New Zealand Pool Industry Association Incorporated, PO Box 17069 Greenlane 1546 email executive@poolguild.org.nz

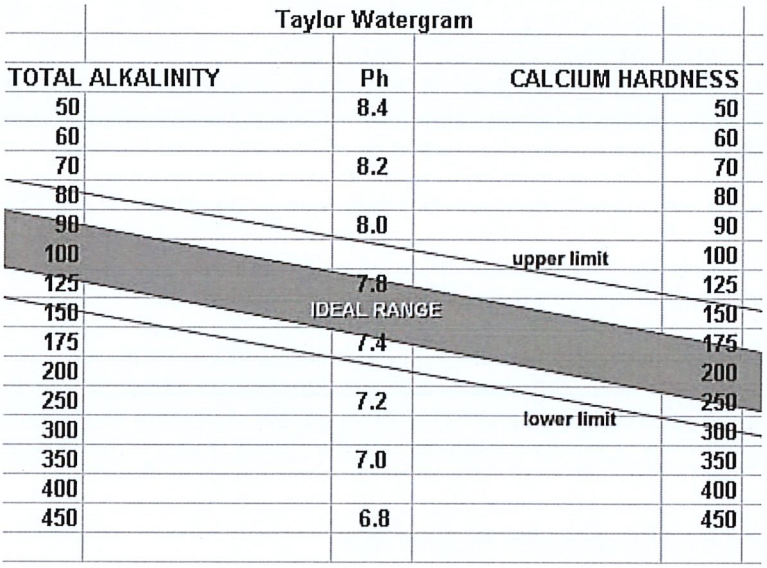
PAPER 8

POOL WATER TESTING, DOSING EQUIPMENT

This Paper is relevant to all swimming pools being chemically sterilised (i.e. NOT Ozone pools)

Swimming pool water requires sterilisation. Mainly due to being a catchment area of many square meters, lots of detritus falls into the pool: dust, bird droppings, falling leaves and many other things. Then there is the contamination from the pool users: sweat, urine, skin flakes, hair, dirt from feet and other contaminants. These need to be neutralised, as many will start rotting and contaminating the water

Swimming pool water requires balancing and chemical treatment to establish certain desirable properties of the water. Some chemicals are naturally present in the water, while others have to be added – especially in New Zealand metropolitan areas where much of the town supply water comes from reservoirs (i.e. Rainwater – which is "distilled").



The graphic (above) attributed to scientific engineer Fredrick Winslow Taylor* (Hence the name Taylor Watergram) is a quick index to the relationship range of chemicals that are ideal for a home swimming pool. If data collected from a pool fits the IDEAL RANGE as shown above, then you will have a "Happy Pool".

But there will be a wide range in the quality of water in the pool and make-up water. Optimum requirements vary according to the interior finish of the pool; (i.e. marble plaster, paint, vinyl liner, crushed quartz etc.) so, it is not possible to add treatment chemicals to a Predetermined Formula, so testing must take place.

The First step is to consider the type of finish of the pool, then the Second step after filling the pool is that the water has to be tested.

Third and Fourth steps are to calculate the correct quantities of the required chemicals and add and mix thoroughly with the water, then the resulting water has to be checked again.

Sampling is very important. Ideally the filter should be operating, and the water is to be thoroughly mixed before taking the sample, however, this is not always possible.

Consideration should be that a small volume of the sample represents 50, 60 or even many more thousands of litres of water. Thus, one or more representative samples should be taken as the accuracy of the test results depends on the samples.

DOs and DON'Ts of chemical testing: Using the standard "Test Kit" Colour Comparison kit

Test Reagents should be fresh and renewed every swimming season.
Chemicals and the colour-test comparator should be stored in a dark, cool place.

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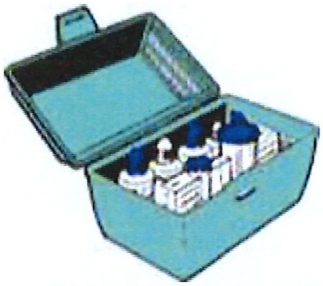

Chemicals should not left exposed to heat or sunlight.
Don't let your fingers come into contact with the test rReagents, as many of the chemicals are harmful if in contact with the skin.
Tested samples should be poured away from the pool out of reach of people and children, never poured back into the pool.
Children and immature teenagers should not be allowed to handle the test Reagents.

A sample of pool water is collected into the clear plastic comparison device. This has two collection tubes with plastic tops.

Gather a test sample from at least 300mm below the water level.
Follow the instructions included in the Test Kit container.
It is important to hold the colour Reagent bottle vertically (upside down) and squeze gently to dispense the one or more drops as indicated in the instructions. The colour in the water sample should change, allowing it to be compared with the Indicator Strips embedded in the device. (i.e. the "Comparison" system)

1. Chemicals used to determine Chlorine or Bromine levels and other water balance levels

1.1 ORTHOTOLIDINE (OTO). Harmful and a strongly acid solution, not recommended by the Health Department, and not generally in use at this time. Some older Test Kits use it. The solution is RED in colour

When added to a chlorine containing solution it develops a yellow colour. The amount of chlorine is determined by matching the intensity of the colour with a calibrated set of colour standards. The higher the chlorine content the darker the yellow colour is. The Reagent will produce a brown colour if the chlorine concentration is too high. In this case the sample should be diluted, and the result multiplied by the degree of dilution.

OTO determines the total chlorine content of the pool water.

1.2 DPD. **N,N-diethyl-p-phenylenediamine.** Let's refer to this as DPD. There are two Reagents used and they are No 1 and No 3. Both are available in liquid or tablet form. The tablets are usually more stable than the solution. The appearance of any pink or brown colouration of the Reagents indicates that it has deteriorated beyond use.

DPD No 1 is used to determine free chlorine. The pink colour developed after adding the Reagent should be read within 2 minutes by matching to a set of calibrated standards. DFD No 3 is than added to the SAME sample and the colour is matched again. This value is the total chlorine.

The difference between the total and free chlorines (second reading minus the first reading) is the amount of combined chlorine.

The above methods equally apply to the determination of bromine as well.

1.3 There are ion-selective electrodes to determine chlorine and bromine, however, the equipment requires careful calibration which is beyond the capability of the pool shops.

There are imported Asian little bimetallic gadgets to determine chlorine. These were found completely useless; they should not be relied on.

2. POLYMERIC BIGUANIDE

It has its own Reagent and colour standard and that has to be used.
There is no test kit for the hydrogen peroxide.

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3. TOTAL ALKALINITY

As a rule three Reagents are used: chlorine neutralizer which is mixed with the sample to destroy chlorine otherwise the colour of the indicator is affected leading to erroneous results.

The coloured indicator will change its colour when the measurement is complete. The third solution is the measuring solution. It is added dropwise, counting each drop until the indicator has changed its colour. The actual number of the drops used multiplied by a factor - usually 10 - is the total alkalinity as mg/L calcium carbonate.
The indicator solution used in this determination cannot be substituted by any fo the other indicators in the test kit.

4. pH "Potential Hydrogen"

pH can be measured by using indicator solutions (Reagents) or electronic pH meters.

4.1 The coloured pH indicator most frequently used is PHENOL RED which is yellow at or below pH 6.8, changing to deep read at the above pH 8.2 Phenol red will indicate the correct pH only between 6.8 and 8.2. For instance, it is not possible to establish whether the pH of a sample is 6.8 or 6.0 or even 5.0 as the colour is the same yellow.

Since some of the older fibreglass pools must be maintained at pH 6.8 to avoid the appearance of the dreaded black stain BROMOTHYMOL BLUE indicator is recommended instead of phenol red. Bromothymol blue has a green colour at pH 6.8, it is yellow at pH 6.0 and it is blue at 7.6.

4.2 The electronic pH meter consists of a millivolt meter which is calibrated to read pH values and a probe which consists of a glass measuring and a calomel or similar reference electrodes. The electrode is fragile and it should be handled with care.

4.3 The pH meter has to be calibrated using accurately made buffer solutions. There are portable models and those requiring mains power. A good quality pH meter has the full range of the pH and is recommended for pool servicing technicians.

5. CALCIUM HARDNESS TEST

The kit consists of a buffer solution indicator and a measuring solution which is added dropwise counting the drops. The colour change is usually from read to pure blue. The multiplying factor is 10 or 50. The latter is better for hard waters, but it is not very accurate for soft waters like those in Auckland or most parts of Rural New Zealand. In concrete pools, the CH should be no less than 200 and up to 500cl per l to protect the plaster finish being "eaten" as the pool water seeks to be harder (as it will)

This test is not usually provided to the home pool owners.

6. CYANURIC ACID TEST

A sample of the pool water is mixed with the Reagent which will produce a turbidity the intensity of which is dependant on the amount of the cyanuric acid in the water. The test has to be carried out within a specified time and at room temperature (say 20-25 deg c.)

7. TEMPERATURE

It is measured with a thermometer or with a probe some pH meters have built in. True values can be obtained only on site.

8. TOTAL DISSOLVED SOLIDS

These are measured either with a conductivity meter which requires calibration or with a hydrometer which measures the density of the water. It also requires calibration. The values provides an estimate of the total amount of the salts, but not the identity of the individual constituents.

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9. SALT CONTENT DETERMINATION

This value is important for the efficient operation of the salt water chlorinators. The yellow indicator solution turns brown when enough drops were added to the water sample. The multiplying factor is usually 500. Care should be taken with the silvernitrate Reagent solution as it is affected by light and thus it should be kept in the dark when not in use. Also it stains the skin, apart from being poisonous.

AUTOMATIC DOSING EQUIPMENT

1. Chlorine dispensing and generating equipment.
Liquid chlorine is pumped into the water by a small peristaltic pump. The rate of dosing is predetermined as well as the length of the time of dosing. The pump is activated by the filter motor. The dosage rate has to be set to suit the conditions.

An improved version is the unit which has a sensor and it adds chlorine depending on the chlorine content of the water. If the predetermined chlorine level was achieved no more chlorine is added.

The saltwater chlorinator starts producing chlorine when the filter starts. The length of time will determine how much chorine is generated.

The humble floating dispenser which is designed to contain either 25mm or 75mm Trichlor tablets (chemical name: trichloroisocyanuric acid or 1,3,5, trianzine – commonly called TriChlor) or the less common 25mm Cal Hypo tablets (not as common in New Zealand as Australia, and as they dissolve very rapidly they create higher water treatment costs) is a very simple device. It is suitable form of "automatic" chlorination for supplementary chlorination, but it is not usually enough on its own.

The dosage rate is dependant on the temperature of the water and on the movement of the float in the water. An improved version is the dispenser which is built in the return line of the filter and the dosages rate can be adjusted as required. Remember that Trichlor Tabs have a very low pH (2.0 to 3.0) and acidic water will result from continued use of Trichlor as well a build up of cyanuric acide in the pool (ideally 30 to 60 ppm – above this inhibits the effectiveness of chlorine in the pool water)

A similar device is used in spas for the dosage of the spa water with the bromine sticks. The amount of water that flows through the dispenser determines the level of the bromine in the spa water.

NOTE: The trichlor or Cal Hypo tablet dispensers should be used with the slow dissolving tablets only, NOT with granular chlorine. Also mixing of two different chlorine compounds should be avoided as serious accidents can occur.

Although the above dispensers are more or less automatic frequent testing of the water is necessary to ensure that it is sanitary and correctly balanced for the interior of the pool at all times.

2. pH Controller equipment

This unit measures the pH of the water and if the pH is higher than the preselected value it adds liquid acid via a connected peristaltic pump to the water.

These units are quite unnecessary and the ones which inject the acid into the suction line before the filter should be avoided.

ROUTINE POOL WATER MAINTENANCE

DAILY IN SEASON	- filter the water every day – at minimum, one complete turnover- - add or generate chlorine to minimum 1 cl per L or bromine to Spa pool - remove visible leaves, twigs etc.
WEEKLY	- in addition to the daily route - check the pH is 7.6. If it is higher or lower than required test the total alkalinity.

- adjust it as required. This will also adjust the pH
- vacuum the pool unless it is carried out automatically
- check the filter and backwash or clean if required.

MONTHLY
- in addition to the weekly tests -
- check the total alkalinity and adjust as required
- The water should be tested by a competent pool technician and adjusted as necessary
. Superchlorinate the pool with Chlorine to 2 cl per L

OFF-SEASON
- when the pool is not used -
- vacuum monthly to avoid the building up of dirt
- add an effective algaecide every three - four weeks
- chlorinate if algaecide cannot cope
- when home is unoccupied, turn the pump off to avoid the pump running dry

BEFORE USING
- superchlorinate the water to 2cl per 1l
- check the pH and adjust as before pool is ready for use

BEFORE THE SEASON

- Tested chemical levels by competent pool technician and adjust as required.
- Obtain fresh Reagents

By following these guidelines, a "happy" pool – and pool customer – should result

Other testing methods:

Dip Strips are a quick and easy way to check the pool chemical levels – and reasonably cheap to buy.

Convenient, but WARNING: They can be "past dated" quickly, and the results will be invalidated.

Check the "Use By" date on the bottom of the tube of strips.

Electronic devices are available for accurate testing
Check that the batteries are not run down.

-end-

* = TBC