The Centennial Pool Operators Guide

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September 2013

Chlorine

Free Chlorine (FC): *Ideal 2-4ppm (Must be ≥ 1.0 and ≤ 5)*

Free chlorine is the active available disinfectant in the water. FC dissipates for several reasons (large bather loads, sun, high pH). If FC is less than 1.0ppm or higher than 5, the pool must be closed so FC can be adjusted to an appropriate level.

Raising FC:

For every 1ppm you wish to increase the free chlorine @ Centennial Pool:

- Add 2 Cups of Granular Chlorine (1lb)
  **See Appendix 1.A for calculations*

Lowering FC:

Ensure chlorinator is set to a low level or temporarily turned off. Fresh water may be added with a hose and old water can be backwashed out. If the weather is sunny, pool blankets should be left off to allow the sun to dissipate FC.

Combined Chlorine: *Ideal= 0ppm. (Must be below 1.0ppm)*

Combined chlorine is chlorine that has been "used up". It has reacted with either ammonia or organic nitrogen compounds. The resulting chloramines are no longer an effective disinfectant and are the cause of skin and eye irritation and "chlorine" odor. A build up of combined chlorine is bad and must be checked for 2x a day minimum.

Combined Chlorine = (Total Chlorine – Free Chlorine). Ideal is 0ppm

@ 0.5ppm or more we must superchlorinate the pool to eliminate excess chloramines

Superchlorinating:

When the combined chlorine is 0.5ppm or higher you must superchlorinate. If combined chlorine is 1.0ppm or higher, pool must be closed until levels can be decreased to an acceptable level. **See Appendix 1.B for sample calculation.*

How to Superchlorinate:

- Determine Combined Chlorine (Total Chlorine – Free Chlorine)
- Calculate Breakpoint Chlorination Amount (Combined Chlorine Value x 10)
- Determine Desired Change Amount = (Breakpoint Chlorination – Free Chlorine)
- Multiply desired amount by 2 to get the total amount of Granular Chlorine in Cups needed to reach breakpoint
- Granular should be broadcast throughout the pool.

<u>Total Alkalinity</u> Ideal = 100ppm (Must be within 80-120ppm)

Total alkalinity is the measure of the ability of water to resist changes in pH. Total alkalinity is like an anchor for keeping pH where it should be.

Raising Alkalinity:

For every 10ppm you wish to increase total alkalinity @ Centennial Pool:

- Add 21 Cups of Sodium Bicarbonate (10.36lbs)
  **See Appendix 1.C for calculations*

Lowering Alkalinity:

You should not need to lower your total alkalinity as you will constantly be trying to raise it. If for some reason your total alkalinity is above 120ppm consult Table 13-9B on page 172 of "The Complete Swimming Pool Reference (Second Edition)" for how much Muriatic Acid to add to the pool to lower total alkalinity.

<u>Calcium Hardness</u> Ideal = 200ppm (Must be within 200-400ppm)

Calcium Hardness is the measure of dissolved metals and minerals in the water. Hardness can enhance the water clarity, sheen and colour of the water (ex. "blueness")

Raising Calcium Hardness:

For every 10ppm you wish to increase calcium hardness @ Centennial Pool:

- Add 21 Cups of Calcium Chloride (8.89lbs)
  **See Appendix 1.D for calculations*

Lowering Calcium Hardness:

You should not have to lower calcium hardness as you will almost always be trying to raise it. If for some reason you do have to lower calcium hardness, backwash and add new water. If you have an extremely high calcium hardness consult Page 172 of "The Complete Swimming Pool Reference (Second Edition)"

<u>pH</u> Ideal = 7.5 (Must be within 7.2-7.8)

pH is the measure of the pool waters acidity or basicity. Properly maintained pH levels have the greatest impact on properly balanced water and patron comfort. The ideal pH level for comfort is 7.5 because the pH of human tears is 7.5. After doing a PH test with a Taylor test kit and determining that the pH needs adjusting. Check the chart below for chemical amounts needed based on base and acid demand tests. **See Appendix 1.E for calculations.*

Raising pH:

If pH needs to be raised you do a Base Demand test and add the corresponding amount of Soda Ash to the pool based on the number of drops necessary to reach the desired pH. **See chart below* (pH usually needs to be raised as the pH of our hose water is around 6.8.)

Lowering pH:

If pH needs to be lowered, adding hose water will bring down the pH as will bather loads and time. If your pH is very high and needs to be adjusted chemically, do an Acid Demand Test and add the corresponding amount of Muriatic Acid to the number of drops necessary to reach the desired pH. **See chart below* (Adding Muriatic Acid should most likely not be necessary unless you added too much Soda Ash and raised the pH above the acceptable threshold. It is fairly difficult to raise the pH)

Base Demand Test			
Drops	Pounds	Cups	**Soda Ash**
1	2.37 lbs	4 Cups	
2	4.74 lbs	8 Cups	
3	7.12 lbs	13 Cups	
4	9.49 lbs	17 Cups	
5	11.85 lbs	21 Cups	
Acid Demand Test			
Drops	Litres	**Muriatic Acid**	
1	2L		
2	4L		
3	6L		
4	8L		

***Cyanuric Acid* Ideal = 30-50ppm (Must be less than 80ppm)**

Cyanuric Acid is the stabilizer that is added to our chlorine to keep the free chlorine from being destroyed by the UV light in sunlight. For optimum UV protection the CyA level should be maintained between 30 and 50ppm.Excessive levels of Cya may lead to an increased risk of algae and or cloudy water.

Lowering Cyanuric Acid:

The most common method of reducing CyA concentration is to partially drain and replace water with fresh water.

Algaecide:

Algae are single celled plants that are a major concern to pool operators. There are several thousand species of algae that can populate a pool and are carried by the wind and can even be in the hose water you put into the pool. The most common algae are green, black, and yellow. It is believed that algae itself is not harmful to bathers. Algae does make your pool look unattractive to swimmers and in the early stages of growth can cause cloudy water which is dangerous if lifeguards cannot see if someone is drowning.

An initial dose of algaecide should be done 24 hours after shocking the pool for the first time followed by a weekly maintenance dose to prevent algae from taking hold in the pool. Once the algae do take hold it is very difficult to rid the pool of it.

Information below is based on the use of Sani-Marc ALGAE 400. If using a different type of Algaecide new calculations will most likely need to be made.

The initial dosage for a pool having no visible algae is 100mL of Algae 400 per 10, 000L of pool water. For the Centennial Pool @ 278, 515 L the initial dosage of Algae 400 is 2.79L. Rounding up to an even 3 L is fine.

Weekly Dose is 1L(Bottle) rounded up from 974.75mL after doing the math for a 278,515L @ 35mL per 10,000L. If algae becomes present add the weekly dosage 24 hours after superchlorinating, sweeping and scrubbing the floors and walls of the pool.

Clarifier:

Clarifier is used to bond small particles that would normally pass right through the filter to each other and make them large enough to get caught by the filter. Clarifier helps with cloudy water that is due to lots of small particles in the water.

An initial dose of Clarifier can be added at the same time as the initial dose of Algaecide, during the opening procedure at the beginning of the season.

Information below is based on using ei PRO Clarifier. If using a different type of Clarifier, new calculations will most likely need to be made.

Both the initial dose and weekly dosage for ei PRO Clarifier are 50mL of clarifier per 10,000L of pool water. For the Centennial Pool @ 278, 515 L the dosage is 1.39L. Rounding up to an even 1.5 L is fine. After giving the clarifier some time to work (8+ hours) vacuuming may be needed to pick up any of the newly formed larger particles off the bottom of the pool that didn't get sucked up by the skimmers.

Centennial Pool Volume and Turnover Rate

Centennial Pool Volume:

74,000 U.S. Gallons

278,515 L

Turnover Rate:

The ideal turnover rate for a pool like ours is 6 hours or less. To achieve a turnover rate of 6 hours at a pool with a volume of 278,515L the flow rate would need to be 774 Litres per minute. With the way that our pool circulation system, filter, and pump are set up we cannot achieve a 6 hour turnover rate. The average flow rate during the 2013 Summer Season was 525 LPM with a turnover rate of 8.84 hours.

The Centennial pool has 3 main lines where water comes in to the pump from the pool.

- Line 1 is from the skimmers on the near side (the side of the pool closest to the pump house).
- Line 2 is from the skimmers on the far side (the side of the pool farthest from the pump house).
- Line 3 is from the Main Drain in the centre and bottom of the deep end.

Ideally, with all three lines open fully the flow rate of each line should be 1/3 of the total flow rate. Unfortunately this does not happen at our pool so you will need to adjust the valves on the main intake lines (closing down line 1 and 2 to approximately ½ open) and monitor the flow rate on the main drain (flow rate gauge farthest from the pump) until it reaches 1/3 (or slightly more) of the total current flow rate (seen on the flow rate gauge located nearest the pump). View picture below for how we had the valves set for the 2013 season. **Be careful when adjusting these valves because if you close the valves on lines 1 and 2 too much then the pump has to over work and can be damaged. When turning the valves, go slowly and listen to the pump. If it starts to rev louder then you need to open the valve you are closing until it no longer sounds loud.*

Intake water lines in pump house.
From left to right: 1. Near Side. 2. Far Side. 3. Main Drain

Appendix

Appendix 1.A

How to calculate how much granular chlorine to add to the Centennial Pool to raise the free chlorine by 1ppm:

Look at Table 13-3. “Amount of chlorinating agent” on page 173 in “The Complete Swimming Pool Reference (Second Edition)”

We then look at the value for a chlorinating agent with 60% available chlorine in a 50,000gal volume and see that 11.1oz is needed to raise the free chlorine 1ppm in 50,000gal of water. We choose 60% available chlorine because that is the closest number in the chart to the actual 62% available chlorine we use and 50,000gal because it is the closest to without going over volume to our actual volume of 74,000gal.

To figure out how much chlorine we need for the Centennial Pool with a volume of 74,000gal we need to solve for x where x is the amount of 60% granular chlorine needed to raise the free chlorine 1ppm in 74,000gal of water.

$$\frac{11.1oz}{50{,}000gal} = \frac{x}{74{,}000gal}$$

$$x = \frac{11.1oz}{50{,}000gal} x 74{,}000gal$$

$$x = 16.43oz$$

$$x = 1.03lbs$$

$$1.03lbs\ of\ Granular\ Chlorine\ x \frac{2cups}{1lb} = 2.06cups\ of\ Granular\ Chlorine$$

This tells us that to raise the free chlorine 1ppm in the Centennial Pool we need to use 2.06 cups of chlorinating agent with 60% available chlorine. At the Centennial Pool in the 2013 season we used granular chlorine with 62% available chlorine which means we could use slightly less granular chlorine to achieve the same desired 1ppm increase in free chlorine, so we rounded it to an even 2 cups.

Appendix 1.B

How to Superchlorinate:

- Determine Combined Chlorine (Total Chlorine – Free Chlorine)
- Calculate Breakpoint Chlorination Amount (Combined Chlorine Value x 10)
- Determine Desired Change Amount = (Breakpoint Chlorination – Free Chlorine)
- Multiply desired amount by 2 to get the total amount of granular chlorine in Cups needed to reach breakpoint
- Granular should be broadcast throughout the pool.

Example:

We take a free chlorine test using our Taylor Test Kit and find that our FC is 2.0ppm. We then test our total chlorine and find that it is 2.5ppm. We now get our combined chlorine by subtracting our FC from our TC (2.5-2.0) and find that our CC is 0.5ppm.

Now that we have a value for our CC and see that it is at 0.5ppm we know we must superchlorinate to get rid of the CC. The next step is to calculate our breakpoint chlorination amount (CC x 10) so we multiply 0.5ppm x 10 and we get 5ppm for our breakpoint chlorination amount.

Next we determine the desired change amount by subtracting the FC from our newly found breakpoint chlorination amount. So 5ppm-2ppm = 3ppm Desired Change. This tells us that to Superchlorinate effectively and get rid of the excess chloramines we need to raise the FC in the pool by 3ppm to reach 5ppm.

Now to find out how much granular chlorine we add to the pool to achieve this we just have to multiply the desired change of 3ppm by 2 because for each ppm we wish to increase the FC by we have to add 2 Cups of 62% free available chlorine granules. So 3ppm x 2 Cups = 6 Cups of granular chlorine.

Broadcast 6 Cups of granular chlorine to the pool to achieve breakpoint chlorination.

**Note: This should only be done when the pool is closed as the levels of chlorine are too high usually to be safe for bathers. Also when superchlorinating it is important to reach the breakpoint value because if you undershoot you can end up just creating more chloramines and having to try again and keep the pool closed longer. Adding slightly more chlorine than you calculate is ok to insure you reach that breakpoint level.*

Appendix 1.C

How to calculate how much Sodium Bicarbonate to add to the Centennial Pool to raise the alkalinity by 10ppm:

Look at Table 13-8. “To raise total alkalinity using Sodium Bicarbonate” on page 170 in “The Complete Swimming Pool Reference (Second Edition)”

We then look at the value for 10ppm in a volume of 50,000gal and see that 7.0lbs of Sodium Bicarbonate is needed to raise the total alkalinity of a 50,000gal pool by 10ppm. These numbers give us a basis for calculating how much Sodium Bicarbonate is necessary for us.

To figure out how much Sodium Bicarbonate we need for the Centennial Pool with a volume of 74,000gal we need to solve for x where x is the amount of Sodium Bicarbonate needed to raise the total alkalinity by 10ppm in 74,000gal of water.

$$\frac{7.0lbs}{50{,}000gal} = \frac{x}{74{,}000gal}$$

$$x = \frac{7.0lbs}{50{,}000gal} \times 74{,}000gal$$

$$x = 10.36lbs$$

$$10.36lbs\ of\ Sodium\ Bicarbonate\ \times \frac{2Cups}{1lb} = 20.72Cups\ of\ Sodium\ Bicarbonate$$

This tells us that to raise the total alkalinity by 10ppm in the Centennial Pool we need to use 21 cups of Sodium Bicarbonate.

Appendix 1.D

How to calculate how much Calcium Chloride to add to the Centennial Pool to raise the calcium hardness by 10ppm:

Look at Table 13-11. “To increase calcium hardness using calcium chloride dihydrate” on page 174 in “The Complete Swimming Pool Reference (Second Edition)”

We then look at the value for 10ppm in a volume of 50,000gal and see that 6.01lbs of Calcium Chloride is needed to raise the calcium hardness of a 50,000gal pool by 10ppm. These numbers give us a basis for calculating how much Calcium Chloride is necessary for us.

To figure out how much Calcium Chloride we need for the Centennial Pool with a volume of 74,000gal we need to solve for x where x is the amount of Calcium Chloride needed to raise the calcium hardness by 10ppm in 74,000gal of water.

$$\frac{6.01lbs}{50{,}000gal} = \frac{x}{74{,}000gal}$$

$$x = \frac{6.01lbs}{50{,}000gal} \times 74{,}000gal$$

$$x = 8.89lbs$$

$$8.89lbs\ of\ Calcium\ Chloride\ \times \frac{2.33Cups}{1lb} = 20.71Cups\ of\ Calcium\ Chloride$$

This tells us that to raise the calcium hardness by 10ppm in the Centennial Pool we need to use 21 cups of Calcium Chloride.

Appendix 1.E

How to calculate how much Soda Ash to add to the Centennial Pool to raise the pH based on a base demand test:

Perform a base demand test according to the instructions in the Taylor Test kit. And record the number of drops necessary to reach the desired pH level.

Look at Table 13-5. “To raise pH employing the Taylor base demand procedure using soda ash” on page 169 in “The Complete Swimming Pool Reference (Second Edition)”

We will use 1 drop as our example and look at the value for 1drop in a volume of 50,000gal and see that 1.6lbs of Soda Ash is needed to raise the pH of a pool with a volume of 50,000gal. These numbers give us a basis for calculating how much Soda Ash is needed to raise the pH of the water to the desired level.

To figure out how much Soda Ash we need for the Centennial Pool with a volume of 74,000gal we need to solve for x where x is the amount of Soda Ash needed to raise the pH by to the desired level in 74,000gal of water.

$$\frac{1.60lbs}{50{,}000gal} = \frac{x}{74{,}000gal}$$

$$x = \frac{1.60lbs}{50{,}000gal} \times 74{,}000gal$$

$$x = 2.37lbs$$

$$2.37lbs\ of\ Soda\ Ash\ \times \frac{1.75Cups}{1lb} = 4.15Cups\ of\ Soda\ Ash$$

This tells us that if we do a base demand test and our result is 1 drop then to raise the pH to the desired level in the Centennial Pool we need to use 4 cups of Soda Ash. To calculate the desired Soda Ash for other base demand results just use the same math as above, substituting 1.60lbs for the corresponding weight in a 50,000gal pool for the number of drops determined during your base demand test.

Appendix 2.A

Quick Chart for adding Chemicals

Test	Chemical	Desired amount to raise	Cups Needed
Free Available Chlorine	Granular Chlorine	+ 1ppm	2 Cups
Calcium Hardness	Calcium Chloride	+ 10ppm	21 Cups
Alkalinity	Sodium Bicarbonate	+ 10ppm	21 Cups
PH	Soda Ash	*See PH Chart	

*Cyanuric Acid – Drain and add some fresh water

Base Demand Test			
Drops	Pounds	Cups	**Soda Ash**
1	2.37 lbs	4 Cups	
2	4.74 lbs	8 Cups	
3	7.12 lbs	13 Cups	
4	9.49 lbs	17 Cups	
5	11.85 lbs	21 Cups	
Acid Demand Test			
Drops	Litres	**Muriatic Acid**	
1	2L		
2	4L		
3	6L		
4	8L		

Measurements for Chemicals:

1lb of Granular Chlorine is 2 Cups

1lb of Calcium Chloride is 2 1/3 Cups

1lb of Soda Ash is 1 3/4 Cups

1lb of Sodium Bicarbonate is 2 Cups

Appendix 2.B

Names Brands and Sizes of Chemicals

Generic Name	Brand	Name	%	Container Size	
Granular Chlorine (Stabilized)	*Sani Marc*	*Super Chlor*	*62% Available Chlorine*	*18kg*	
Chlorine Pucks (Stabilized)	*ei Pro*	*Pucks 200*	*90%*	*18kg*	
“”	*BioGuard*	*Tabguard Tabs*	*90%*	*20kg*	
Sodium Bicarbonate	*ETi SODA*	*Sodium Bicarbonate*	*99%*	*25kg*	
Calcium Chloride	*Quadra*	*Calcium Chlorine Flakes*	*77%*	*50lbs*	
Soda Ash	*Solva Chems*	*Dense Soda Ash*		*50lbs*	
Clarifier	*ei Pro*	*Clarifier*		*4L*	
Algaecide	*Algae 400*		*40%*	*1L*	

*This is just a list of chemicals that we used during the 2013 Season

Pool Opening: Chemical Balancing

1st) Chlorine – Ideal 2-4 ppm

Initially, we should shock the pool to get rid of any impurities. I like to raise the chlorine to approximately 10 ppm when I am starting the pool up. To raise the chlorine to 10 ppm, add approximately 10 lbs (20 Cups) of granular (%62 available chlorine) or a bit more.

2nd) Alkalinity – Ideal = 100ppm

Our alkalinity in the untreated water should be about 30 ppm or a bit below. For each 10 ppm increase required add about 10.5 lbs (21 Cups) of Sodium Bicarbonate. So I would do an initial dosage of about 70 lbs (1.5 bags). **Having your alkalinity where it should be will make your life easier as it will help keep the pH stable.*

For further fine tuning of the Alkalinity please see "The Centennial Pool Operators Guide" provided.

3rd) pH- Ideal= 7.5

The water we use to fill the pool has a pH of approximately 6.8. Therefore we will always need to RAISE the pH upon opening. I would start by adding about 15 lbs of Soda Ash (26.25 Cups). The next day you should do a pH test and complete a base demand test (instructions in Taylor chem kit). Add the corresponding amount of Soda Ash to the number of drops your test yields.

Base Demand Test		
Drops	**Pounds of Soda Ash**	**Cups of Soda Ash**
1	2.37 lbs	4 Cups
2	4.74 lbs	8 Cups
3	7.12 lbs	13 Cups
4	9.49 lbs	17 Cups
5	11.85 lbs	21 Cups

For more drops see pg. 169 of The Complete Swimming Pool Reference

4th) Calcium Hardness – Ideal 200ppm

We usually have a calcium hardness of 150 or lower in our untreated water. I would initially add 1 bag (approx. 50 lbs or 116.5 Cups) and then test the calcium hardness. For further fine tuning, see "The Centennial Pool Operators Guide".

Appendix 2.D

Pool Closing: End of Season Maintenance

- Give the filter a good back wash before you drain the pool
- Drop the water level 4-6” bellow the lowest inlet fittings
- Blow all water out of the inlet lines and skimmer lines, from the mechanical room back to the pool
- Blow down the main drain as much as you can, the pool water static level will be as far as you can go, then poor 5 gals of antifreeze
- It is helpful to use a shop vac to suck out the skimmers first
- When all lines are drained add antifreeze to each of the 5 lines and blow it through until you can see the antifreeze at the inlets and skimmers
- Use a minimum of 5 gals per inlet line, skimmer line, and main drain
- Drain down the sand filter, heaters, and remove the plugs from the pump
- Remove drain plug from the 4” line from the pump to filter and filter to heaters
- Add 2 gal of antifreeze to each heater and pump
- Drain the pressure gauges at the filter by removing the copper fitting at the base of the gauge
- Turn off breakers to equipment
- Install winter plugs in skimmers and inlets
- Add ½ gal of antifreeze to each skimmer, then put a garbage bag over the skimmer lid hole, then snap the skimmer lid in place (This will act as a water seal from surface water)
- Add Algaecide and winterizing shock to the pool surface
- There may be more water traps in the mechanical room to look for, so go over the system to make sure all lines are empty

In 2011 they used:

- 32 gals of antifreeze
- 3 litres of algaecide
- 2 kg of shock treatment

Appendix 2.E

Ordering

Company	**#**	**Products we order**
Commercial Aquatics	1 (800) 663-5905	Taylor Reagents and Merchandise (goggles, swim caps, etc.)
S.C.P. (formerly "Ideal Distributors LTD.") *Kamloops* Location	1 (250) 374-8835	All of our pool chemicals
Cleanway	1 (800) 663-5181	Cleaning supplies (Bulk window cleaner, garbage bags, toilet paper, paper towel, soap for dispensers *only)

***Note:** We found it to be more cost efficient to by the rest of our cleaning supplies locally such as Mr. Clean, Toilet Cleaner and Lysol Wipes.*