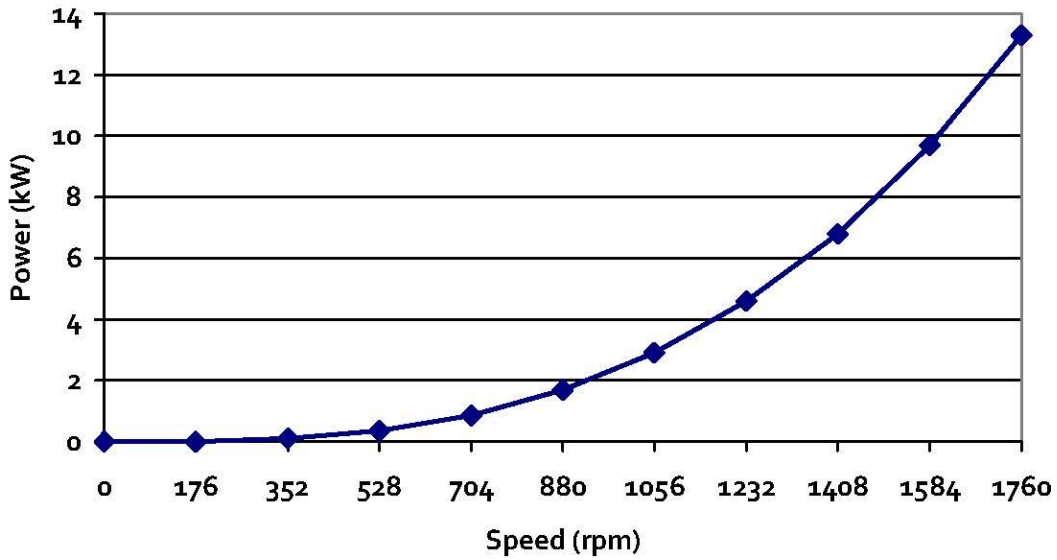
Figure 5: Relationship Between Pump Speed and Flow



For example, reducing the pool's recirculation pump speed from 1760 rpm to 1584 rpm because of low bather load and turbidity conditions (0.25 NTU) would reduce the pump flow rate of our 15 hp (13.1 kW) pump from 600 gpm to 540 gpm.

Another interesting relationship or Affinity Law that exists for centrifugal pumps is that pump power (hp, kW) is directly proportional to the cube of pump speed (Figure 6).

Figure 6: Relationship Between Pump Speed and Power



In this case, reducing the pump speed from 1760 rpm (600 gpm) to 1584 rpm (540 gpm), would also reduce the pump's power requirements from 13.3 kW to 9.7 kW.

In other words, a 10% reduction in speed would result in a 27% savings in energy!

The greater the actual installed capacity of the pump is above present code requirements or th e greater the variance in hourly bather loads, the greater the potential energy savings will be.

A typical pool will have times during the day when there are just a few bathers (i.e. swim team) or no bathers at all. Therefore, it would be helpful if you could take advantage of these low loa d conditions to reduce the pool's operating cost.

During non-peak bather loads, the amount of insoluble matter (i.e. suspended solids) introduce d into the pool (which directly affects actual water clarity conditions) is typically relative (i.e. hi gh degree of correlation) to the suspended solids introduced during peak load conditions.

Therefore, as bather load deceases, the turbidity typically decreases as well (i.e. clarity gets bet ter) and thus the flow rate could decrease as well (i.e. lower number of turnovers) to meet this decreased suspended solids demand.

Likewise, as bather load increases, the turbidity typically increases proportionally (i.e. clarity ge ts worse) and thus the required flow rate would have to increase as well.

6. AQUADRIVE™

The Aquadrive™ is a proprietary based technology designed to maintain proper pool water filtr ation and clarity by varying the speed (rpm) and flow (gpm) of the recirculation pump in direct r esponse to the actual pool water clarity conditions.

And as we saw from the Figure 6, even a small reduction in pump speed (rpm) and resulting pu mp flow rate (gpm) will result in a significant reduction in energy (kW) usage and costs.

In addition, the Aquadrive™ can provide continuous real time monitoring, trending, alarming a nd recording of the actual pool clarity conditions.

This unique feature provides the operator with data that can be used to evaluate the actual per formance of the filtration system and support documentation in the event that pool water clari ty comes into question in a pool drowning or liability situation.

The Aquadrive™ is connected to the pool water recirculation pump motor. The turbidity sensor

is typically installed in a slipstream off the pool water piping, upstream of the filters as illustrat ed in Figure 7.

Figure 7: Aquadrive™ General Schematic

The Aquadrive™ control system would then use the turbidity information to either speed up (t urbidity readings above setpoint) the recirculation pump or slow down (turbidity readings belo w setpoint) the pump in direct response to these actual pool water clarity conditions.

The minimum flow rate setting (gpm) for the Aquadrive™ is field adjusted to account for the m inimum turnover rate required by Code and other site specific factors such as the type of filters being used, Net Positive Suction Head requirements, pool hydraulics, pool recovery times, pu mp cavitation, piping, pool heaters, heat pump dehumidifiers, chemical controllers, valve sizin g and so on.

In terms of potential energy savings, let's look at one of the actual energy logs from an aquatic facility that installed this technology on their two 15 hp pool pumps.

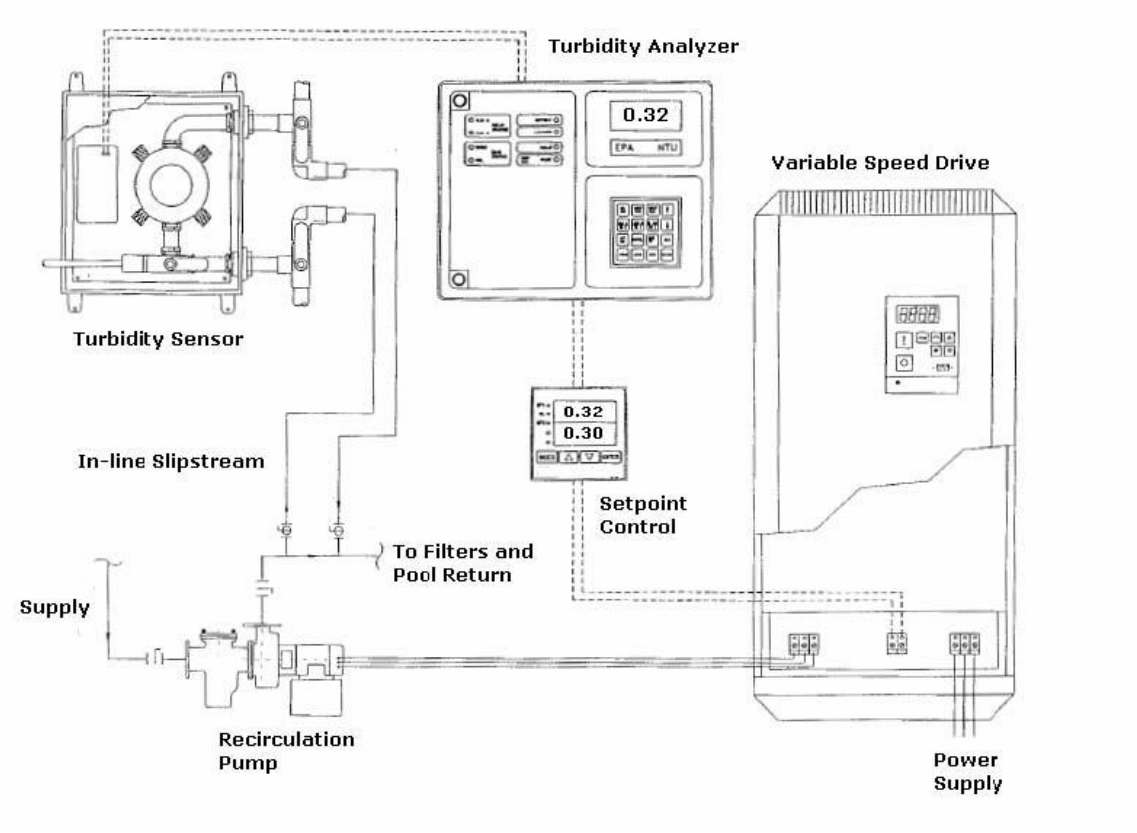


Figure 7: Comparison of Electrical Loads: No Control vs. Control

During the particular test period, the two 15 hp pool pumps without control would normally

draw about 30 Amps (verified with Amp meter).

However, under clarity control, the recording amp meter showed that the motor drew only about 8 amps (corresponds to 625 gpm setpoint) with several peaks of about 18 amps each (corresponds to 950 gpm maximum setpoint).

Therefore, even if we assume an average electrical load of 10 Amps over this 1 week period, the water clarity control scenario shows an electrical savings of about 67%.

Therefore, whether you currently own or operate a pool, are a aquatic facility designer or an energy management company, you may want to consider an Aquadrive™ water clarity and control system to help you reduce your energy and operating costs, improve safety and pool operation while enhancing your risk management program.