



# INDUSTRY PRECOURSE BASICS: YOUR GATEWAY TO THE POOL AND SPA PROFESSION

## WEEK 6B: SPA WATER CHEMISTRY LEARNER GUIDE

*Your ticket to employment*



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## INTRODUCTION

In spas, water chemistry plays a crucial role in maintaining a safe and relaxing environment. Due to their smaller water volumes and higher temperatures, spas require more frequent monitoring and adjustments than pools.

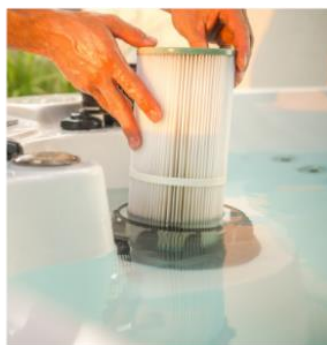
Correct chemical balance protects spa surfaces, such as jets and heaters, from scaling or corrosion.

It also ensures bather comfort by minimizing irritation to the skin and eyes while keeping water clear and free from unpleasant odours.



Spas often experience unique challenges, including rapid sanitizer depletion from high temperatures, cloudy water resulting from heavy bather loads and organic contaminants, and scaling in plumbing and jets due to elevated calcium levels.

Effective management of these factors ensures that spas remain inviting and functional.



## GLOSSARY OF TERMS

### Bromine

Bromine is a chemical sanitizer or disinfectant used to kill bacteria and algae in pool and spa water. It is effective at maintaining water clarity and sanitation but does not eliminate swimmer waste unless combined with an oxidizer. Bromine is highly susceptible to degradation by direct sunlight, making it less efficient for outdoor pools unless protected with stabilizers.

#### Ideal Concentrations:

- Pools: 2.0 to 4.0 ppm
- Spas: 3.0 to 5.0 ppm

Typically, bromine is introduced into water in the form of hypobromous acid, a compound of bromine, hydrogen, and oxygen. This form dissolves in water to sanitize it effectively. When bromine reacts with nitrogen compounds (e.g., from swimmer waste), it forms bromamines. Unlike chloramines, bromamines produce less odour and are less likely to irritate swimmers, making bromine a preferred choice for indoor pools and spas.

### Calcium Hardness

The concentration of calcium and magnesium in pool and spa water. Proper calcium hardness levels help prevent equipment corrosion and scaling. The ideal range is 200 to 400 ppm for both pools and spas.

### Calcium Hypochlorite

A type of disinfectant commonly referred to as “cal-hypo.” It is the dry form of chlorine and is available in tablet, briquette, or granular form.

- **Effect on pH:** Raises water pH from the ideal 7.5 to a higher range of 8.5 to 11. If the pH becomes too high, adding muriatic acid through the pool's circulation system can help lower it.
- **Impact on Calcium Levels:** Prolonged use may increase calcium levels, beneficial for soft water but potentially causing scaling when calcium becomes excessive.



## GLOSSARY OF TERMS

### Chlorine

A chemical used as a sanitizer and disinfectant in pool and spa water. It kills bacteria, algae, and oxidizes ammonia and nitrogen compounds such as swimmer waste.

#### **Ideal Concentrations:**

- Pools: 1.0 to 3.0 ppm
- Spas: 1.5 to 3.0 ppm

### Colorimetric tests

A test for chlorine, bromine and pH where the reagent causes a change in color when reacting with the specified chemical.

### Cyanuric acid

Cyanuric acid is a chemical stabilizer that reduces the breakdown of free chlorine in pool or spa water caused by sunlight. It helps maintain a reserve of "free available" chlorine, protecting it from UV rays and ensuring consistent sanitization.

#### **Usage in Pools and Spas:**

- Primarily used in outdoor pools due to their direct exposure to sunlight.
- Not used in spas because spas are usually covered.

#### **Presence in Chlorine Products:**

Cyanuric acid is found in certain solid chlorine sanitizers, such as trichlor and dichlor:

- Dichlor: Contains 57% cyanuric acid by weight.
- Trichlor: Contains 54% cyanuric acid by weight.

#### **Application:**

- Can be added as a supplement or used through chlorine products that already contain cyanuric acid.
- It is recommended only for outdoor pools that use chlorine as the primary disinfectant.
- Proper use of cyanuric acid ensures the longevity and effectiveness of chlorine in maintaining clean and safe pool water.

## GLOSSARY OF TERMS

### Dichlor

Dichlor (sodium dichloroisocyanurate) is a dry, fast-dissolving tablet used as a disinfectant for pools and spas. It has a nearly neutral pH of 6.7, making it suitable for applications where pH control is a concern.

#### Key Properties:

- Highly water-soluble.
- Contains cyanuric acid, providing stabilization against UV breakdown of chlorine.
- Often used for superchlorination in vinyl-lined pools to prevent damage to the liner.

#### Usage in Spas and Pools:

- Effective for spas where precise pH balance is critical.
- Commonly used in outdoor pools to maintain chlorine levels.

#### Safety Considerations:

- Dichlor is a hazardous oxidizing chemical and must be handled with care.
- Proper storage and usage instructions should always be followed to prevent accidents.

Dichlor's combination of solubility, stabilization, and moderate pH impact makes it a versatile choice for maintaining clean and balanced water in pools and spas.

### DPD

A test method for measuring chlorine or bromine levels in water. It uses a colour change indicator to separately measure free available chlorine and combined chlorine

### End-point reaction

The color change that occurs in a test sample when drops of a reagent are added. The number of drops corresponds to a measurable result.

### Free available chlorine

The active, killing form of chlorine available in pool or spa water for sanitization.



## GLOSSARY OF TERMS

<b>Lithium hypochlorite</b>	A granular chlorine disinfectant known for dissolving quickly in water, often used in pools and spas.
<b>Muriatic acid</b>	A strong liquid acid commonly used to reduce pH and total alkalinity levels in pools. Not recommended for use in spas due to its strength.
<b>OTO</b>	A test method for chlorine or bromine levels using a colour change indicator. This method does not differentiate between free available chlorine and combined chlorine.
<b>Oxidizers</b>	Oxidizers complement sanitizers by targeting pollutants such as sweat, body oils, shampoos, soap, and urine. While oxidizers work slowly and are less efficient at eliminating waste, they break down the structure of these contaminants, making them easier for sanitizers to eliminate. The sanitizers can then attack and kill the organisms.
<b>Ozone</b>	A highly reactive gas that acts as a sanitizer and oxidizer. It cannot create a sanitizer residual and requires additional disinfectants for complete sanitization.
<b>Parts per million(ppm)</b>	A unit of measurement used to quantify levels of chemicals in pool and spa water, including chlorine, bromine, total alkalinity, calcium hardness, and total dissolved solids.
<b>pH</b>	<p>A measure of the acidity or basicity of pool and spa water.</p> <p><b>Ideal Range:</b></p> <ul style="list-style-type: none"> <li>• Pools: 7.4 to 7.6</li> <li>• Spas: 7.2 to 7.8</li> </ul>
<b>Phenol red</b>	A common reagent used in pH testing, which indicates pH levels through colour changes.

## GLOSSARY OF TERMS

<b>Salt</b>	Used in saltwater systems, it produces chlorine when passed through an electrolytic cell. Each system takes a specific amount of salt depending on what brand you're working with and selling. Proper salt levels depend on the manufacturer but you can start from 1200 to 4000 ppm.
<b>Sanitizers</b>	<p>Sanitizers, also known as disinfectants, are essential for keeping pool and spa water clean and safe. They work by eliminating contaminants and preventing the growth of harmful microorganisms. To be effective, sanitizers must always be present in the water at a minimum concentration, known as a residual.</p> <p>When adding a sanitizer, ensure there is enough to kill existing contaminants and maintain a residual that neutralizes dirt, debris, and germs between treatments.</p>
<b>Sanitizers Alternative</b>	<p>While chlorine and bromine are the most common sanitizers, there are alternative methods worth considering:</p> <ol style="list-style-type: none"> <li><b>1. Ozone</b> (see ozone)</li> <li><b>2. Ionizers:</b> This system introduces silver and copper ions into the water through circulation. Ionizers are effective sanitizers but require the addition of an oxidizer for complete disinfection.</li> </ol> <p>These alternatives can enhance water care, particularly when used alongside traditional sanitizers, to achieve optimal water quality.</p>
<b>Scale formation</b>	Deposits on pool or spa walls caused by high levels of calcium hardness, total dissolved solids, pH, and total alkalinity.
<b>Shocking</b>	The process of adding a large dose of chlorine or another chemical to rapidly increase the amount of free available sanitizer, clearing contaminants and combined chlorine.
<b>Soda ash</b>	A chemical used to raise pH and total alkalinity levels in pools. Not recommended for spas.
<b>Sodium bicarbonate</b>	Commonly known as baking soda, it is used to raise pH and total alkalinity in pools and spa.



## GLOSSARY OF TERMS

### Sodium hypochlorite

Often called “liquid chlorine” widely used as a disinfectant in pools and spas.

- **Available Chlorine Content:** 10-12%
- **pH Level:** 13 (high, alkaline).

To balance, muriatic acid or CO<sub>2</sub> can be added to lower the pH.

### Test strips

Chemically treated strips that test for free and total chlorine, bromine, pH, calcium hardness, total alkalinity, and cyanuric acid.. Simply dip them into the water and read the reactions. These strips can test free available and total chlorine, bromine, pH, calcium hardness, total alkalinity and cyanuric acid.

### Titration test

A testing method for acid and base demand, total alkalinity, and calcium hardness. It involves adding drops of a reagent to achieve a colour change, correlating with a measurement.

### Total alkalinity

The buffering capacity of water, which protects against sudden pH changes.

#### Ideal Range:

- Pools: 80 to 140 ppm
- Spas: 80 to 120 ppm

### Total dissolved solids

The total concentration of dissolved materials in water.

#### Ideal Range:

- Pools: 0 to 8,000 ppm
- Spas: 0 to 2500 ppm

## GLOSSARY OF TERMS

### Trichlor

This disinfectant, commonly known as trichlor, is available in dry tablet or stick form and is introduced into pool or spa water using an erosion feeder. It is a highly effective chlorine source, but it requires careful handling due to its classification as a Class I oxidizer. Trichlor can accelerate combustion and, if contaminated, may ignite.

#### Effect on pH:

Trichlor has a low pH of 2.8–3.5, making it acidic. Regular use can lower the pH of pool or spa water, requiring adjustments with sodium carbonate or sodium sesquicarbonate to maintain a balanced pH.

#### Stabilization:

Trichlor produces cyanuric acid, which stabilizes chlorine against UV degradation. However, excessive cyanuric acid levels can reduce chlorine's effectiveness and cause water cloudiness.

#### Maintenance Tip:

To ensure proper water balance, regular testing is essential. Monitoring pH, chlorine, and cyanuric acid levels helps maintain clear, sanitized water and prevents potential issues related to overuse or imbalance.

Always follow safety guidelines when handling trichlor to ensure safe and effective use.

### Turbidity tests

Turbidity tests are used to measure the amount of cyanuric acid in pool or spa water. The test reagent creates cloudiness in the sample, and the degree of visibility (or clarity of a reference dot in the test vial) is compared to the manufacturer's chart to determine the cyanuric acid level.

### Water balance

Water balance is achieved when all key chemical elements—pH, total alkalinity, calcium hardness, and total dissolved solids—are within their recommended ranges. Maintaining this balance ensures safe, clear, and comfortable water for users.



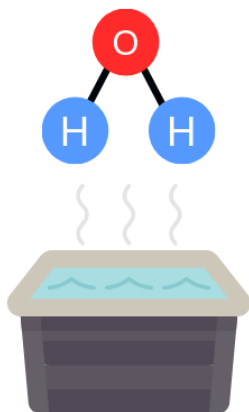
## BALANCING WATER AND ITS IMPORTANCE

### Content Overview

In order to have effective disinfection, you must make sure that your water is “balanced.” This means that all chemical parameters need to be kept within the required limits.

Water balance is critical in spas due to their unique characteristics. Small water volumes and elevated temperatures increase the risk of rapid chemical changes, making frequent testing and adjustments essential. Properly balanced water minimizes issues such as scaling, corrosion, and discomfort for users, while also preventing cloudy water and sanitizer inefficiency.

Participants will examine how pH, alkalinity, and calcium hardness interact in spas, and how they differ from pools in terms of recommended ranges and maintenance practices. Hands-on activities will allow participants to apply their knowledge by analyzing test results and making adjustments to achieve water balance.



## INTRODUCTION TO SPA WATER CHEMISTRY

Spa water chemistry is the science and art of maintaining clean, safe, and enjoyable water in a spa environment.

Unlike pools, spas present unique challenges due to their smaller water volume, higher temperatures, and higher bather loads relative to water volume.

These factors create a more reactive chemical environment, where imbalances can occur rapidly and significantly impact water quality, bather comfort, and equipment longevity.

Proper spa water chemistry management is essential for multiple reasons. Firstly, it ensures the health and safety of users by eliminating harmful microorganisms such as bacteria, fungi, and viruses, which thrive in warm, humid conditions. Secondly, it enhances the spa experience by preventing unpleasant odours, skin or eye irritation, and cloudy or foamy water.

Finally, effective water chemistry protects the spa’s mechanical components—such as pumps, heaters, and jets—from damage caused by scaling, corrosion, or biofilm buildup.

## Your ticket to employment

Key aspects of spa water chemistry include maintaining proper sanitation levels, managing pH and total alkalinity, balancing calcium hardness, and performing regular shock treatments. Unlike pools, spas require more frequent monitoring and adjustments due to their dynamic water environment.

Higher temperatures (typically between 98°F and 104°F) accelerate chemical reactions and microbial growth, while the small water volume means that contaminants introduced by users—such as body oils, sweat, and cosmetics—concentrate quickly.

In addition to these core principles, spa maintenance involves periodic water replacement, filter cleaning, and the use of tools like spa covers to reduce debris and evaporation. Advanced technologies, such as automated dosing systems and ozone or UV disinfection, can further simplify water management and enhance water quality.

Understanding and maintaining spa water chemistry not only ensures a safe and hygienic environment for users but also preserves the longevity and performance of the spa itself.

By mastering the principles of spa chemistry, spa owners can enjoy a consistently pristine and relaxing experience while minimizing maintenance challenges and costs.



## SPA WATER VOLUME AND TURNOVER

Spas operate with a significantly smaller water volume compared to pools, typically holding 200 to 500 gallons of water.

This compact size creates a highly dynamic environment for water chemistry management.

While the smaller volume allows for quicker chemical adjustments, it also means that contaminants introduced by bathers—such as body oils, sweat, and cosmetic residues—become concentrated more rapidly.

As a result, spa water requires more frequent testing, adjustments, and maintenance to ensure optimal quality.



## WATER VOLUME DYNAMICS IN SPAS

The small water volume in spas amplifies the impact of any chemical imbalance or contaminant introduction. In a pool, with its thousands of gallons of water, the effects of a single swimmer are diluted significantly. However, in a spa, where the bather-to-water ratio is much higher, even minor contributions from users can have a profound effect on water chemistry.

For example, a single bather introduces sweat, oils, and other contaminants that can rapidly alter pH levels, consume sanitizers, and contribute to organic buildup. This dynamic environment necessitates careful monitoring and frequent chemical adjustments. Spa owners must test water chemistry regularly—daily or after each use—to ensure that sanitizer levels, pH, alkalinity, and other parameters remain within the recommended ranges. Automated chemical dosing systems can help manage these frequent adjustments by delivering precise amounts of chemicals to maintain balance.



## TURNOVER RATE AND CIRCULATION IN SPAS

The turnover rate—the time it takes for all the water in a spa to pass through the filtration system—is a critical factor in maintaining water clarity and hygiene. Due to their small volume, spas achieve a much faster turnover rate compared to pools. On average, spa water circulates through the filtration system every 15 to 20 minutes, compared to the 6–8 hours typical for pools. This rapid turnover ensures that contaminants are continuously removed and chemicals are evenly distributed throughout the water.

Efficient circulation is vital for preventing localized imbalances in water chemistry. Poor circulation can lead to "dead zones," where water stagnates, potentially fostering microbial growth and reducing sanitizer effectiveness. To maintain proper circulation, spas rely on high-performance pumps and filters, often using cartridge filters due to their efficiency and ease of maintenance. These filters must be cleaned weekly, or more frequently in heavily used spas, to prevent clogging and ensure optimal water flow.

Return jets also play a critical role in spa circulation. Strategically placed jets ensure that filtered water re-enters the spa evenly, preventing stagnation and promoting thorough mixing of chemicals. Spa owners should regularly inspect jets and circulation systems to ensure they are functioning correctly and efficiently.



## CHALLENGES OF HIGH TURNOVER RATES

While a high turnover rate improves water quality and clarity, it also accelerates the degradation of chemicals, particularly sanitizers like chlorine and bromine. Elevated spa temperatures, typically between 98°F and 104°F, further exacerbate this issue, as they increase the rate of chemical reactions. As a result, spa owners must frequently monitor and replenish sanitizers to maintain effective levels.



## PRACTICAL TIPS FOR MANAGING SPA WATER VOLUME AND TURNOVER

**Frequent Testing:** Test water chemistry daily or after each use to address rapid changes in pH, alkalinity, and sanitizer levels.

**Filter Maintenance:** Clean cartridge filters weekly to ensure efficient removal of debris and contaminants.

**Circulation System Checks:** Regularly inspect pumps, jets, and plumbing to ensure proper water flow and mixing.

**Sanitizer Replenishment:** Maintain sanitizer levels within the recommended range (3–5 ppm for chlorine or bromine) to prevent microbial growth.

**Shock Treatments:** Perform regular shock treatments to oxidize organic matter and restore sanitizer effectiveness.

### Conclusion

The small water volume and rapid turnover rate in spas create a unique set of challenges for water chemistry management.

While the compact size allows for quicker chemical adjustments, it also demands more frequent testing, monitoring, and maintenance.

By prioritizing efficient circulation, diligent testing, and routine cleaning, spa owners can maintain a safe, clean, and enjoyable environment for users while protecting the longevity of their spa components.





## SPA WATER TEMPERATURE

The temperature of spa water plays a crucial role in chemical stability, microbial control, and overall user comfort. Unlike pools, which are typically maintained between 78°F and 82°F (26°C to 28°C), spas operate at significantly higher temperatures, ranging from 98°F to 104°F (37°C to 40°C).

This elevated temperature creates a relaxing and therapeutic environment for users but also introduces unique challenges in spa maintenance and water chemistry management.

### Impact of High Temperatures on Chemical Stability

If temperatures are extremely high, scalding can occur in a spa.

Warm water accelerates chemical reactions, leading to faster degradation of sanitizers like chlorine and bromine.

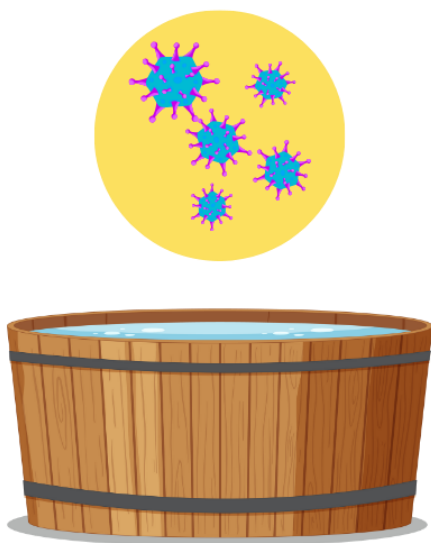
Chlorine, in particular, becomes less stable at high temperatures, dissipating quickly and requiring more frequent replenishment to maintain the recommended levels of 3 to 5 ppm.

Bromine, which is more stable under these conditions, is often preferred for spas due to its ability to remain effective across a broader pH range and elevated temperatures.

The high temperature also affects pH stability, as warm water tends to cause pH levels to rise more rapidly. This fluctuation increases the risk of scaling on spa surfaces and equipment if pH is not carefully managed.

To combat these issues, frequent testing and adjustments of pH, alkalinity, and sanitizer levels are essential in spa maintenance.





## **MICROBIAL GROWTH AND ELEVATED TEMPERATURES**

While the warmth of spa water enhances relaxation, it also provides ideal conditions for microbial growth.

Bacteria, such as *Pseudomonas aeruginosa*, thrive in these temperatures, increasing the risk of skin infections and other waterborne illnesses.

The elevated temperature also opens the skin's pores, making bathers more susceptible to irritation or infection from contaminants in the water.

To address this heightened microbial risk, spas require robust sanitation practices. Sanitizer levels must be maintained.

## **INTRODUCTION TO SANITIZERS AND TESTING WATER**

### **Content Overview**

Sanitizers in spas play a similar role to those in pools but require more precise management due to the smaller water volume and higher temperatures. Chlorine and bromine are the most common sanitizers used in spas, but alternative systems such as UV and ozone can also enhance water quality by reducing chemical use.

Maintaining sanitizer levels in spas is critical, as low levels increase the risk of microbial growth, while high levels can cause skin and eye irritation. Spas also face additional challenges from organic contaminants like sweat, body oils, and lotions, which deplete sanitizers rapidly. Participants will learn best practices for managing these issues, including the use of shock treatments to restore sanitizer levels and oxidize organic matter.

Interactive activities will allow participants to practice testing sanitizer levels, diagnosing issues, and implementing corrective actions to maintain safe and comfortable spa environments.



## TESTING THE WATER

It is ideal that each licensed pool or spa have a diethyl-p-phenyldiamine (DPD) test kit. Keep these guidelines in mind when using the test kit.

**Read directions.** Not all test kits are the same. Before using your test kit, read all directions.

**Store in cool, dark place.** The testing chemicals in some kits have an adverse reaction to high or low temperatures and light. Keeping the kit closed and in a cool area will help the chemicals remain accurate.

**Keep equipment clean.** Debris, dust, or foreign chemicals may cause the testing equipment to give a false reading. Keep the kit closed when not in use.

**Do not mix test kits.** Some kits use different reagents or different strengths of reagents. You should only use the reagents made for your kit and follow the testing directions for that kit.



**Replace reagents yearly.** The reagents used in testing can go bad, so replacing them yearly will ensure that they will work accurately, with proper care. Read the directions for your kit to see if you need to replace the reagents more often.

You must be able to measure these factors:

- Chlorine (or bromine)
- pH
- Total alkalinity
- Cyanuric acid
- Water temperature
- Clarity

## TIPS WHEN TESTING THE WATER

When testing your pool or spa, remember these helpful tips:

- Test pools upon opening and at least once every four hours.
- Spas and pools with automatic chemical controllers must be manually tested every 12 hours and prior to opening.
- Take water sample away from inlets and outlets.
- Make sure all chemical treatments have completely dissolved and mixed.
- Test logs must be kept on file for at least 2 years.
- Calibrate your thermometer regularly to ensure accurate readings.

If water is not tested and properly balanced, the chance for growth of a waterborne illness in the water is increased.



## SPA SANITIZERS

Sanitization is a critical aspect of spa water maintenance, ensuring that the water remains clean, safe, and inviting for users.

The unique conditions of spas—higher temperatures, smaller water volumes, and higher bather loads relative to volume—require sanitization systems tailored to this environment.

Proper sanitization eliminates harmful microorganisms, such as bacteria, fungi, and viruses, which thrive in the warm, humid conditions of spa water.

While chlorine is a traditional sanitizer, bromine is often preferred for spas due to its stability at higher temperatures and broader pH tolerance.

Alternative systems like ozone and UV disinfection also play a role in enhancing spa sanitization.

## BROMINE: THE PREFERRED SANITIZER FOR SPAS

Bromine is widely regarded as the most effective sanitizer for spas due to its superior performance in high-temperature environments. Unlike chlorine, which can degrade rapidly at elevated temperatures, bromine remains stable and effective in the typical spa range of 98°F to 104°F (37°C to 40°C). Bromine also performs well across a broader pH range, from 7.0 to 8.5, making it more forgiving in the fluctuating conditions of spa water.

Bromine operates by breaking down into hypobromous acid (HOBr) and bromide ions in water. Hypobromous acid actively destroys microorganisms by disrupting their cell walls, effectively neutralizing bacteria, viruses, and fungi. Bromine also produces fewer odours compared to chlorine, enhancing the user experience by reducing the chemical smell often associated with pool sanitization.

To maintain effective sanitization, bromine levels in spas should be kept between 3 and 5 parts per million (ppm). These levels ensure that the water is safe for bathers while preventing microbial growth. Bromine tablets, often used with floating dispensers or built-in feeders, provide a convenient and consistent method of dosing.

Regular testing is essential to ensure levels remain within the recommended range.





## CHLORINE: A VERSATILE SANITIZER

Chlorine, though more commonly associated with pools, is also an effective sanitizer for spas when managed correctly. It operates by forming hypochlorous acid (HOCl) in water, which is highly effective at neutralizing harmful microorganisms and oxidizing organic contaminants.

Chlorine levels in spas should also be maintained between 3 and 5 ppm to ensure safety and effectiveness.

However, chlorine's performance diminishes at higher temperatures, where it degrades more quickly, necessitating frequent testing and adjustments.

Chlorine is also more sensitive to pH fluctuations, with its efficacy significantly reduced as pH rises above 7.8. These factors make bromine a more convenient choice for most spa owners, but chlorine remains a viable option for those who prefer it.

## CHALLENGES OF SANITIZATION IN SPAS

The warm water and small volume of spas present unique challenges for sanitization:

**Rapid Contaminant Build-Up:** High bather loads introduce sweat, body oils, lotions, and other organic contaminants, which can quickly deplete sanitizer levels.

**Chloramines and Bromamines:** When chlorine or bromine reacts with organic contaminants, it forms chloramines or bromamines, which are less effective as sanitizers and contribute to unpleasant odours. Regular shocking of the spa water helps break these down and restore sanitizer efficiency.

To address these challenges, spa owners should conduct regular shock treatments using oxidizers like potassium monopersulfate (non-chlorine shock) or calcium hypochlorite.

These treatments eliminate organic contaminants, restore sanitizer effectiveness, and prevent odours.



## ALTERNATIVE SANITIZATION SYSTEMS

In addition to chlorine and bromine, several alternative systems can complement or partially replace traditional chemical sanitizers in spas:

### 1. Ozone Generators

Ozone ( $O_3$ ) is a powerful oxidizer that eliminates microorganisms and organic contaminants.

Ozone generators inject ozone gas into the spa water, providing strong disinfection without adding residual chemicals.

While highly effective, ozone does not leave a residual sanitizer in the water, so a small amount of bromine or chlorine is still needed for long-term protection.



### 2. UV Disinfection Systems

Ultraviolet (UV) systems use high-intensity light to kill microorganisms by disrupting their DNA.

Water passes through a UV chamber, where harmful bacteria, viruses, and algae are neutralized.

Like ozone, UV systems are excellent secondary sanitizers but do not provide residual protection, necessitating the use of chlorine or bromine.



### 3. Mineral-Based Systems

Mineral systems release ions such as silver and copper, which have natural antimicrobial properties.

These systems reduce the need for high concentrations of traditional sanitizers.

Mineral sanitization is often used in combination with bromine or chlorine for added protection and balance.







## CHOOSING THE RIGHT SANITIZER FOR YOUR SPA

Selecting the best sanitizer for a spa depends on several factors, including:

**Usage Patterns:** Heavily used spas may require bromine for its stability under demanding conditions.

**User Preferences:** Bromine's reduced odour and gentler impact on skin and eyes make it a popular choice for spa enthusiasts.

**Budget and Maintenance:** Traditional chlorine is often more affordable, but alternative systems like ozone or UV may reduce long-term chemical costs.

Regular testing of water chemistry is essential regardless of the sanitizer chosen. Automated dosing systems, test kits, and digital meters can simplify this process, ensuring consistent and accurate measurements.

## Conclusion

Sanitization is the backbone of spa maintenance, protecting users from harmful microorganisms and ensuring a clean, enjoyable environment. While bromine is the preferred choice for its stability and convenience in high-temperature conditions, chlorine and alternative systems also have their place depending on individual needs and preferences. By maintaining proper sanitizer levels and integrating complementary systems like ozone or UV, spa owners can achieve pristine water quality and a superior spa experience.

## REGULAR TESTING AND MAINTENANCE FOR SPA WATER QUALITY

Regardless of the sanitization system used, regular testing and maintenance are crucial to maintaining a clean, safe, and inviting spa environment. Effective water treatment begins with frequent monitoring of key chemical parameters, ensuring that the spa water is balanced and free from harmful contaminants.

Testing Recommendations:

- Test spa water chemistry at least twice a week to monitor sanitizer levels, pH, total alkalinity, and stabilizer concentrations.
- Use tools like automatic chemical controllers or testing kits for real-time data and accurate adjustments.

By prioritizing regular testing, spa owners can prevent common issues like cloudy water, scaling, or sanitizer inefficiency, ensuring a safe and enjoyable experience for users.

## IMPORTANCE OF PH AND ALKALINITY IN SPA WATER MAINTENANCE

Maintaining proper pH and total alkalinity is vital for swimmer comfort, sanitizer efficiency, and the protection of spa surfaces and equipment. These factors are interconnected and directly influence the overall water quality.

### pH: The Foundation of Water Chemistry

pH measures the acidity or alkalinity of water on a scale from 0 to 14, with 7 being neutral. The ideal pH range for spa water is 7.4 to 7.6, as it aligns with the natural pH of human skin and eyes.

### Why pH Matters:

- **Swimmer Comfort:** Prevents eye and skin irritation.
- **Sanitizer Efficiency:** Ensures chlorine and other sanitizers work effectively.
- **Equipment Protection:** Prevents corrosion or scaling of spa surfaces and components.



### Consequences of pH Imbalance:

#### Low pH (Acidic Water):

- Corrosion of metal components (e.g., jets, heaters)
- Surface damage, leading to rough textures
- Increased sanitizer consumption
- Irritation to skin and eyes

#### High pH (Alkaline Water):

- Calcium scaling on surfaces and equipment
- Cloudy water, reducing visual appeal
- Reduced effectiveness of sanitizers

### Total Alkalinity: A pH Buffer

Total alkalinity (TA) measures the concentration of alkaline substances, such as bicarbonates, that stabilize pH levels. The recommended TA range for spas is 80–120 ppm.



## BENEFITS OF PROPER ALKALINITY LEVELS

- Prevents sudden pH fluctuations.
- Protects spa surfaces and components from corrosion or scaling.
- Enhances the effectiveness of sanitizers.

## ADJUSTING PH AND ALKALINITY

Regular adjustments are essential to keep spa water balanced. Here's how to manage pH and alkalinity effectively.

### Raising pH:

Use sodium carbonate (soda ash) to increase pH without significantly affecting alkalinity.

### Lowering pH:

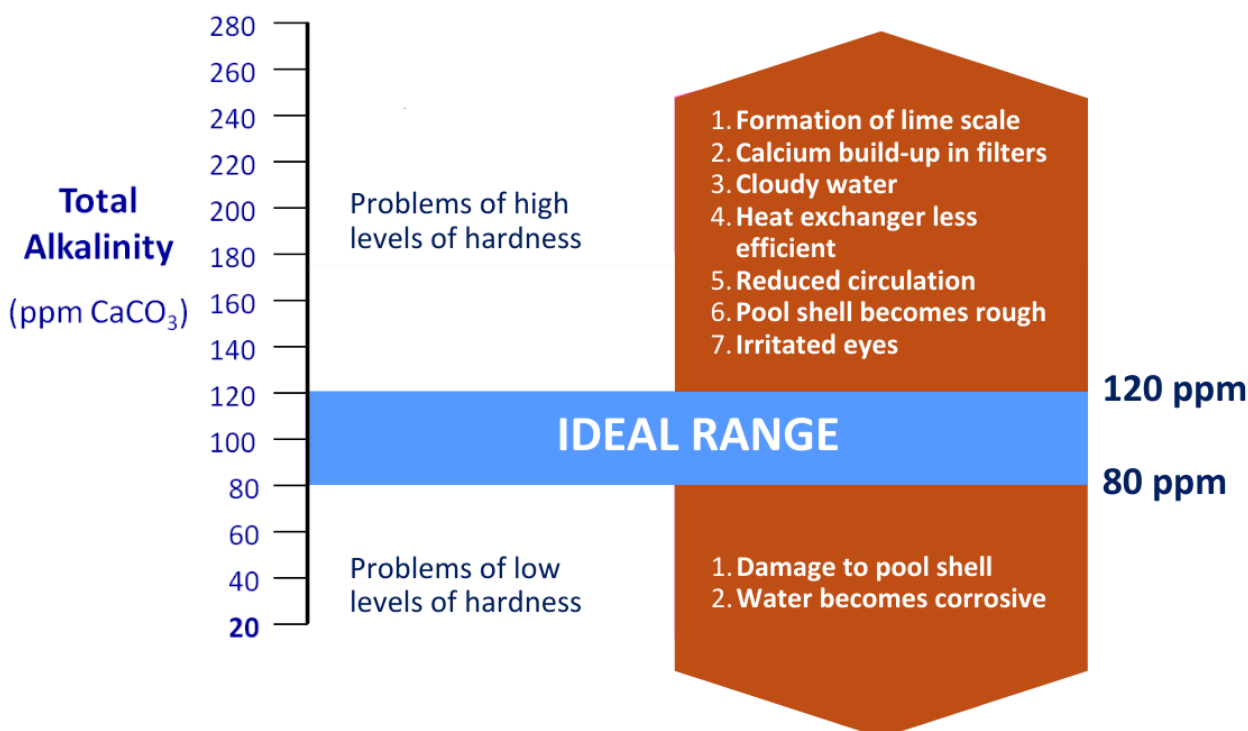
Use muriatic acid or sodium bisulfate (dry acid) to lower pH and alkalinity.

### Increasing Alkalinity:

Add sodium bicarbonate (baking soda) to raise TA without drastically altering pH.

### Decreasing Alkalinity:

Apply muriatic acid in small, calculated doses, following the "acid demand" process to avoid overcorrection.



## BALANCING PH AND ALKALINITY TOGETHER

pH and alkalinity are interdependent:

- Raising alkalinity often slightly increases pH.
- Lowering alkalinity with acid may decrease pH, requiring subsequent pH adjustments.

**Pro Tip:** Automated chemical controllers are highly effective in managing these interdependencies, making real-time adjustments to maintain balance.



- Retest water after making chemical adjustments to confirm desired levels.
- Consider professional servicing for periodic deep cleaning and equipment inspection.

## BEST PRACTICES FOR MONITORING AND MAINTENANCE

To ensure optimal water quality:

- Test spa water twice a week for residential spas; commercial spas may require daily testing.
- Use digital testing devices for more precise readings.



## CALCIUM HARDNESS: ESSENTIAL FOR SPA WATER MAINTENANCE

Calcium hardness is a critical element of spa water chemistry, ensuring the protection of surfaces and equipment while maintaining water clarity and swimmer comfort.

Proper calcium hardness management helps prevent scaling and corrosion, which can lead to costly repairs or maintenance. For spas, the recommended calcium hardness range is typically 150-250 ppm, slightly lower than pools due to the higher water temperatures in spas.



## What Is Calcium Hardness?

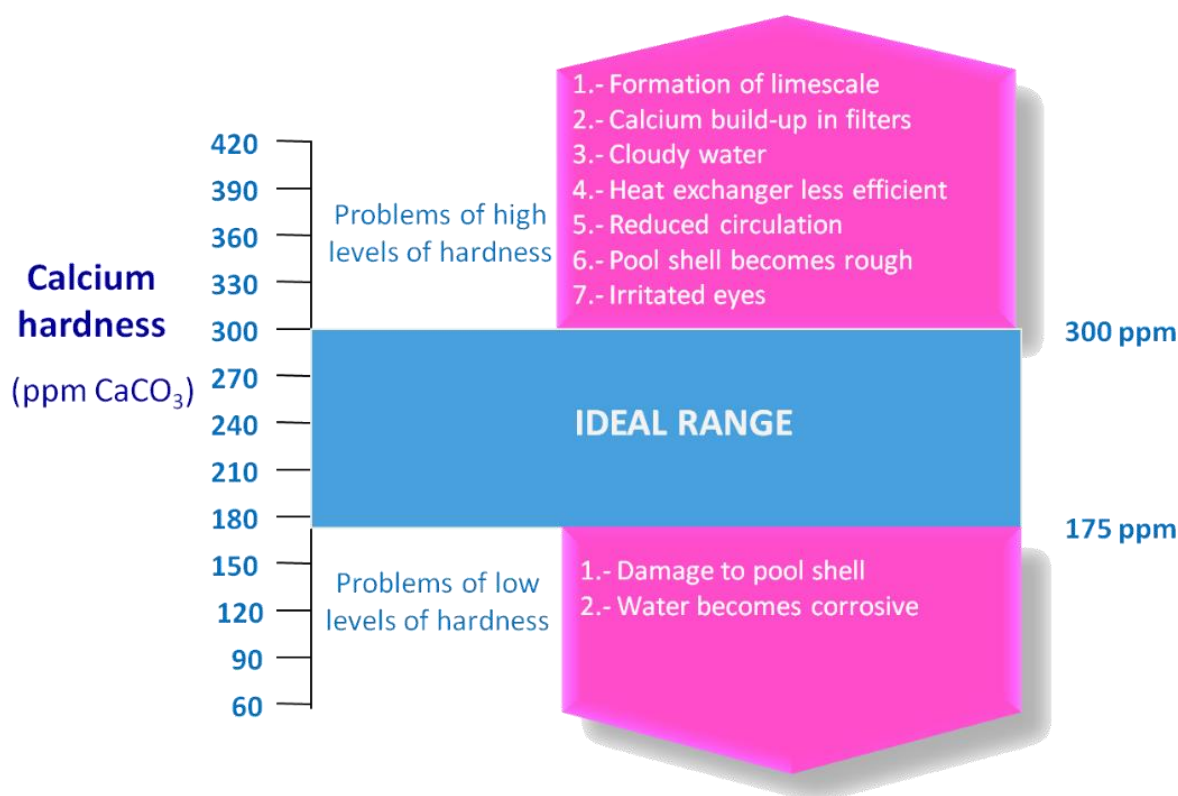
Calcium hardness measures the concentration of dissolved calcium ions in water, determining whether the water is "hard" or "soft."

Balanced calcium hardness levels help maintain water quality, prevent equipment damage, and ensure user comfort.

## Why It's Important

**Low Calcium Hardness (Soft Water):** Water lacking calcium becomes aggressive, leading to corrosion of spa surfaces, plumbing, and metal fixtures.

**High Calcium Hardness (Hard Water):** Excess calcium causes scaling, creating rough deposits on spa surfaces and clogging plumbing and equipment.



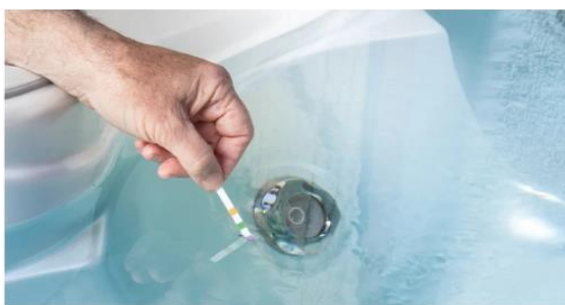
## The Effects of Imbalanced Calcium Hardness

### Low Calcium Hardness (<150 ppm):

- **Corrosion:** Soft water dissolves calcium from plaster, tile grout, and other surfaces, causing etching and pitting.
- **Damage to Fixtures:** Metal parts like jets, heaters, and pumps may corrode, reducing their lifespan.
- **Water Imbalance:** Stabilizing pH and alkalinity becomes difficult, leading to further chemical issues.

### High Calcium Hardness (>250 ppm):

- **Scaling:** Excess calcium precipitates as scale, forming a chalky residue on surfaces, heaters, and plumbing.
- **Cloudy Water:** High calcium can cause water to appear murky.
- **Efficiency Loss:** Scaling reduces heater efficiency and clogs spa jets and pipes.



## Adjusting and Maintaining Calcium Hardness

### Testing:

Test calcium hardness levels weekly, especially in spas with frequent use or in areas with naturally hard or soft water. Use liquid reagent kits or digital testing devices for accurate measurements.

### Adjustments:

#### Raising Calcium Hardness:

Add calcium chloride to increase hardness levels. Calculate the required dose based on spa volume and current calcium levels.

#### Lowering Calcium Hardness:

**Dilution:** Drain a portion of the spa water and refill with fresh water with a lower calcium concentration. Consider using a water softener for refills in areas with hard water.



## Preventing Calcium-Related Issues

### 1. Monitor Water Chemistry

Test pH, alkalinity, and temperature regularly, as they influence calcium behaviour.

Maintain pH (7.4-7.6) and total alkalinity (80-120 ppm) to reduce scaling and corrosion risks.

### 2. Control Evaporation

Use a spa cover to minimize evaporation, which concentrates calcium levels in the remaining water.

### 3. Clean Regularly

Remove scale deposits promptly using spa-safe descalers to maintain appearance and performance.

## Interplay with Other Chemical Parameters

Calcium hardness interacts with pH, alkalinity, and temperature to influence overall water balance. For instance:

- **High pH or alkalinity:** Increases the risk of scaling.
- **Low pH:** Amplifies the corrosive effects of soft water.



**High temperature:** Promotes calcium precipitation, making spas more susceptible to scaling than pools.

Understanding and managing these relationships ensures a balanced and healthy spa environment.

## Summary

Calcium hardness management is vital for maintaining spa water quality and protecting surfaces and equipment.

By keeping calcium levels within the recommended range of 150-250 ppm, regularly testing water, and making appropriate chemical adjustments, spa owners can prevent scaling and corrosion while ensuring a safe and comfortable experience for users.

## SHOCK TREATMENTS IN SPA MAINTENANCE

Shock treatments are a vital part of spa maintenance, ensuring water remains clean, safe, and inviting for users. These treatments involve the application of a concentrated dose of an oxidizing agent, such as chlorine or a non-chlorine alternative, to the spa water.

The primary goals of shock treatments are to oxidize organic matter, eliminate chloramines, and restore sanitizer levels.

By incorporating shock treatments into a regular maintenance routine, spa owners can prevent water quality issues, protect equipment, and enhance the overall spa experience.

Shock treatments are especially important for managing the buildup of organic contaminants like body oils, lotions, and sweat, which accumulate in spa water over time.

These materials consume sanitizers and reduce their effectiveness, potentially leading to cloudy water or unpleasant odours. Shock treatments break down these contaminants, ensuring the water remains clean and clear.



Additionally, chloramines, which are byproducts of chlorine reacting with organic compounds, can cause eye and skin irritation and are responsible for the strong “chlorine smell” often associated with spas.

Shock treatments oxidize chloramines, restoring free chlorine levels and creating a more comfortable environment for users.

Algae growth is another concern that shock treatments address effectively. Warm spa water creates an ideal environment for algae to thrive, particularly if sanitizer levels drop or pH becomes imbalanced.

By delivering a concentrated dose of oxidizer, shock treatments destroy algae, preventing water from becoming cloudy or green. This not only ensures clear water but also reduces the risk of more severe algae blooms, which can be costly and time-consuming to eliminate.



## Definition

Superchlorination, often called “shocking,” is a method of adding a larger dose of chlorine. This dose should be 10 times the amount of combined chlorine, subtracting the existing free chlorine, to achieve breakpoint chlorination. This results in the elimination of combined chlorine and increases the free chlorine level. Free chlorine is 25 times more effective than combined chlorine. Therefore, superchlorination causes a decrease in bacteria and algae growth.

**Combined Chlorine x 10 - Existing Free Chlorine = Break Point**

During swimming season, superchlorinate as needed when the combined chlorine level exceeds 0.4 ppm. At all times, combined chlorine levels should remain below 1.0 ppm.

Because free chlorine levels above 5 ppm can cause irritation to swimmers, swimming should be limited until the free chlorine level drops below 5 ppm.



It is best to superchlorinate after hours to allow the disinfectant to properly circulate. If there is a fecal-related accident at your spa, close and shock the spa.

## Purpose of Shock Treatments in Spas

### 1. Oxidizing Organic Matter

Organic contaminants like body oils, lotions, and sweat accumulate in spa water, consuming sanitizer and causing water clarity issues. Shock treatments break down these materials, keeping the water clean and clear.

### 2. Eliminating Chloramines

Chloramines form when chlorine reacts with organic compounds, causing eye and skin irritation and a strong “chlorine smell.” Shock treatments oxidize chloramines, restoring free chlorine levels and enhancing water comfort.

### 3. Preventing and Combating Algae Growth

Warm spa water creates an ideal environment for algae growth, especially when sanitizer levels drop. Shock treatments deliver a high dose of oxidizer, destroying algae and preventing cloudy or green water.



## Types of Shock Treatments

### 1. Chlorine-Based Shocks

#### a) Calcium Hypochlorite:

Releases a high concentration of free chlorine for rapid sanitization and oxidation.

#### b) Sodium Hypochlorite (Liquid Chlorine):

Effective for oxidizing contaminants and killing pathogens.

### 2. Non-Chlorine Shocks

#### Potassium Monopersulfate:

A chlorine-free alternative ideal for spas with light usage or when immediate re-entry is required. It oxidizes organic contaminants without increasing chlorine levels.

## How to Perform a Shock Treatment in Spas

### 1. Test Water Chemistry

- Ensure pH is in the optimal range of 7.2–7.4, as chlorine works most effectively at this level.
- Measure sanitizer levels and assess the need for shock.

### 2. Add the Shock Product

- Calculate the correct dose based on the spa's volume and product instructions.
- Distribute the shock evenly across the water's surface to ensure proper coverage.

### 3. Run the Circulation System

- Keep the spa pump and jets running to mix the chemicals thoroughly and speed up oxidation.

### 4. Wait for Safe Chlorine Levels

- Allow chlorine levels to return to the safe range of 1–3 ppm before allowing bathers to re-enter the spa. Depending on the type of shock, this may take several hours or overnight.



## Benefits of Shock Treatments

### 1. Prevents Common Problems:

Reduces algae growth, cloudy water, and unpleasant odours.

### 2. Improves Water Comfort:

Eliminates irritants like chloramines, enhancing the spa experience.

### 3. Protects Equipment:

Reduces buildup of contaminants, prolonging the life of filters, pumps, and heaters.

### 4. Maintains Hygiene Standards:

Essential for high-usage or commercial spas to ensure health and safety compliance.



## Special Considerations for Spa Shock Treatments

**High Temperatures:** Spa water is often warmer than pool water, which can accelerate chemical reactions. Always monitor chemical levels closely.

**Non-Chlorine Alternatives:** Ideal for frequent use, as they allow bathers to re-enter the spa shortly after treatment.

**Regular Testing:** Monitor pH, alkalinity, and sanitizer levels regularly to ensure the effectiveness of shock treatments.

## Summary

Shock treatments are a critical component of spa maintenance, ensuring clean, safe, and inviting water for users. These treatments involve applying a concentrated dose of an oxidizing agent, such as chlorine or non-chlorine products, to the spa water. The primary purposes of shock treatments are to oxidize organic matter, eliminate chloramines, and restore sanitizer levels.



## Your ticket to employment

Regular shock treatments prevent water quality issues, safeguard user health, and extend the life of spa equipment.

There are two main types of shock treatments used in spas. Chlorine-based shocks, such as calcium hypochlorite or sodium hypochlorite, are highly effective for oxidizing organic contaminants and killing pathogens. Calcium hypochlorite releases a high concentration of free chlorine upon dissolving, providing rapid sanitization. Non-chlorine shocks, such as potassium monopersulfate, offer an alternative that does not raise chlorine levels. These are particularly beneficial for spas with light usage or when immediate re-entry into the water is desired.

The frequency of shock treatments depends on several factors, including how often the spa is used, the number of bathers, and environmental exposure. As a general rule, spas should be shocked weekly to maintain water clarity and prevent the buildup of contaminants. However, after heavy use or exposure to significant organic matter, such as sunscreen or debris from the environment, an additional shock treatment may be necessary. Weather events, such as rainstorms, can introduce pollutants that dilute sanitizer levels and fuel algae growth, requiring immediate action.



Performing a shock treatment involves a few key steps. First, it is essential to test the water to determine the current levels of pH, chlorine, and alkalinity. The pH level should be adjusted to the optimal range of 7.2 to 7.4 before applying the shock treatment, as chlorine is most effective within this range. The correct amount of shock product should then be measured based on the spa's volume and the severity of the contamination. The treatment should be distributed evenly across the water surface, and the spa's circulation system should be running to ensure thorough mixing and to expedite the oxidation process.

After applying the shock treatment, it is important to allow time for chlorine levels to return to a safe range, typically between 1 and 3 parts per million (ppm), before allowing users to re-enter the spa. This waiting period can range from several hours to overnight, depending on the type of shock used and the initial water conditions.



## Your ticket to employment

Non-chlorine shocks, in particular, allow for quicker re-entry, making them a convenient choice for spas with frequent use.

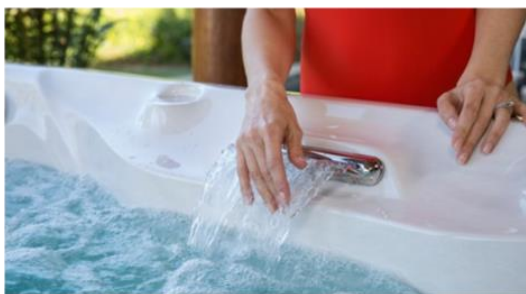
Regular shock treatments provide numerous benefits for spa maintenance. By addressing contaminants, chloramines, and algae, these treatments keep water clear and free of odours.

They also reduce strain on spa equipment, such as filters and pumps, by preventing the buildup of debris that can clog or damage these components.

For commercial or public spas, shock treatments are essential for meeting health and safety standards, ensuring a safe and hygienic environment for users.

In conclusion, shock treatments are a critical element of spa maintenance, contributing to clean, safe, and enjoyable water. By oxidizing organic matter, eliminating chloramines, and restoring sanitizer levels, shock treatments prevent common water quality issues and extend the life of spa equipment.

When performed regularly and correctly, these treatments support the long-term health and functionality of the spa, enhancing the experience for all users.



## SANITATION IN SPAS

### Chlorination

This is the most used method of sanitation today. Bromine and iodine are other members of the halogen family of chemicals also used to sanitize water. Other chemicals include ozone, silver and copper compounds. Ultraviolet light is a nonchemical disinfectant.

All chlorine, regardless of whether it is introduced as a gas or as a dry or liquid compound when added to water, does exactly the same thing: it forms hypochlorous acid (HOCl) and hypochlorite ions (OCl<sup>-</sup>).

HOCl is the killing form of chlorine; OCl<sup>-</sup> is relatively inactive. However, together, they are free available chlorine (FAC).

HOCl is an extremely active, powerful chemical. It not only destroys such harmful organisms as bacteria, algae, fungi, viruses, etc., it also destroys impurities that are not removed by filtration.

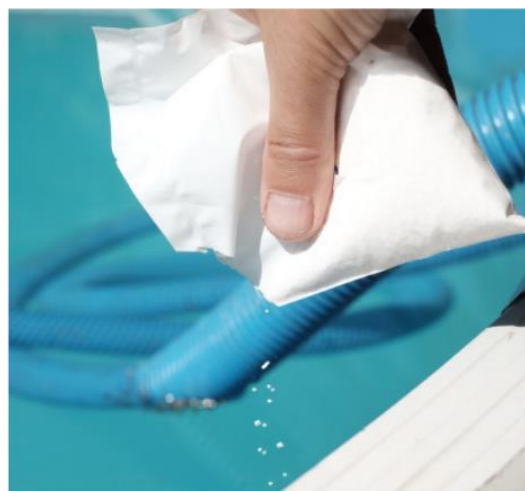
## Sanitation

Sanitation is the process of destroying organisms that are harmful to people. These organisms, referred to as pathogens, include bacteria, fungi, viruses, etc. Chlorination also controls algae (which are not usually harmful themselves, but may harbor pathogenic organisms). In addition to being unsightly, algae can cause the surfaces around the pool to become slippery and unsafe.

While each of these organisms may require different amounts of HOCl for control, local health officials often establish the required amount for public spas. Very often, local codes will specify an FAC residual of 1.0 -3.0 parts per million (ppm), but some might vary from this.

## Oxidation

Oxidation is the process of chemically removing organic debris, such as body waste, particulate matter and perspiration, from the water.



The process is similar to burning trash in air. It is not important to understand the chemistry involved; it is sufficient to know that enough chlorine in water will chemically “burn” impurities.

The use of chlorine to clean up water is a supplement to filtration.

Filters remove the dirt and debris suspended in water, but even the best filter cannot remove dissolved impurities because they are not physically separate from the water.

If the water looks dull or hazy, even though the filter system is operating properly, the operator should consider a shock treatment to oxidize the organic impurities and restore the clarity of the water.

Although there are some non-chlorine shock treatments available, the most common method used to shock water is superchlorination.



## NEXT STEPS

Now that you have finished reading this Learner Guide, follow these steps to continue your learning:

### **Complete Your Action Plan**

Refer to your journal and document your key takeaways.

Outline how you will apply this knowledge in practice.

### **Prepare for the Knowledge Exam**

Review the exam section to understand the format and expectations.

Ensure you have covered all key concepts before attempting the exam.

### **Complete the Practical Exam Tasks**

Refer to the practical exam section for task instructions.

Follow the guidelines to demonstrate your skills effectively.

*If you have any questions, refer back to the manual or seek assistance from your trainer.*