An introduction to
Pool Chemicals & Water Testing
Part I

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Why do we test and dose swimming pool water with Chemicals?

- The water in the swimming pool must be safe to swim in and have clarity in order to see any obstructions or even bathers underwater.
- This is achieved by a combination of chemical dosing; filtration and water flow around the pool shell.
- Bacteria, Algae and Viruses are killed by the sanitiser and then removed from the water by the filtration system, with the aid of other chemicals.
- The pool flow fittings, pipe work and filtration system should also be designed to give an adequate movement of water around the pool shell to ensure that there are no dead areas.

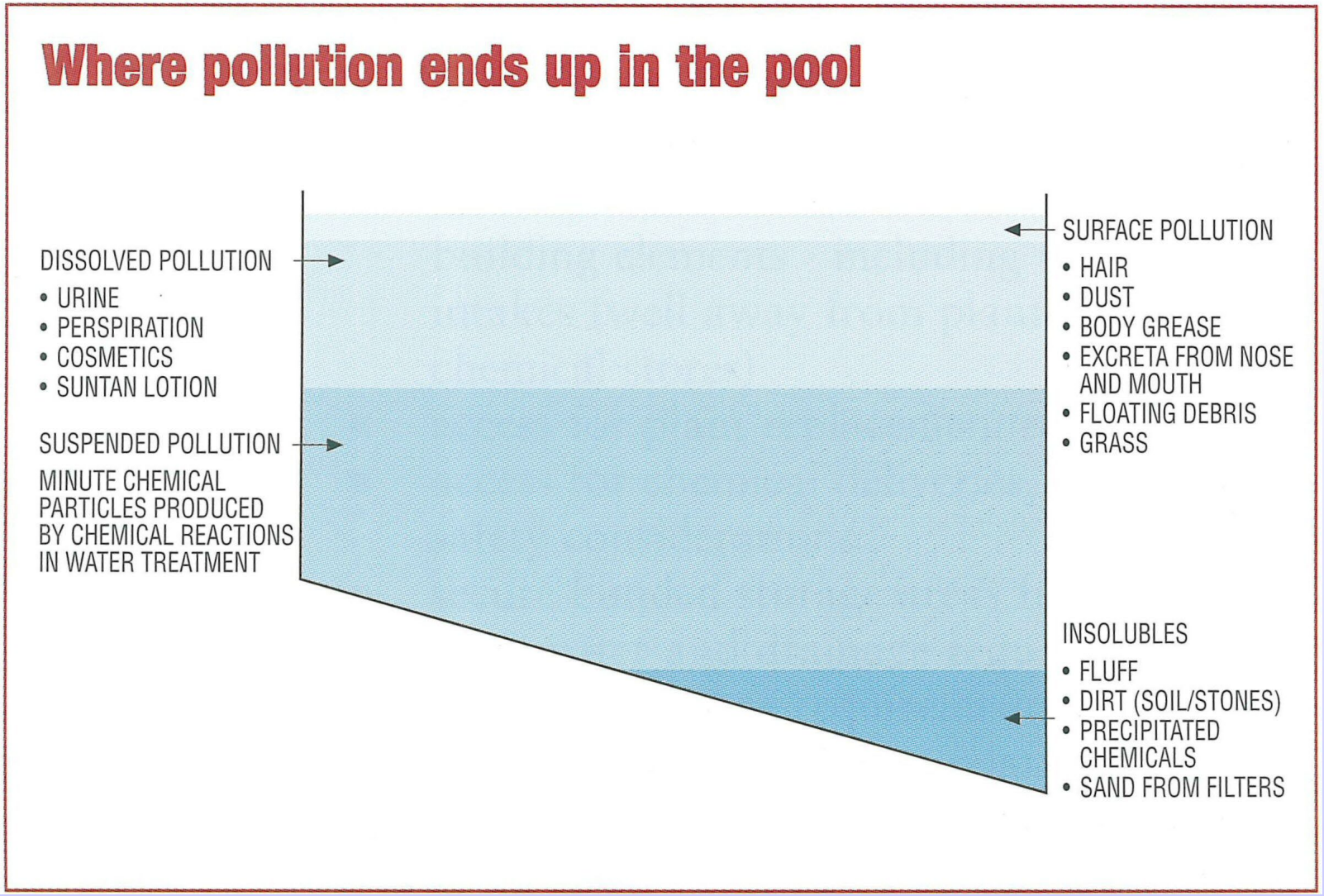
Excluded from the pool

- Persons with sore or inflamed eyes, colds, nasal or ear discharge, boils, or other acute or obvious skin or body infections, or cuts shall be excluded from the pool.

- Animals and pets

- Definitely crocs and Cryptosporidium

Pollution in a Swimming Pool



Water Balance

- The pool water should be in balance (neither corrosive or scale forming) so that it is also comfortable for the bather and does not cause any damage to the pool equipment.
- Water balance is a combination of several factors, pH, Total Alkalinity (T/A), Water Hardness and Total Dissolved Solids (TDS), and temperature.
- All pools when freshly filled must have a full water balance test, and also each spring after a lot of winter rain.
- Rain has very low mineral content, it is acidic and it will alter pool chemistry dramatically. It is ‘Hungry’ water!
- Any imbalances must be corrected before the next stage.

Water Balance, SPATA Standards

- Standard Values for a domestic pools are: -

	Ideal	Acceptable Range
pH	7.4	7.2 – 7.8
Chlorine	1 to 1.5	0.5 to 2ppm
T/A	120ppm	80 – 160ppm
Hardness	250ppm	75 – 500ppm
TDS	Source plus	1000ppm – 1500ppm

- These are SPATA standards.
- There is a calculation involving water temperature as well, called the Langelier Index, and this will indicate if the water is corrosive or scale forming.

Water Balance, BISHTA Standards

- Standard Values for a domestic spa or hot tub are: -

	Ideal	Acceptable Range
pH	7.4	7.2 – 7.8
Chlorine	3 to 3.5	2 to 5ppm
T/A	120ppm	80 – 150ppm
Hardness	250ppm	100 – 500ppm
TDS	Source plus	1000ppm – 1500ppm

- 3 – 5 mg/l for Chlorine, or 4 – 6 mg/l for Bromine.

Water Balance - Hardness

- The Hardness of the water is an indication of the concentration of mainly Calcium and also magnesium salts in the water.
- It can be increased easily by the addition of Hardness Plus (Calcium Chloride).
- To lower it is harder, pump some water out and refill from a source of lower hardness, such as from a supply that runs via a water softener.

Water Balance - pH

- Technically speaking the pH of the water is the negative logarithm of the concentration of hydrogen ions. All acids release Hydrogen Ions and this what an acid consists of.
- In simple terms pH is an indication of how acid or alkaline the water is. The scale runs from 0 to 14 with 7.0 being neutral. pH below 7 is acid whilst a pH above 7 is alkaline.
- We run swimming pools ideally with a pH of 7.4 as this is the pH of the fluid in our eyes and therefore the most comfortable level for us to swim in. A pH range of 7.2 to 7.8 is acceptable.
- pH is a logarithmic scale so the difference between 7.2 and 7.3 is a factor of 1.0 not 0.1, so a small difference in pH can be a large difference in the concentration of Hydrogen Ions.

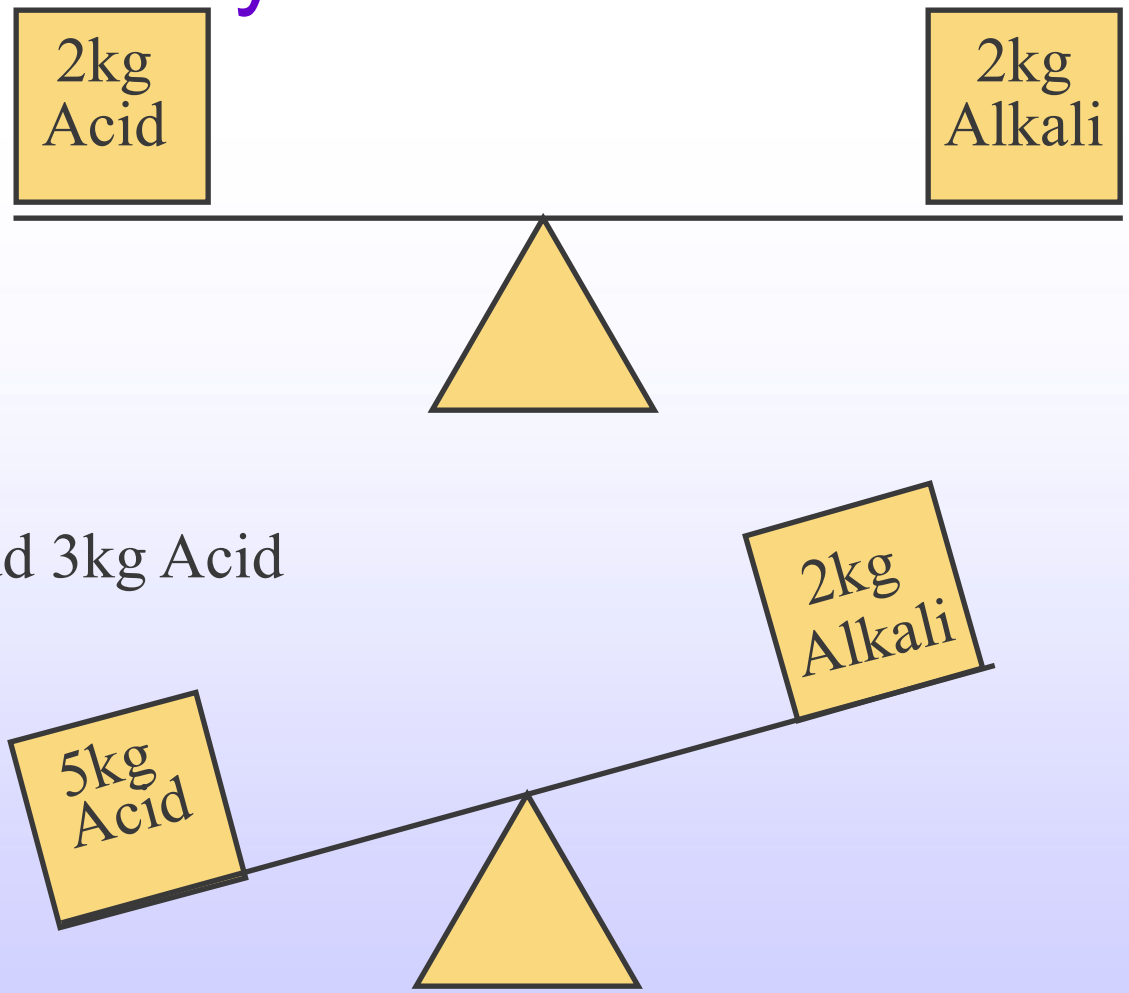
Water Balance - pH

- A pool run outside of the 7.2 to 7.8 range may cause irritation to any swimmers eyes.
- Below 7.0 the water is corrosive and it will attack the pool shell, pipes and equipment, and the first indications on a tiled pool is the grout being eaten away.
- At concentrations above 7.8 the water will tend to become scale forming, and calcium starts to come out of solution and deposit itself over any pool surface. This is very rough, and is not pleasant to touch.
- With any imbalance in pH you must carry out a full water test especially the T/A as they are closely related.
- **The T/A must always be corrected first.**

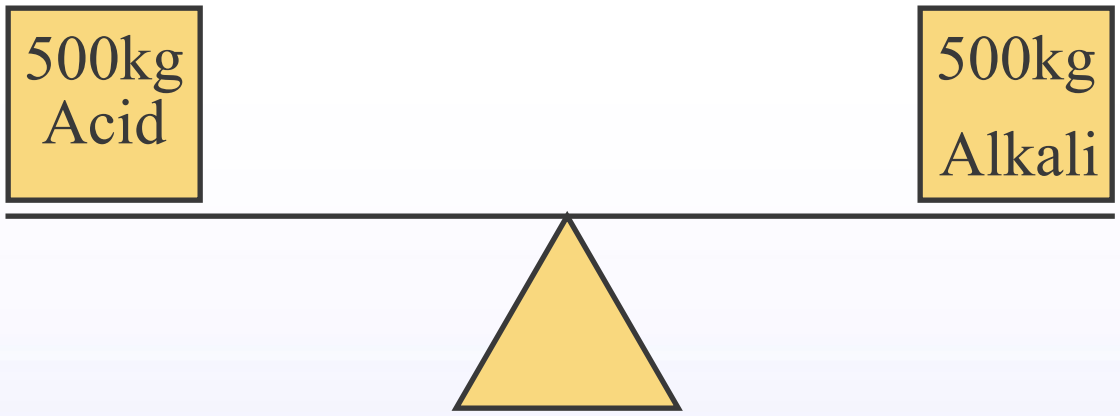
Water Balance - Total Alkalinity

- We are fortunate in that we have a simple test that will confirm the total amount of Alkali dissolved in the water.
- If the total level of Alkali (T/A) is too low then any chemical addition to the water will cause the level of the pH to fluctuate wildly.
- Once we reach a concentration of 100ppm then it buffers the movement of the pH, and makes it much easier to control.

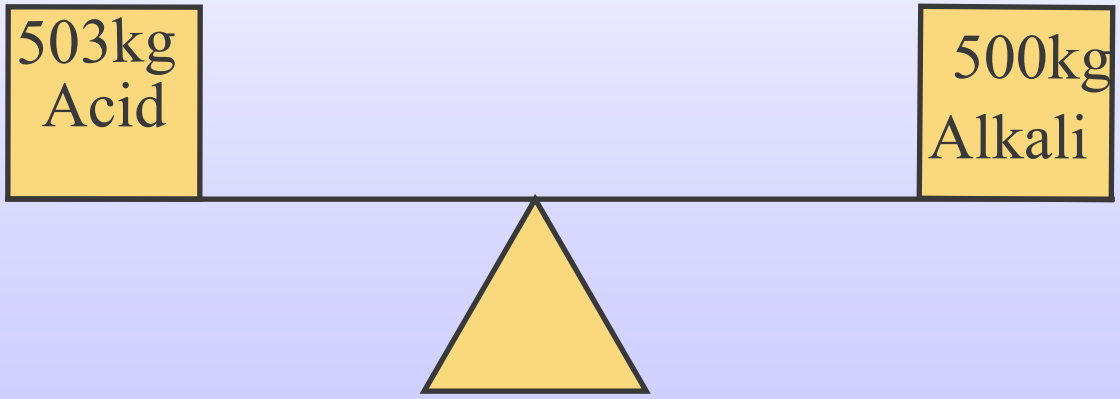
Total Alkalinity



Total Alkalinity



Add 3kg Acid



Water Balance - Total Alkalinity

- Levels lower than 100ppm also indicate that the water is corrosive.
- Levels above about 150ppm indicate that the water is scale forming.
- If the pool water has a T/A below 100ppm or above 150ppm it must be corrected.
- The addition of T/A plus raises the T/A, but to lower it is much more difficult.

Lowering the T/A

- On a commercial pool where the staff are trained, the addition of Hydrochloric Acid at 30% strength may be used to lower the T/A.
- For a domestic pool or spa, Hydrochloric Acid cannot be used as it is far too dangerous.
- Turn off the filtration system, and allow to settle up to 20 mins.
- Take a container of pH minus (acid) and stab holes in it with a screwdriver.
- Allow the pH minus to dissolve (this may take a couple of days) and then switch the filtration system back on.

Sanitising the water.

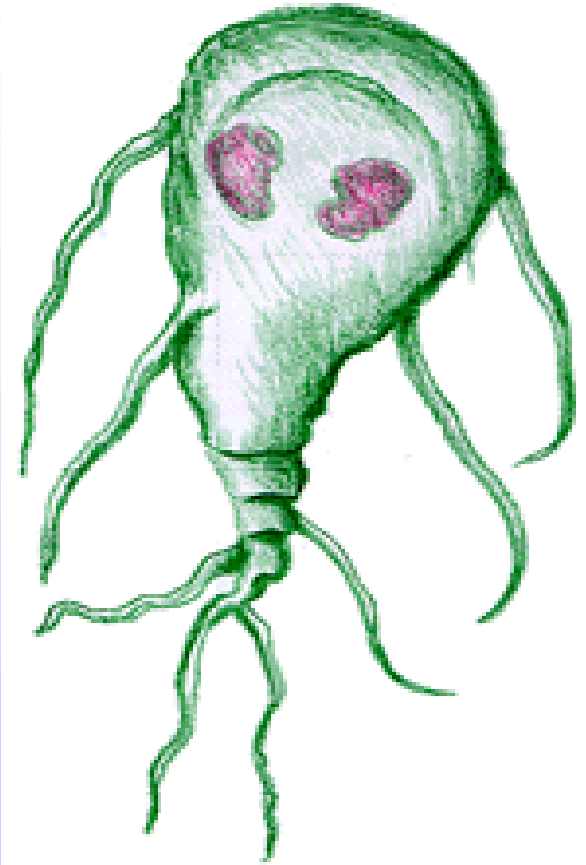
- For pool water to be safe we need a level of sanitiser, normally Chlorine or Bromine, (but possibly aided by Ozone or UV in addition) in the water so that Bacteria are not able to survive and breed in the water.
- With Chlorine in a domestic pool, we try to maintain a level of about 1.5ppm with a shock dose up to about 10ppm every two weeks.
- Shock Dosing has two functions, to kill off any Bacteria that have been able to develop an immunity to the 1.5ppm concentration, and also to “burn out” any small dead organic matter, too small for the filter to remove, and hence to assist in clarifying the pool water.

Sanitising the water.

- It is the Bacteria that are dangerous as this is what can cause infections.
- Chlorine is also used in large doses if there is a problem such as an algae bloom in a pool. Be aware that if there is algae living in the pool water, there will be Bacteria as well, and it is unsafe to bathe.
- Unfortunately, Bacteria can only be tested for in a laboratory with a test that takes time, typically 1-3 days.
- If you have the correct level of sanitiser in the water, and this we can test for, then you know the water is safe to swim in.

Nasties, you don't want to swim with!

Giardia lamblia or E. coli 0157:H7



Chlorine

- Still the most common sanitiser used in commercial or domestic pools.
- Available as Chlorine Gas in the commercial market where the staff are trained to handle it.
- Available for the domestic market as
- A Tablet – Trichloroisocyanuric Acid 90%
- Or – Calcium Hypochlorite 65%
- A granule – Sodium Dichloroisocyanuric Acid 55%
- Or –Lithium Hypochlorite 65%
- Liquid – Sodium Hypochlorite 10-15%

Bromine

- Generally used on Spas and indoor pools.
- Less effect on the pH of the pool water and more stable at higher temperatures.
- The atmosphere above a Bromine treated pool is less aggressive to the fabric of the building than that above a Chlorine treated pool.
- Slow eroding tablets (Bromo-chloro-dimethyl-hydantoin, BCDHH), they need to have running water over them so must be dosed via an erosion feeder, and not just thrown in the skimmer basket.
- Compatible with Chlorine so you can use Chlorine to shock dose, or bring the level of sanitiser up quickly.

Cyanuric Acid

- Outdoor pools running on Chlorine should also have a level of Cyanuric acid established.
- This prevents the loss of Chlorine from the pool under the action of UV light.
- A minimum level of 50ppm with a maximum of 200 meets SPATA standards.
- From practical experience, I would only allow a max of 50 -80 ppm as above that it appears to require massive amounts of Chlorine to kill any Algae infestation.

Algae & Algaecides

- You will always get Algae spores falling into a swimming pool, especially an outdoor pool.
- A well run pool with correct chemical levels will kill the Algae spores before any Algae can form.
- However, sometimes Algae can take hold and a pool environment is ideal, warm, lots of light and nutrients in the water – this can cause an Algae bloom.
- It can double its numbers in 20 minutes.
- As soon as you see any sign of Algae in a pool, add chemicals immediately. Treat with Shock Chlorine at the rate of 1kg per 10,000 gallons or if really bad 1kg per 4,000 gallons.

Algae & Algaecides

- It is still the Chlorine that kills the Algae.
- However if you have been dosing your pool with an Algaecide, there is much less chance of ever getting a problem, and it is easier (uses less chemicals) to sort it out.
- Algaecides interfere with the reproductive cycle of the Algae and slow it down.
- This normally gives the Chlorine already in the water a chance to kill the Algae.
- Algaecides are less expensive than Chlorine, so use them in a pool and leave the Chlorine to carry out its main function of killing Bacteria.

Clarifiers and Flocculants.

- These products work to bind very small particles together, and make it possible for the Filter to remove them from the water.
- Generally speaking, the Clarifiers tend to bind particles together to a size that still stays in suspension, and they will then be drawn into the filter in the water flow.
- Flocculants tend to produce particles large enough to sink to the bottom of the pool.
- Flocculants can be added via the skimmer, to coat the top of the filter bed, and so filter out smaller particles. This is then lost on backwashing, and so need replacing.
- Sometimes if clearing up an Algae Bloom or a really bad pool, use both a clarifier and a flocculant to speed the process up.
- FLOCK THEN SHOCK

Water Testing, Types of Test Kits

- In increasing order of price and accuracy.
- Test Strips (quick but not very accurate)
- Tablet Kits (good standard kit)
- Comparator Type Kit c/w slow dissolving tablets, (minimum requirement for any commercial type pool, or any pool shop)
- Small Electronic Test Pens (only certain tests are reliable, but very useful for those)
- Comparator Kit with light source
- Photometer Test Kit (Best available but the operators must be trained to use it correctly)

Water Testing, best practice.

- Always take water samples from the same place.
- Take the water sample from about 6”-12” below the surface, as you can get a false reading if scooping surface water, as about 90% of all contaminates are in the top 2” of the water.
- With a tablet type kit, make sure the test tablets are solid and not discoloured.
- Try not to touch the test tablets and let them come straight out of their foil into the test kit.
- Make sure the tablets are fully dissolved.
- Use natural daylight for comparator type tests.
- Test strips are quicker to use but NOT very accurate.

Dosing Chemicals

- When dosing any Chemicals into a swimming Pool there are a few very important points.
  - Always pre-dissolve any dry chemicals, in a bucket of water. Always add the Chemicals to the Water. Stir with a large wooden spoon if necessary, and only use these items for pool chemicals.
  - Add a solution to the pool, never throw granules or tablets into a pool.
  - Tablets can be placed in a Skimmer basket or preferably in a specialist erosion unit. Circulation regime must be correct.
  - Always take the chemicals to the poolside and don't dissolve them in a confined space such as a plant room.
- **Never mix Chemicals** - make sure there is no residue left in a bucket when dissolving them, and rinse the bucket after use.

Dosing Chemicals

- Always wash your hands immediately after using any chemicals, do not touch eyes or face etc.
- Most liquids can be added directly to a pool, but for Water Clarifier, dilute in more water in a bucket and dose all around the pool.
- Shock dose and add Algaecides on alternate weeks, as copper based algaecides should not be dosed into a high concentration of Chlorine.
- Shock dose at the end of a weekend, as that is normally the heaviest bather loading, leave the Solar Cover off for 24 hours, and it will last longer.

Chemical Safety

NO
SMOKING

Chemical Safety

KEEP OUT OF THE REACH OF CHILDREN!

DOH!

Water Testing – Good practise

- At least twice a year have a sample of the pool water tested at a laboratory. They should have a more accurate system, and they will test for things that you cannot.
- Test the same water yourself. This will also give you feedback as to how accurate your test kit actually is !
- The most important time is when you first open the pool in the spring, and then once halfway through the summer season.

- ALWAYS RECORD YOUR READINGS

29.11.04		Comparitor	Test Strip	Aquachk	Insta Tst	Insta Tst4	Checkit
	Free Chlr	4	1	2	3	3	?
	Ph	7.8	7	7.8	8	8	7.5
	TA	140	60	100	120	120	
			PH- Added				
30.11.04		Comparitor	Test Strip	Aquachk	Insta Tst	Insta Tst4	Checkit
	Free Chlr	3	1	2	2	3	?
	Ph	7.5	6.6	7.8	8	7.8	7.7
	TA	100	60	100	80	60	
01.12.04		Comparitor	Test Strip	Aquachk	Insta Tst	Insta Tst4	Checkit
	Free Chlr	3	1	2	2	2	?
	Ph	7.5	6.8	7.6	8	7.8	7.6
	TA	100	60	100	60	60	
			Chlorine added				
03.12.04		Comparitor	Test Strip	Aquachk	Insta Tst	Insta Tst4	Checkit
	Free Chlr	8	6	8	6	6	?
	Ph	7.6	6.4	7.6	8.4	8.2	7.7
	TA	100	20	100	60	60	

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