How To Choose the best Pump or Pumps for The Job.

With the plethora of pumps on the market installers and customers must understand the different technologies and the type of water feature they are trying to create. Choosing the best pump does not come down to price alone. Better pumps and using two pumps can save hundreds and even thousand of dollars over the warranty and life of a pump. It is crucial dealers and end users understand the different technologies in order to make the correct purchasing decision.

For flow rates under 1300gph, better quality synchronous pump technologies, like the Syncra line, are, without question, the most economical and best choice. But for flow rates up to 10,000gph, installers must consider many factors and technologies.

Head Pressure

When designing a system, no one should consider pumps choices without an understanding of head pressure and plumbing friction. Plumbing size, distance, elevation the pump must push, plumbing fittings, and valves all add friction to a system and, in fact, to the Total Dynamic Head pressure or TDH.

The technical chart below shows plumbing sizes and maximum flow for various pressures, including gravity draining. Remember, increasing plumbing size provide less restriction and TDH on pumps and provides room to expand pumps. In systems with multiple pumps, more than one line should be used or a larger pipe size to get maximum flow.

		Assume Gravity Flow. About 6f/s flow velocity, also suction side of pump		Assume Average Pressure. (20-100PSI) About 12f/s flow velocity		Assume "High Pressure" PEAK flow. About 18f/s flow velocity*		
Sch 40 Pipe Size	ID (range)	OD	**GPM** (with minimal pressure loss & noise)	**GPH** (with minimal pressure loss & noise)	**GPM** (with minimal pressure loss & noise)	**GPH** (with minimal pressure loss & noise)	**GPM** (with significant pressure loss & noise)	**GPH** (with significant pressure loss & noise)
1/2"	.50-.60"	.85"	7gpm	420gph	14gpm	840gph	21gpm	1,260 gph
3/4"	.75-.85"	1.06"	11gpm	660gph	23gpm	1,410 gph	36gpm	2,160 gph
1"	1.00-1.03"	1.33"	16gpm	960gph	37gpm	2,220 gph	58gpm	3,510 gph

1.25"	1.25-1.36"	1.67"	25gpm	1,500 gph	62 gpm	3,750 gph	100 gpm	5,940 gph
1.5"	1.50-1.60"	1.90"	35gpm	2100 gph	81 gpm	4,830 gph	126 gpm	7,560 gph
2"	1.95-2.05"	2.38"	55gpm	3300 gph	127 gpm	7,650 gph	200 gpm	12,000 gph
2.5"	2.35-2.45"	2.89"	80gpm	4800 gph	190 gpm	11,400 gph	300 gpm	17,550 gph
3"	2.90-3.05"	3.50"	140gpm	8400 gph	273 gpm	16,350 gph	425 gpm	25,650 gph
4"	3.85-3.95"	4.50"	240gpm	14,400 gph	480 gpm	28,800 gph	700 gpm	42,000 gph
5"	4.95-5.05"	5.563"	380gpm	22,800 gph	750 gpm	45,000 gph	1100 gpm	66,000 gph
6"	5.85-5.95"	6.61"	550gpm	33,000 gph	1100 gpm	66,000 gph	1700 gpm	102,000 gph
8"	7.96"	8.625"	950gpm	57,000 gph	1900 gpm	114,000 gph	2800 gpm	168,000 gph

Calculating the correct pump for a pond (The simplified version)

1) Calculate the approximate gallons in your pond:

In Feet = (L x W x Average Depth) x 7.5

In inches = (L x W x Average Depth) / 231

2) Pump size needs to be calculated based on turning over the pond 1 time/hour, after Total Dynamic Head is figured. For large ponds over 4000 gallons less turnover is ok but consider added aeration.

3) To calculate the Total Dynamic Head = Static Head + Friction Head

- Static Head: The vertical distance (measured in feet) - Distance from the water surface of the pond to the high point in the system

- Friction Head: Resistance created by length of tubing, # of elbows & check valves. To simplify we will calculate based on
    - 1' for every 10' of tubing
    - 1' for every 3 elbows and check valves

4) Now figure the flow needed for your waterfall. To calculate:

figure the width of the spillway or weir

- for low flow over falls allow 100 gph for each inch of width of the spillway (figured at Total Dynamic Head)
- for high flow over falls allow 200 gph for each inch of width of the spillway (figured at Total Dynamic Head)
- Alternately see the flow chart below

5) Using the above calculations use the pump chart to figure out the right pump for your pond. You will use the larger flow needs (Waterfall flow needs vs minimum turnover of a pond, whichever is larger)

6) Use the right tubing for the job, based on the Tubing Flow Rate Chart, to reduce your friction to a minimum (note: Some pumps will have a smaller fitting out of the pump to create correct head pressure, and a reducer will be needed for the correct size tubing to be used)

Example: Pond is 100” x 50” x an average depth of 24”. There is 10 feet of tubing, 3 elbows. Waterfalls is 5’ above water surface.
Weir is 8”, want low flow over falls
1) pond is =(100 x 50 x 24)/231 = 519 gallons
2) Pump needs to be a minimum of 519 gph after the head pressure is calculated to turn the pond over 1 time/hr
3) Total Dynamic Head is 5’ (static head) + 2’ (friction head of 1’ for tubing & 1’ for elbows) = 7’ total
4) Waterfall, we want high flow, so 100 gph x 8 = 800 gph
5) go to the chart and look at the needs based on 800 gph at a 7’ Total Dynamic Head (waterfall needs is higher than turning over the pond needs.
6) Use 1” tubing for least amount of friction

- PUMP IN THIS CASE, FROM THE CHART, WOULD NEED TO BE A, MAG DRIVE 18….. Now lets look at the filtration!

WATERFALL WIDTHS AND FLOW RATES Minimum flow rates required to give:		
	A thin 1/4" layer of water over a smooth lip	A bold 1" film of water over a waterfall lip
4" lip	200gph	400gph
6" lip	300gph	600gph
10" lip	700gph	1200gph
16" lip	1300gph	2100gph
24" lip	3000gph	4000gph

Types of Pumps

Direct Drive vs Magnetic Drive Pumps

In the early days of pond building, direct drive submersible pumps, which were derived from sewage (effluent pumps), were chosen. There were not many choices and they provided high pressure along with non-clogging benefits. On these pumps, the impeller is attached directly to the motor. Although they provide high head pressures, they are not energy efficient and they will cost large amounts of electrical dollars to run. These types of pumps are not needed unless a system design calls for pumping heights beyond 12 feet or large debris handling over 1/2”. Even in this case, many external direct drive pumps are much more energy efficient and better choices. Some are now coming with “Diamond Seals” which are the best choices for longer life.

Direct drive pumps have impellers attached directly to motors via seals, often 2 or 3. These pumps use added energy to overcome the resistance of the shaft seals which are clamped down tightly on the spinning impeller and shaft. In addition, they have a heavy impeller and shaft that requires torque and the power of a heavy motor to operate. “Magnetic Induction Pumps were developed by NASA in the 60’s for the Space Program to overcome this.”[1]

Better magnetic drive pumps are more energy efficient to operate but many cannot handle large debris, and, because of the impeller style, usually have lower max head pressure. Within this category there are Synchronous, Asynchronous, Hybrid, and the all new Electronic Synchronous Hybrid design by Sicce.

Hybrid pumps use direct drive style impellers with magnetic induction motors. They are more efficient at low to medium head heights but consume less electricity than equal

[1] Demi Fortuna Pond Builder Magazine

direct drive models. A direct drive pump might consume over 1000 watts to push 5000gph at 15' of total head pressure; if the total dynamic head can be reduced to half that, an asynchronous Hybrid Mag Drive can move the same amount of water for less than 500 watts. This adds up to $50 savings per month over the average 3 year life of the pump - that's $1800 back to home owners." [2]

Synchronous Electronic technology like the Sicce Syncra HF is the next revolution in pumps and yields a .99 power factor with a synchronous motor and direct drive style rotor. These pumps have all the advantages of both hybrids and synchronous motors while being even more energy efficient. They have a service life and warranty that exceeds those of Hybrids and other types of pumps.

How to get lower electric bills and longer pump life - the simple way to save money

Two smaller pumps will use less electricity (up to 50%), outperform, and add safety in redundancy for any system. Two pumps are more efficient than one large pump.

With two pumps, the filter can be run continuously. During the day, both pumps can be run for visual effect, sound effect and increased oxygen when it is hot. By putting the second pump that does not run the filter on a timer, a 30-50% electrical savings can be achieved. With two hybrid synchronous pumps, an even greater savings is achieved.

Consider the warranty and service life of the pump because a more expensive pump that lasts longer has a higher power factor, saves on energy bills, and will pay for itself many times over its life.

Low head pressure math [2]
This shows the math on why the use of two pumps is less expensive to operate than one.

Head pressure (gph) is directly proportional to impeller diameter.
Head pressure increases by the square of the impeller diameter.
Power consumption (wattage) increases by the cube of the diameter.

Increase the size of an impeller by 20% and you will have 120% more gph, provide 44% more head pressure and consume 73% more wattage.

Reduce the impeller 20% will give it 20% less flow and 64% of its original head, but it will consume .8x.8x.8= 51% or about half the wattage."For the technically minded more information is available at www.pumped101.com.

"Reducing the head pressure and impeller size drops the a wattage so the best way to save electricity is to use two pumps."

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[2] Demi Fortuna Pond Builders Magazine

Here is how 2 Hybrid or Synchronous pumps compare producing 5000 gph.
1 5000gph direct drive = 1000 watts
1 2500 direct drives = 660 watts
2 2500 Hy-drives = 330gph
2 2500 Synchronous Hybrid Sicce = 290 watts

Now that is not all about electrical savings. Many areas of the world charge for power factor. All will eventually. Advanced synchronous motors have power factors of .9 to .99, 1 being ideal. Mag Drive pumps and hybrids can be as low as .56 which means even more of their energy is lost or wasted and they generate more heat. The higher your home power factor is the lower your over all utilities will be. Example: Energy Star compliance washers and dryers have a higher power factor. For more on power factor see http://sicceus.com/pdf/power_factor.pdf

The steps and considerations for choosing a pump the right way.

1 Choose the correct flow and requirements. (See flow charts) Remember, two pumps are always better than one large one.
See this http://sicceus.com/pdf/Gr_Reset_Ninpheo.pdf for and example diagram of two pumps configuration.
Then, look for the best pump or pumps to reach the desired flow.

2 Look a the Energy consumption.

Choose higher Power Factor rating pumps like with synchronous motors because wattage alone is not the only determining factor.

3 Consider the life of the pump and the warranty.

Multiply the savings out over the life of the pump to decide if the initial expense is worth the cost. A 950 gph pump with a .56 power factor can cost up to 100 dollars more a year to run over a .92 synchronous pump. So a synchronous pump with a 5 year warranty will save you 500.00 over the warranty period alone.

I would like to acknowledge Demi Fortuna, Doug King, Dan Wiles, and Gianni Ottoboni for information leading to this article.

Ralph C Cabage III