Monthly Manager Moments Article #16

Part 1 of a Series on How Pools Work – Circulation

Overview -

Circulation in a pool refers to the movement of the water within the mechanical system. The water flows through a series of loops, passing by or through different features to treat and clean it. What I'll call the "big loop" is the main supply and return lines that are powered by the pool's circulation pump. Little loops are off the big loop, and are for the purposes of heating, treating, and testing the water.

The Big Loop

The main line at this pool includes two 10" pipes coming from the pool, and one 8" pipe going back to the pool. For some perspective, an 8" pipe has a maximum flow rate of about 1600 gallons/minute (GPM). 10" pipes can handle flow rates of over 2000 GPM. Our required flow rate is 792 GPM. That is based on two things: the *capacity* of the pool in gallons, and the WAC code requirement for "*turnover*." More about that later.

Water exits the pool via the gutter and the main drain, which is at the bottom of the deepest part. About 75% of the water exits from the gutter. This is intentional, to maximize skimming off the surface. The better a pool skims, the better the circulation, and the better the distribution of chemicals to treat the water. After exiting the pool, the water goes into a *surge tank*. Here, the surge tank is also the filter tank. This pool has "old school" *vacuum DE filters*. The water is pulled through the filters by a *vertical turbine pump.* Because the water is pulled through the filters, flow and pressure are both lost as the filters get dirty and plug up. Vacuum is created on the suction side of the pump; thus the term vacuum DE filters. What about the DE part? That's an abbreviation for diatomaceous earth. Traditionally, DE was the only filter aid used on this type of filter. Now there are a few man-made alternatives, such as Harborlite. We use Harborlite here because it is much lighter than DE, especially when soaked with water. DE makes a pretty heavy sludge that is difficult to clean up when rinsed off the filters.

After the water is pulled through the filters, it is then pushed back toward the pool (pressure side of the pump). Along the way back, all of the little loops are installed. Water goes back into the pool via the inlets. In our pool, all of the inlets are on the bottom, which is ideal. They are laid out in a scatter pattern to maximize distribution and promote good skimming.

Surge

Surge is displaced water that must be absorbed somewhere. At the EWU Aquatic Center, surge is handled both by the gutter and the surge tank. Static surge is from people standing in the water. Dynamic surge occurs from people swimming and creating waves that spill into the gutter. Generally, pools are designed to handle about the square footage of the surface in gallons. For example, our surface is 5390 ft^2. We should have about 5400 gallons of surge capacity. We have much more.

Next, the little loops that are part of our system at the EWU Aquatic Center.

The Little Loops

Loop 1 – Chlorine gas loop. This loop is a 1" line that supplies water to the chlorine flowmeter, or *rotometer*. A small booster pump is used in that loop to ensure good flow through it and even delivery of the gas on the return side.

Loop 2 – HVAC heat recovery loop. This is a 2" line that sends a small amount of water to the HVAC unit to reclaim some heat generated by the unit upstairs.

Loop 3 – CO_2 loop. This really isn't a loop at all, since the gas from the carbon dioxide tank is pushed into the pool main line off the tank pressure through poly-tubing. Another rotometer is used to control the amount of flow when the system is active.

Loop 4 – *Chemical Controller* loop. This loop is very small, and uses small poly-tubing instead of pipe. Here it's a side loop off the chlorine gas loop (supply side of course). The controller loop is usually the very first loop after the filters and/or surge tank, so the sample that the controller gets from this loop is "true." Electrodes called *probes* are used to measure the oxidation potential and pH of the pool continuously. These probes feed data to the controller, which is a computer that analyzes the data and turns on chemical feeders to satisfy set points that are established by the pool operator (me, in our case.)

Turnover

Now back to turnover - Turnover is defined as the amount of time it takes for the entire pool capacity to pass through the filters. The EWU Aquatic Center pool is 285,000 gallons. In our state, as in most, a pool such as ours must turn over every 6 hours or less (4X/day). This is because it takes 4 turnovers to get virtually all of the pool's water molecules to the filters. Water swirls around in the system and some of it does not make it to the filter in the first three turnovers; but by the fourth, nearly 100% of the water has seen the filters. However – if the pool has dead spots where the water doesn't move, that water may never see the filters – and thus will receive no chemical treatment either! To make the State code requirement for turnover in 6 hours (360 minutes), we must maintain flow at 792 GPM. Flow is verified by a flow meter that is typically installed in the return to the pool.

How do we maintain such crystal clear water? Is it just great filtration? Nope. Actually, it's mostly from great oxidation. The filters provide about 1/3 of the great clarity that we typically enjoy here. 2/3 of the sparkle is provided by *Oxidation Reduction Potential (ORP).* Remember the probes in loop 4? The ORP probe measures the oxidation potential of the pool continuously. By setting and maintaining a high ORP level, the water maintains the sparkling look that we now expect. Our ORP is normally between 840-850 millivolts. To kill bacteria, ORP needs to be greater than 650 mV.

Glossary of terms

Circulation – the movement of the pool's water through the mechanical system.

Capacity – the volume of the pool in gallons. EWU's pool is 285,000 gallons.

Turnover – occurs when the entire capacity in gallons flows through the filters; must be 6 hours or less.

Surge tank – a collection tank where surge is accommodated. Here, it's also the filter tank.

Vacuum DE filters – fabric filters with DE or other product caked on them to filter the water. Vacuum DE means that the pump is after the filters and the water is pulled through.

Vertical turbine pump – type of pump typically associated with vacuum DE filters.

Rotometer – a flowmeter that regulates the amount of gas flowing into the system.

Chemical controller – a computer connected to probes/electrodes that measure ORP and pH. Probes are associated with set points in the computer that maintain proper levels of designated chemicals.

Oxidation Reduction Potential (ORP) – the oxidizing power of the water. Generally, the higher the better. ORP at very high levels must be balanced with chlorine use and cost.

Questions about circulation? Send me an email!

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