



Basic Pool & Spa Care

Module 2: Water Balance

Exceptional People. Proven Methods

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Module 2: Water Balance

This module should take you approximately 3.5 hours to complete.

Objectives

2.0 Given a scenario, describe BioGuard® Water Balance products and their functions according to BioGuard standards.

- 2a Define pH.
- 2b Describe how pH affects comfort, clarity, equipment longevity, and chemical efficiency.
- 2c Identify the maintenance levels of pH.
- 2d Identify symptoms caused by high or low pH.
- 2e Define the importance of Total Alkalinity and its proper balance.
- 2f Define Water Hardness and its appropriate level.
- 2g Identify the affects of too little hardness.
- 2h Identify the affects of high temperatures on hardness.
- 2i Define the Saturation Index.
- 2j Identify the results of a high or low Saturation Index.
- 2k Define Total Dissolved Solids and their recommended level.
- 2l Describe how to maintain the proper Saturation Index with BioGuard® balancing products.
- 2m Define the importance of water testing.
- 2n Identify parameters for testing.
- 2o Identify the different methods of water testing.
- 2p Describe the advantages of BioGuard® ALEX.

Purpose

This module describes water balance and the factors used to balance water including pH, alkalinity, water hardness and saturation. BioGuard products in the category are presented as well as their functions.

pH

This topic should take you approximately 60 minutes to complete.

Objectives

- Define pH
- Describe how pH affects comfort, clarity, equipment longevity, and chemical efficiency.
- Identify maintenance levels of pH.
- Identify symptoms caused by high or low pH.

Topic Introduction

This topic describes:

1. Water Balance
2. What is pH?
3. What the Pool/Spa Owner Wants to Know about pH
4. The pH Chart
5. Swimmer Comfort
6. Water Clarity
7. Surface and Equipment Longevity
8. Sanitizer Efficiency
9. If pH is Too High
10. If pH is Too Low

Water Balance

Chlorine and bromine work best in water that is properly balanced. Balanced water is also more comfortable for swimmers and safer on equipment. pH is the primary factor in balanced water.

What is pH?

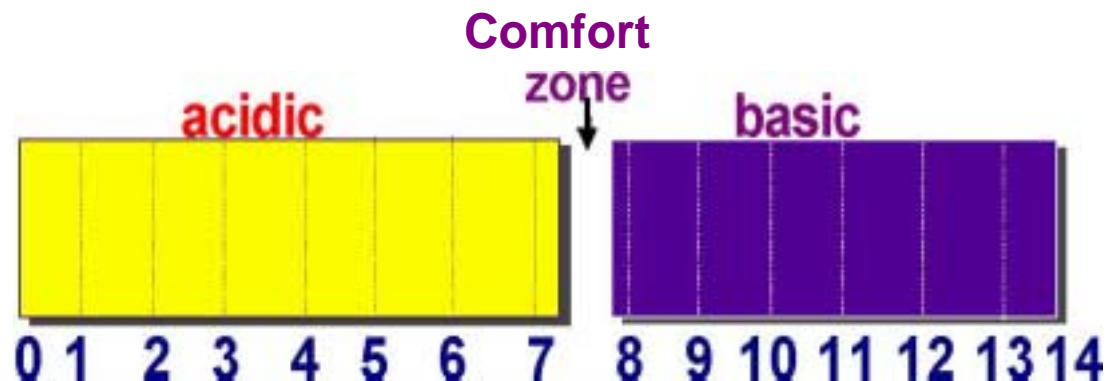
pH is a number that characterizes the acidic or basic characteristics of a liquid substance. Expressed as a number on a scale of 0 to 14, with 7.0 being neutral; values less than 7.0 are acidic and values greater than 7.0 are basic.

What the Pool / Spa Owner wants to know about pH

A typical pool / spa owner only wants to know things that affect them. So what are the features of water with a proper pH? What are the benefits of these pH features?

- Swimmers are comfortable.
- Water remains clear.
- The pool/spa equipment and surface last longer and perform better.
- The sanitizers in the water work more efficiently.

The pH Chart



Acceptable pH range: 7.2 to 7.6

Swimmer Comfort

If pH is too high or too low, the water will feel uncomfortable to swimmers. As a matter of fact, an improperly balanced pH causes most complaints of itchy or irritated skin and burning, blood-shot eyes. What chemical is typically given the rap for these water characteristics? The answer is chlorine. Now we know

chloramines do pose some discomfort to bathers but a pool or spa owner that performs proper maintenance minimizes this discomfort.

Water Clarity

Generally speaking, a high pH will promote cloudy water and a low pH will promote clear water. As a matter of fact, low pH is a huge problem because the water does not give the owner any visual clue that there is a problem. This low pH is not only affecting bather comfort, it's also eating away at the pool and equipment. A high pH is typically handled more quickly because the water will begin to cloud. This visual clue will prompt pool/spa owners to do something because they know they have a problem.

Surface and Equipment Longevity

Anything the water touches can be affected by the pH. An improper pH can cause corrosion or scale formation on the pool surfaces, equipment and plumbing.

Sanitizer Efficiency

Of the three primary sanitizers (chlorine, bromine and biguanide), chlorine is the most vulnerable to an improperly balanced pH. Simply put, when the pH is below 7.2, the activity of chlorine increases to such an accelerated rate that the HOCl leaves the water prematurely. When the pH is above 7.6, the amount of HOCl is reduced to the point where it cannot provide adequate sanitizing opportunity to the water. Bromine (HOBr) is more tolerant of the pH, maintaining adequate sanitizing effectiveness in a pH range from 7.0 - 7.8. Biguanide (PHMB) sanitizing effectiveness is not adversely affected by pH swings one way or the other. However, the effectiveness of the sanitizer is only one of four reasons to monitor the pH.

If pH is Too High ... (above 7.6)

Contributors to high pH include rain, plaster surfaces, algae, and some pool chemicals. The water will be cloudy and swimmers will complain of dry skin and irritated eyes. The water will have a tendency to form scale in the plumbing and on the surfaces. The available chlorine will be less effective. Lo'N Slo can be used to lower a high pH level.



If pH is Too Low ... (below 7.2)

Contributors to low pH include most rain, new vinyl liners, swimmers, and some chemicals. The water will be clear, but it will irritate skin and make eyes red. It will also corrode equipment and the HOCl will be used up quickly. Balance Pak® 200 can be used to raise low pH.



Alkalinity

This topic should take you approximately 20 minutes to complete.

Objectives

- Define the importance of Total Alkalinity and its proper level.

Topic Introduction

This topic describes:

1. Buffering the Water Against Change
2. Total Alkalinity – the pH Buffer
3. If Total Alkalinity is Low
4. If Total Alkalinity is High

Buffering the Water Against Change

Chemical buffers are critical to easily manage the dynamic changes that can occur in a pool or spa. Heavy rains, heavy bather load, and routine application of chemicals will typically have an affect on the pH of the water. If the water is not *buffered* to prepare it for this routine and expected use, the pH can fluctuate wildly.

Total Alkalinity – the pH Buffer

Total Alkalinity is a measure of the ability of the water to resist pH change. With this test, we are measuring the concentration of carbonates, bicarbonates, silicates, borates and other chemical compounds that contribute to Total Alkalinity. If the Total Alkalinity of water is kept within its ideal range, it acts as a buffer against changes in pH. So if it rains heavily or a lot of people go for a swim, the Total Alkalinity absorbs the shock of pH changing events and the pH doesn't bounce around.

The ideal range for Total Alkalinity is:

ALL POOLS: 125-150 ppm

Since Total Alkalinity can dramatically affect the ability to keep water in balance, a Total Alkalinity test is part of every water analysis.

IF TOTAL ALKALINITY IS LOW ...

the pH will bounce around dramatically, making it difficult to keep the water clear and comfortable. If the pH ever drops to 4.5 or below, all Total Alkalinity is destroyed. Balance Pak® 100 can be used to raise the total alkalinity level.



IF TOTAL ALKALINITY IS HIGH ...

pH will also be high (and difficult to bring down) and you face the problems of cloudy water, dry skin, scale formation and inactive chlorine that come with having a high pH. To lower Total Alkalinity, apply Lo' N Slo in dosages over several days.

Water Hardness

This topic should take you approximately 30 minutes to complete.

Objectives

- Define Water Hardness and its appropriate level.
- Identify the affects of too little hardness.
- Identify the affects of high temperatures on water hardness.

Topic Introduction

This topic describes:

1. Water Hardness- Water's Favorite Minerals
2. Temperature and Calcium Hardness
3. If Hardness is High
4. If Hardness is Low

Water Hardness – Water’s Favorite Minerals

Remember, water is the *universal solvent*. Given enough time, pressure, and/or proper temperature, water will dissolve most metals or minerals into a solution. Because of this tendency, any minerals that are present in the water’s environment will ultimately end up dissolved in the water.

Hardness in pool and spa water is an important water balance characteristic. Water that has too little hardness is likely to be *aggressive water*. This aggressive nature is defined by the water’s need to satisfy its mineral appetite. If there are not enough minerals in solution to satisfy this appetite, the water will look for a way to satisfy its mineral hunger. The surface of plaster pools and spas is the most vulnerable to this aggressive search for mineral satisfaction so depending on the pool or spa surface, the hardness level is adjusted accordingly.

PLASTER and *SoftSwim* POOLS: 200 - 275 ppm

ALL OTHER POOLS: 175 - 225 ppm

Temperature and Hardness

The water’s appetite for minerals changes with the temperature.

- When water is cold; the water gets “hungry,” and works more aggressively to dissolve calcium from surfaces and equipment. This results in corrosion or etching of pool surfaces.
- When water is warm, the water forces minerals out of solution and scale forms more readily.

IF HARDNESS IS HIGH ...

the water may have a tendency to form scale on surfaces, plumbing and equipment, especially if the water temperature is high. The only way to lower Hardness is to drain some of the water and add new source water. BioGuard® Scale Inhibitor can be added to control the formation of scale, but it will not lower the Hardness level.





IF HARDNESS IS LOW ...

the water will corrode pool equipment and plumbing and etch pool surfaces. This tendency is intensified if pH and Total Alkalinity are also low. Plaster pools are particularly susceptible since the surface itself provides a ready source of calcium for hungry water. Adding Balance Pak® 300 will raise the Hardness level in a pool.

The Saturation Index

This topic should take you approximately 30 minutes to complete.

Objectives

- Define the Saturation Index.
- Identify the results of a high or low saturation index.
- Define Total Dissolved Solids and their recommended level.
- Describe how to maintain the proper Saturation Index with BioGuard® balancing products

Topic Introduction

This topic describes:

1. The Saturation Index
2. Saturation Index Values for Calculation
3. Total Dissolved Solids
4. If Total Dissolved Solids are Too High
5. Maintaining the Proper Saturation Index

The Saturation Index

The *Saturation Index* is a way of measuring the relationship between pH, Total Alkalinity, Hardness, and temperature. It is used to determine the waters tendency to be acidic (and corrosive) or basic (and scale forming). The Saturation Index is a mathematical formula:

$$\mathbf{SI = FT + pH + FTA + FCH - 12.1}$$

Temperature, total alkalinity, and hardness are all represented by values. You can find these on the Saturation Index chart below. Once you have the sum of these values, and the pH, you always subtract 12.1* to find the Saturation Index.

Saturation Index Values for Calculation

⁰ F	FT	ppm	FCH	FTA
32	0.0	5	0.3	0.7
39	0.1	25	1.0	1.4
46	0.2	50	1.3	1.7
53	0.3	75	1.5	1.9
60	0.4	100	1.6	2.0
68	0.5	150	1.8	2.2
76	0.6	200	1.9	2.3
84	0.7	300	2.1	2.5
94	0.8	400	2.2	2.6
110	0.9	800	2.5	2.9
128	1.0	1000	2.6	3.0

*This 12.1 is based on the TDS being 1200 ppm or lower. For every 1000 ppm of TDS you should deduct an additional .1 from the SI total (example at 2000 ppm TDS you would deduct 12.2 not 12.1).

If the Saturation Index calculates to zero, the water is neither scale forming nor corrosive. A positive number means the water is tends to be scale forming. A negative number means the water tends to be corrosive. The objective is to maintain the Saturation Index within the acceptable range...

IDEAL SATURATION INDEX: + .3 TO -. 3

Total Dissolved Solids

Remember water is the *universal solvent*. Water will dissolve (put into solution) as much as it can hold. Metals, minerals, perspiration, salts, chemicals, organic waste - virtually everything water contacts - goes into solution. We refer to the entire group of dissolved substances, as *Total Dissolved Solids*. When too many solids are dissolved, several major problems can occur:

- The water becomes hazy or cloudy. Filtration is ineffective in removing substances dissolved in the water.
- It's harder for sanitizing chemicals to attack and kill bacteria and inhibit algae. The TDS get in the way.
- The pool owner adds more chemicals to fight a problem that really can't be won with chemicals.

IDEAL TDS: BELOW 2500 ppm

(OR LESS THAN 1500 ppm HIGHER THAN SOURCE WATER)

IF TOTAL DISSOLVED SOLIDS ARE TOO HIGH ...

There is only one solution...

- Check the new source water to make sure it has a lower level of TDS.
- Drain some of the pool water and add new source water.

Maintaining the Proper Saturation Index

Maintaining a Saturation Index between -0.3 and 0.3 will help keep your pool water balanced and clear. BioGuard balancing chemicals will keep the components of the Saturation Index in balance. Lo 'N Slo® can be used to bring down a high pH or total alkalinity. Balance Pak 100 will bring up a low total alkalinity while Balance Pak® 200 can raise a low pH. Calcium Hardness Increaser will maintain enough calcium hardness in the water. Working together, these balancing chemicals give the customer the tools needed to maintain proper water balance.

Key #5 - Testing

This topic should take you approximately 45 minutes to complete.

Objectives

- Define the importance of water testing.
- Identify parameters for testing.
- Identify the different methods of water testing.
- Describe the Advantages of BioGuard® ALEX.

Topic Introduction

This topic describes:

1. Key #5 – Testing
2. Testing and Correcting the Water
3. Home Testing Kits
4. BioGuard® ALEX and Accu-Scan®
5. ALEX automates the Saturation Index
6. The BioGuard Water Analysis Laboratory
7. Testing TDS and Minerals
8. Rapid Chlorine Demand Test Station

Pool Care Key #5 – Testing

Pool and spa water has chemical characteristics that must be measured regularly. Pool and spa owners have a responsibility to check two of these characteristics on a regular basis.

1. pH
2. Sanitizer

When these two factors are maintained within specified ranges, the water is probably not going to experience problems. By testing these two factors on a regular basis, a pool or spa owner can understand how bather load, weather conditions and chemical applications affect the water. By assisting customers in understanding the water's *personality* you can help them anticipate potential problems by recognizing changes in these primary tests. They should still plan on bringing in a sample of water to you (every 4-6 weeks) in order to perform a more comprehensive set of tests. This ensures that all the important parameters are in balance. Remind your customers that testing is important because water maintained in the proper test ranges will be:

- Protected from uncontrolled bacteria growth
- Clear, sparkling, inviting
- Comfortable to the eyes and skin of swimmers
- Less aggressive to pool surfaces and equipment
- Protected from growth of algae

Testing And Correcting The Water

There are two opportunities for water testing:

Home Testing – Pool and spa owners have to check key factors like sanitizer and pH regularly. Depending on the chemical treatments used and the pool's personality, the frequency of the tests could range from every day to once a week.

BioGuard® Complete Water Analysis – BioGuard® offers a series of tests that measure every factor needed to balance water. Customers should bring in a sample of pool water for testing at the beginning and end of the pool season plus every four to six weeks while the pool is open.

Home Testing Kits

Although BioGuard® provided complete water analysis, pool and spa owners must still conduct home tests of their pool or spa water at least once a week. BioGuard offers a variety of testing kits for home and professional use:

- **4 Way Strips** – Dip and read one strip that measures HOCl, HOBr, pH and TA. Unlike previous strips, these are much easier and more convenient - all tests can be read after a single dip.
- **OTO pH Test Kit**- Very popular and inexpensive test kit. OTO is used for testing chlorine residuals and phenol red is used for testing pH.
- **DPD Test Kit**- DPD #1 for FAC residual and bromine residual and phenol red for pH.
- **Multi-Test 1200V®** – Provides basic information every pool and spa owner needs for proper maintenance. The five tests include: DPD #1 for FAC residual, pH, Total Alkalinity, plus tests for Acid and Alkali Demand.

Some commercial pools and service companies require a more comprehensive test kit.

- **Professional Model** – Commercial package plus tests for iron and copper. This test kit has all but two of the tests that AccuScan® provides. Manganese and TDS are not included in this test kit.

BioGuard® ALEX and Accu-Scan®

BioGuard technology enables the water test results to be automatically entered into the ALEX program from a patented test strip-reading device called Accu-Scan. AccuScan allows the tester to perform most of the water tests currently done on the “wet” test lab. The Total Dissolved Solids test will still be performed using a separate meter. The rest of the tests, however, will be done using a test strip with the strip being read and the information recorded directly into the customers’ ALEX water analysis. The process should take approximately two to three minutes to test and record those results. Different test strips can test both halogen and biguanide pools, as well as iron and copper.



ALEX Automates the Saturation Index

When test information is entered into ALEX, the BioGuard water analysis program will take all factors into account, including product composition, and make the appropriate recommendations. The water analysis recommendations take many things into consideration, not just the results of the Saturation Index keys. ALEX considers:

- Type of pool surface.
- Type of sanitizer being used.
- Amount of oxidizer being used.
- Type of oxidizer being used.
- Amount of balance product being called for.
- The presence of metals in the water.



There is not another water analysis program in the industry with this level of intuition for making the recommendations necessary for proper pool and spa water care.

The BioGuard® Water Analysis Laboratory



The BioGuard® Table Top and Wet Labs provide an alternative testing method in your store. The lab plays a supporting role to your expertise and can be used to verify other test results. The lab makes such a positive visual impression on the customers so it's important to keep the lab and surrounding area clean and orderly. You should become quite proficient at running the tests. Most of them involve the application of chemical reagents, which react with the water. These reactions produce colors that are then compared to color standards to determine the result of the test.

In the event that your AccuScan unit stops functioning, a wet lab is necessary to continue to provide accurate water testing for customers until the AccuScan is operating properly. Wet lab test results can be entered into ALEX, the exclusive BioGuard® water analysis program. ALEX automatically checks and cross-references the related information and provides a list of treatments needed to properly treat the water.

Testing TDS and Minerals

BioGuard® is proud to introduce new technology for TDS and Minerals Testing. The Myron L Dual Range Pool Meter™. The Pool Meter provides accurate mineral readings for pools that are using the Mineral Springs program, as well as a TDS reading for any sample brought in for analysis. Simply toggle a switch to change from a mineral reading to a TDS reading. It is a self-contained unit powered by a 9-volt battery that has approximately a one-year shelf life. To ensure accuracy, the Multi-Meter needs to be calibrated on a monthly basis. For the most accurate calibration, Calibrating Solution for the meter is provided.