



WATER CHEMISTRY

Washington State Department of Health
April 2018

What Will Be Discussed?

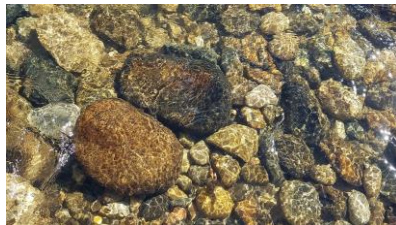
1. Water clarity
2. Chemistry of pH
3. Chemistry of total alkalinity
4. Chemistry of cyanuric acid
5. Chemistry of calcium in water
6. The effect of temperature in pool and spa water



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Why is Water Clarity Important?

- Identify users in distress
- Prevents injuries and/or drownings
- Clearly see all drain covers and pool bottom




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According to CDC, drowning is the second leading cause of unintentional death with children between 1 and 14 years of age. Water clarity is a factor in causing drownings in pools, spa, and other aquatic facilities.

How to Measure Water Clarity Levels

- Maximum requirement of Turbidity is 0.5 ppm
- Visual test: main drain and pool bottom visible at all times



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Turbidity is a measure of the amount of solid particles that are suspended in water and that cause light rays shining through the water to scatter and appear cloudy.

What Causes Poor Water Clarity?

Turbidity - A measure of the cloudiness or haziness of an otherwise clear liquid due to the presence of small liquid or solid particles in the liquid.

Factors:

1. Contaminants
2. Improper filtration
3. Insufficient water circulation or flow rate
4. Poor water chemistry
5. Microscopic suspended particles

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Water Clarity

Contaminants:

- Wind
- Rain
- Vegetation
- Dry skin flakes
- Bacteria
- Cosmetics, sunscreen, lotion, etc.

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Improper Filtration

1. Routine cleaning of filters
2. Backwash too frequent
3. Mud balls / Channeling



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- Monitor flow rate daily; follow manufacturer's recommendations for cleaning filters.
- Backwash according to manufacturer's instructions
- Mud balls is the accumulation of filter material, silt or clay, and flocculated material. Channeling basically creates paths through the sand media bed which allows water to bypass the filter medium and not remove solids from the water.

Other Factors Affecting Water Clarity

- Insufficient water circulation or flow rate
- Poor water chemistry
 - Water balance
- Microscopic suspended particles
 - Water clarifier

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Control of pH

- Comfort of users
- Efficiency of the disinfectant
- Protection of pool equipment



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- Helps prevent skin and eye irritation
- Low pH chlorine loss and High pH chlorine can become inefficient.
- Low pH corrosion, etching of pool surfaces, and staining; High pH clogged filters and heater elements

pH Range

Test frequently enough, but at least once every 24 hours.

Chemical	Minimum	Maximum	Ideal Range
pH (Hydrogen Ion)	7.2	8.0	7.4 to 7.6

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Factors That Affect pH

- User waste: lotion, sunscreen, urine, etc.
- Disinfectants
- Source water
- Air-borne debris



- Water balance chemicals
- Aeration
- Evaporation

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- Showering prior to entering pools is very important.
 - Certain disinfectants can cause pH to increase or decrease.
 - Is the source water coming in Acidic, Basic, or neutral? Provides the baseline of pH
 - Air-borne debris: files, leaves, etc.
5. Aeration – is the process by which air is circulated through, mix with or dissolved in a liquid or substance.

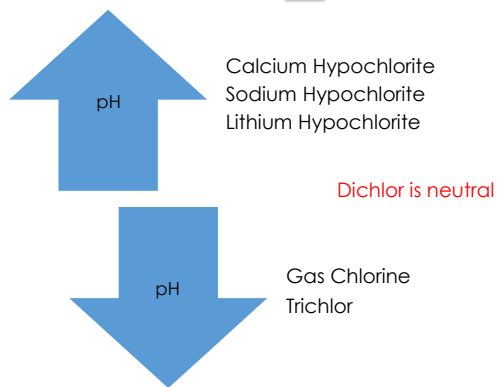
Chlorine + Water = Hypochlorous acid (HOCL) + Hypochlorite ion (OCL-)

- Hypochlorous acid: Active disinfectant
- Hypochlorite ion: non-active disinfectant

HOCL	pH	OCL
97%	6.0	3%
76%	7.0	24%
24%	8.0	16%

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Chlorine Effect on pH



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Different types of chlorines can increase or decrease pH.

pH Adjustments



How to decrease pH

- Muriatic Acid
- Sulfuric Acid
- Sodium Bisulfate
- Carbon Dioxide



How to increase pH

- Sodium Carbonate
- Sodium Hydroxide
- Sodium Bicarbonate

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- Muriatic acid aka Hydrochloric Acid
- Sulfuric acid is non-fuming
- CO2 for pools that use Na Hypo or Ca Hypo
- Na Carbonate or soda ash
- Na Bicarbonate should not be regularly used to increase pH

Total Alkalinity

- A measure of the water's ability to resist changes in pH when acid is added to the water.
- TA of pool/spa water is the water's resistance to a change in pH.



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It is the primary control of pH. Anchor for keeping pH where it should be.

The Buffer



Ranges

Field test kit range

- 0 – 300 ppm

The ideal range

- 80 to 120 ppm



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Effects on Equipment

- Etching of surfaces
- Staining
- Heater failure
- Rough surfaces
- Clogged filter and heater elements

Total Alkalinity Adjustment

Measure at least weekly

Chemical	Increase	Decrease
Sodium Bicarbonate	↑	
Muriatic Acid		↓
Sodium Bisulfate		↓

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What is Cyanuric Acid (CYA)?

- Sometimes referred to as stabilizer or conditioner
- Used to protect Chlorine in outdoor pools from the sun's UV
- When present in outdoor pools' water and in sufficient concentrations, the free chlorine (germ killing agent) residual can remain three to ten times longer than in water without CYA

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NSPF reports half of chlorine in water can be destroyed by sunlight in less than one hour.
Mostly used in outdoor pools.
Key is to maintain CYA at the proper level.

CYA

Forms:

- Stabilized disinfectants: Trichlor and Sodium Dichlor contain cyanuric acid
- Solid, crystalline powder (manual addition)

Usage:

- Maximum allowance is 90 ppm
- Recommend for outdoor pools only
- Swimming pools: chlorine with CYA compound 2.0 ppm
- Spa or wading pools: chlorine with CYA compound 3.5 ppm
- Test weekly

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Controlling and Reducing CYA

If CYA is too high Chlorine will become less effective in killing germs

Control:

- Maintain proper chemical levels – chlorine, pH, and total alkalinity
- Routinely scrub your pool surfaces

Reducing:

- Partially drain water and replace with fresh potable water
- If you have an indoor pool this product is not recommended

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Calcium Hardness

- The level of calcium determines whether water is overly soft (too little) or hard (too much)
- Calcium content of water is present naturally

Temperature's effect on calcium hardness

- As temperature rises calcium becomes less soluble
- Higher temperatures can result into scaling water
- Low temperatures can result into corrosive water

Calcium hardness: the calcium content of water which is present naturally

Corrosive water (low calcium): etching of pool/spa surface, staining of surface walls, heater failure.

Scaling water (high calcium): rough surfaces, clogged filters and heater elements, and reduced circulation.

Calcium Hardness

Ideal operating range for pools:

- 200 to 240 ppm

Ideal operating range for spas:

- 150 to 250 ppm

Recommend checking weekly



Calcium Hardness Adjustments

How to Increase

- Calcium chlorine
 - Hydrated calcium chloride
 - Anhydrous calcium chloride

How to Decrease

- Replace water
- Maintain proper levels of pH and total alkalinity
- Water Softeners are available

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Health Impact of Temperature

- All temperature controls must be locked or made inaccessible to users
 - Not exceed 104 degrees Fahrenheit
- Spas should be equipped with a 15-minute timer
 - Helps prevent loss of consciousness and drownings
- Pregnant women, the elderly, and individuals with chronic illnesses should avoid spas

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Timers: this action allows the body to cool down and helps prevent users from losing consciousness and drowning.

The Impact of Temperature and Light on Chlorine



Temperature

- Many bacteria species grow better in warmer water
- When bacteria proliferates, free available chlorine is then used up quicker



Light

- Free chlorine is lost when hit by sunlight
- UV radiation from the sun breaks apart, releasing the chlorine as gas.
- 90% in just two hours

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- Chlorine forms hypochlorite ions in water, the molecule that is measured as free chlorine
- Daily testing and monitoring: A bright sunny day can reduce the chlorination level of a pool by 90% in just two hours.
- Overall, chlorine plays a major role in killing germs and maintaining proper water quality
- Temperature extremely important with spas

Source: <https://sciencing.com/heat-sun-affect-pool-chlorine-21723.html>

Safety Precautions

1. Always follow the label's directions
2. Make sure to dilute acid chemicals per label directions
3. Remove people from the water before adding chemicals
4. The facility must remain closed until the chemicals are completely dissolved and dispersed

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Diluting acid with water can prevent the potential of corrosion in pool or spa equipment.