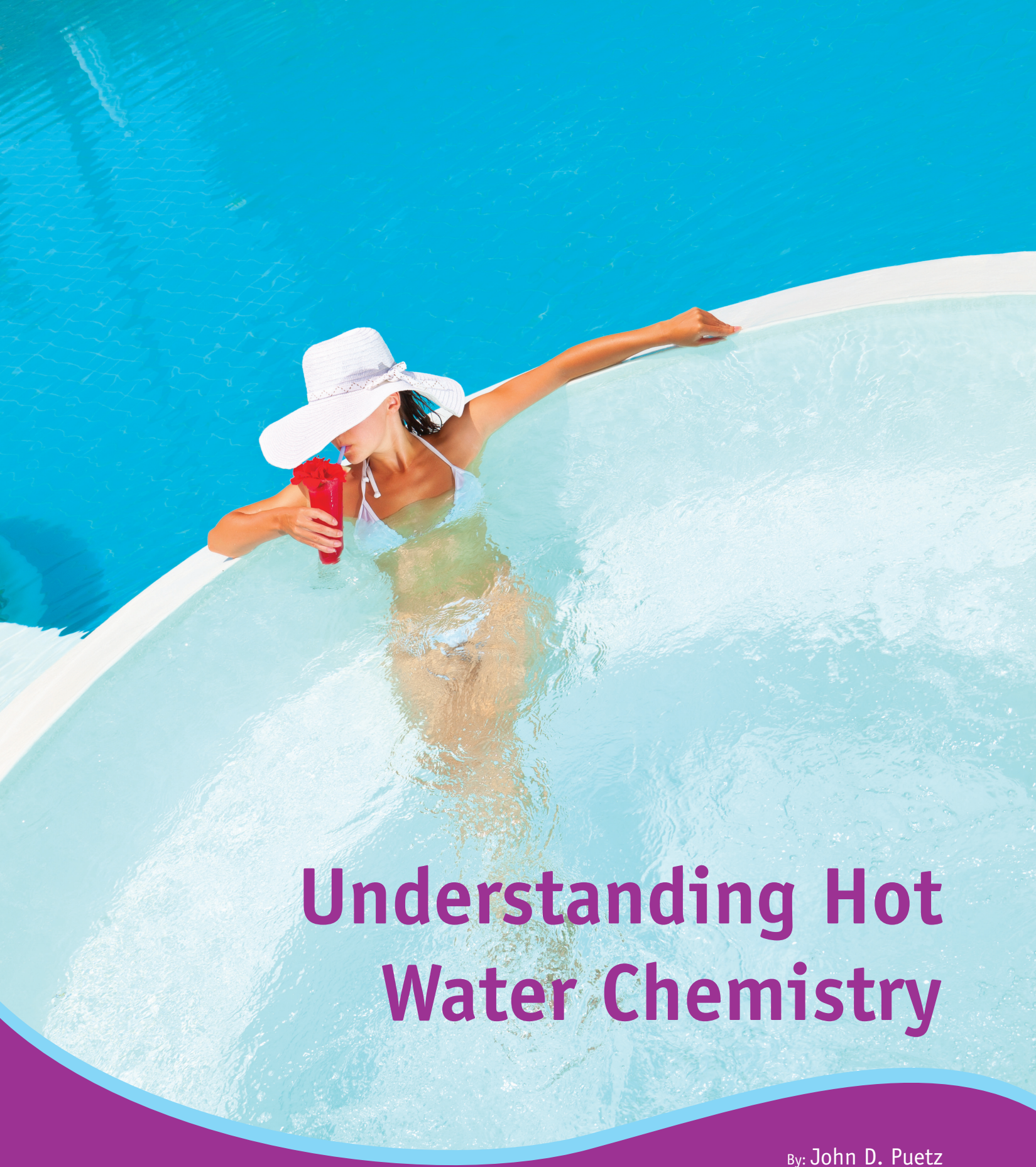


Understanding Hot Water Chemistry

By: John D. Puetz
Director of Technology
Advantis Technologies
A Lonza Business

About the Author

John Puetz is the Director of Technology for Advantis Technologies, now a part of Lonza.

Having served for more than 35 years in the pool and spa industry, John has been a flagship member of the Advantis development team and has been instrumental in bringing many of its most innovative products to the marketplace.

In addition to his duties with Advantis, John conducts pool and spa water chemistry seminars throughout the country for retailers, industry groups and health department personnel.

John has also served on numerous advisory panels throughout the industry including:

- Member, Board of Directors, National Swimming Pool Foundation
- Past Chairman of the NSPI (National Spa & Pool Institute) Technical Council
- Past Chairman of the NSPI Chemical Treatment & Process Committee

About Advantis

Advantis Technologies, part of the Lonza Microbial Control ProDealer Channel, produces some of the most popular pool and spa water care products on the market today in its Alpharetta, GA plant. From the industry's first non-chlorine shock, GLB® Oxy-Brite® non-chlorine shock oxidizer, to the latest in enzyme products and chlorine-free spa care, Advantis has always been on the cutting edge of pool and spa water care technology while consistently offering high quality products.

The Advantis™ family of swimming pool and spa chemical brands include the Leisure Time®, GLB® pool, Rendézvous® Spa Specialties™, Applied Biochemists®, Robarb™, Ultima®, Aqua Silk® pool and Quantum Biochemical® brands.

Visit Advantis on the web at *PoolSpaCare.com* for more information.

LEISURE TIME
LeisureTimeSpa.com

GLB®
GLBPool.com

Rendézvous® spa specialties™
RendezvousSpa.com

APPLIED BIOCHEMISTS®
AppliedBio.net

Robarb™
Robarb.com

AQUA SILK®
AquaSilkPool.com

ULTIMA™
UltimaPoolSpa.com

QUANTUM® BIOCHEMICAL
QuantumPool.com

Understanding Hot Water Chemistry

BY

John D. Puetz

Director of Technology
Advantis Technologies
A Lonza Business

Table of Contents

INTRODUCTION

This book is written to help provide you with a better understanding of how you can assist your customers with getting the most out of their spa/hot tub. Humans have been bathing since the earliest days. From ritual bathing to simple relaxation, we have frequently used water not only to cleanse ourselves but for relaxation and recreation as well. Perhaps your customer is new to owning a hot tub in which case congratulations are in order. Or perhaps they have owned a tub for years. Regardless of which best describes your customer, this book will help guide you through what you need to know to help them get maximum enjoyment and performance from their tub.

Definition of a spa or hot tub...

A spa or hot tub can be simply defined as a relatively small body of water, rarely exceeding 500 gallons for residential use, that contains hot (95 – 104°F) water that is circulated in a vigorous fashion and is further agitated by the injection of "air blowers" into the water stream. The result is hot, turbulent water that at once soothes, relaxes and invigorates the bather. But it is these same qualities that require us to manage these waters differently. We used to think that they were most easily operated as small swimming pools. Experience has proven that approach to be wrong.

Treatment challenges

Three factors contribute the most to our challenges in properly treating a spa or hot tub:

- High water temperature: Hot water creates several conditions that increase the stress on the water and thus on treatment needs. Firstly, the warm water causes the pores on a bather's skin to dilate thus allowing the warm water to carry away some of the natural skin oils. This increases the waste products in the water and places stress on the sanitizing system being employed. Secondly, the warm water increases the evaporation rate. It is important to realize that as water evaporates it will leave behind all of the minerals and other materials dissolved in it. We will explore this in greater detail later on.
- Heavy bather loads: Due to the relatively small water volume the use of a tub by even a small number of bathers creates a significant impact on the water. Consider that two people in a 500 gallon spa are the equivalent of 80 people in a typical backyard swimming pool. This results in large accumulations of bather wastes in a very small volume of water. The water

Notes:

is treated to control these wastes and therefore it is not the volume of water that determines how much we need to treat but the volume of bather waste or the bather load. This is a critical reason why hot tubs cannot be treated as if they were small swimming pools.

- Turbulent water: The rapid movement of spa/hot tub water leads to increases in evaporation, sanitizer depletion, increased concentration of bather wastes, possible foaming and can even alter other chemistry factors that increase corrosion of equipment. Additionally this rapid water movement actually leads to a "scrubbing" action on bather skin that results in removal of dead skin and debris as well as removing protective oils which can result in dry skin complaints.

This manual will introduce the basic factors of spa and hot tub water chemistry and management. In addition to explaining water chemistry, this reference is intended to address the most important aspect of proper maintenance — how to get the most enjoyment and ease of use.

As spa/hot tub professionals, it is important that we always keep in mind that our primary responsibility is not the adding of treatment chemicals or the operation of equipment, but rather, to use these tools in the overall goal of providing clean, clear and healthy water. After all, our performance as a professional is measured largely on how well we prevent problems and keep the water safe and inviting.

Our role in the industry is to help assure that clean, clear water is delivered. In spa management this has not always been an easy task. Given the challenges detailed above spa owners often wrestle with frequent and unusual problems in keeping water clear, clean and odor free. This has led to the introduction of a wide variety of novel and often questionable treatment programs and products. Much confusion has resulted in how these products work, if at all. Customers tell us they are seeking more "natural" or user-friendly products because they are frustrated with the complexity of what they are using and the confusing information they get on how they should be treating their spas.

The goal of this manual is to help you do the best job in keeping your customers positive about their spa experience. This can best be accomplished by providing information that will help simplify how spa maintenance should be carried out and eliminate the conflicting and complicated guidance they may have received in the past. The first part of the book will highlight the basic factors of spa water care: Physical Factors, Chemical Factors, and Biological Factors.

Although many of these points will likely come as a review for you, the purpose here is to provide this information in a centralized resource that will not only help you manage spa chemistry on the job, but more importantly, help you to gain and keep loyal and satisfied customers.

Notes:

BASIC FACTORS

Three basic factors are involved in spa operation. Each of these, when properly managed will work with the others to provide clean, clear, safe and inviting water. These factors are:

A. PHYSICAL factors such as filtration and turnover

B. CHEMICAL factors which include scale and corrosion control

C. BIOLOGICAL factors including disinfection and control of bather wastes and odors

Each of these factors requires management primarily to control what is in the water. Even before we put water into a spa it will contain contaminants and solids that will require filtration in order for the water to start out clear. Additionally, the water may contain naturally occurring minerals such as iron that can stain surfaces or calcium that can cause cloudy water or scale. Once the water is in the spa the bather and resulting wastes become a critical area of focus in our treatment.

A clear understanding of these factors and what is involved in each is vital to understanding how they can be used to manage the water. To do this we will review each in detail.

Notes:

CHAPTER ONE - PHYSICAL FACTORS

The physical factors include filtration, turnover and circulation of the water. In addition there are other factors including the control of oily wastes left behind by the bathers and the maintenance of equipment as well as care of covers and appearance that must be tended to. Each factor plays an important role but is frequently overlooked in the importance it plays in being able to completely enjoy the spa experience.

When faced with a problem in the hot tub or spa, we have a tendency to immediately look into the water chemistry factors as a likely cause. Cloudy water, for example, causes us to question water chemistry when the problem may simply be due to a filtration issue. The management of the physical factors should never be discounted in the value it provides to keeping water clear and even in keeping the water properly sanitized. To really consider how important filtration is to keeping water clean just try to imagine how difficult it would be to keep the water clear without a filter.

Keep in mind that poorly filtered water will contain large amounts of physical waste that will dramatically interfere with sanitizer performance. Another way to think of it is that properly filtered water will allow for maximum benefit from lower levels of sanitizer. Therefore a properly operating filter is essential for your customers who may be seeking a reduction in the level of chemicals they want to employ to keep their water clean.

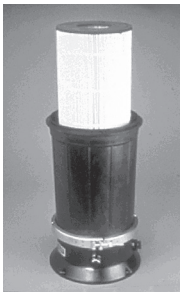
I. FILTRATION

Filtration is the term used to refer to the mechanical cleaning of the water. It is a key element in all water maintenance that is frequently overlooked in its importance. When operating properly, a filter will remove virtually all particulate matter from the water. These particles of dirt and debris are the result of environmental fallout or are left behind by the bathers and, when not properly filtered out, will cause the water to become hazy and cloudy, increase odors, lead to foaming problems and substantially reduce the effectiveness of the sanitizer.

FILTER TYPES

There are three types of filters that may be used on spas: cartridge, sand and diatomaceous earth (DE). While any of the three could be used, the most common type is the cartridge filter and therefore, we will concentrate our discussion on these.

Cartridge Filters



Cartridge filters consist of pleated fabric, typically polyester, arranged in a cylinder form around a rigid core. The fibers of the polyester trap dirt and oils as the water passes through from around the outside of the cylinder and is returned back through to the spa from the center core. While not regarded as the most efficient in terms of their ability to remove the tiniest particles of dirt, cartridge

Notes:

filters are widely selected for their utility in spa water applications. They are easily and quickly removed for cleaning and returned for use. If damaged or when the cartridge wears out, they are easily and economically replaced. Additionally they are excellent in their ability to remove oils and greases, which we know, are a substantial contaminant to spa water.

Cartridge filters will give long and excellent service if they are properly handled. A critical first step in keeping your cartridge operating properly is to keep it clean. Regular rinsing of the cartridge will help in removing large debris; however, deep cleaning will not only assure better-looking water but longer life from your cartridge as well. Deep cleaning is best accomplished by using a cleaner specially formulated for spa filters.

Such a cleaner should be capable of removing both oily and greasy buildup, as well as minerals such as calcium that may have been deposited on the fabric. A good filter cleaner will contain a combination of surfactants for oil and grease removal, as well as agents that will readily dissolve away built up minerals.

Another way to help extend cartridge life is to keep two sets, one set in use and a clean set ready to go. This allows you or your customer to quickly exchange the cartridges when needed and to clean the dirty ones at a convenient time. Once cleaned, allow the cartridges to dry before reinstalling them. This allows the fibers to expand and fluff up thus providing more effective filter area.

Residential spa owners frequently ask about how often they need to completely clean their cartridges. While the answer varies depending upon bather load and frequency a general rule of thumb would be every 30-60 days. It is typically a good idea to at least rinse off your cartridge on a weekly basis using a garden hose. High pressure washers are not recommended as they tend to tear up or rapidly age the cartridge fabric.

Between deep cleanings a “spray-on” type cleaner can be used to help remove oils and greases that would not be easily rinsed off in running water alone. This type of cleaner is ideal for when time does not allow for deep cleaning or for Service People who need to do routine service and want to get better performance than they would get from simple rinsing. The use of a spray-on cleaner between deep cleanings will help reduce the frequency of the need for deep cleaning.

Diatomaceous Earth Filters

Diatomaceous earth filters are only rarely used on spas and come in a variety of forms. Typically they consist of a fine mesh fabric configured in a variety of shapes or forms including bags, grids or screens and “fingers.”
DE is a fine white powder composed of the skeletal remains of nearly microscopic organisms that lived in the sea millions of years ago. These skeletons are mined from the earth and cleaned. The powder is applied to the surface of the fabric and acts to trap dirt as the pool water passes

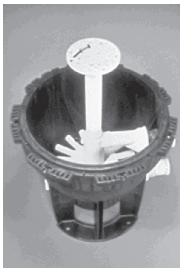
Notes:

through it. As the DE becomes clogged with dirt, it is washed off of the fabric and replaced with new DE to begin the process all over.

While DE provides excellent dirt trapping ability, it is this same quality of being able to filter such small particles that cause these filters to be in disfavor for spa applications. The amount and type of debris in spa water is generally of such a nature as to make these filters impractical, as they tend to clog too easily. In cases where a DE filter is used on a spa, the regular use of a good filter cleaner/degreaser will keep the filter fabric free of oily buildup.

Sand Filters

Sand filters, as the name implies, utilize sand as the filtering medium. Sand is regarded as a good filtering media but because the filters tend to be bulky in size compared to cartridge and DE filters, they are not often used for spa applications.



II. TURNOVER & CIRCULATION

Circulation is the term used to refer to the process of moving all of the water contained in a spa/hot tub. In contrast, the term turnover is used to describe how long it takes for the water being circulated to pass through the pump and filter. When we are managing swimming pool water, circulation is the more critical factor as areas of slow or poor circulation within a pool lead to poor control of algae or sanitation problems. In spa/hot tub maintenance though turnover plays the more critical role. Think about it for a moment. Given the way water in a spa/hot tub is pumped, jetted and aerated, it is pretty hard to imagine all of the water is not being circulated. More important is the need for rapid effective filtration. We need to get the water in the tub to the filter as often as possible to remove the solids being contributed by the bather. Unless the water is being properly filtered and filtered often, these solids can interfere with sanitizer efficiency and increase problems with cloudy water and foaming.

III. OTHER FACTORS

There are several other areas that require attention in order to keep the spa/hot tub looking inviting and ready for use. Proper control of fine particles that would otherwise escape removal by the filter through a process known as clarification and destruction of oily wastes contributed by the bathers by use of an enzyme digestion will not only assure clear water but improve sanitation as well.

CLARIFICATION

Spa/hot tub water creates large challenges for filters to remove all of the debris that contaminates the water. It must be remembered that the amount of waste added to each gallon of spa/hot tub water is much more than would be added to swimming pool water. This is due both to the small volume of water per bather and to the increased stress of high water temperature and the turbulent nature of the water. While the filter, even though properly

Notes:

maintained, is doing a fairly effective job it will be hard pressed to provide maximum water clarity. Fortunately there are aids that you can employ to help remove even the finest particles from the water.

While large particles are most easily removed by the filter it is common for the small particles to pass through the filter and remain suspended in the water leading to the buildup of what is commonly referred to as microparticles in the water. These particles are so small that they simply pass through the filter media without being trapped. To make matters worse, these particles develop a negative electrical charge and since the charges are all alike, they repel one another and do not clump together, which would otherwise make them easier to filter out. The addition of a "clarifier" will solve this problem.

A water clarifier contains a solution of positively charged particles that when added to water will seek out the negative particles and neutralize their charges. The particles will then clump together resulting in larger particles that are easily filtered out. Used regularly, a clarifier will reduce maintenance, improve filter performance and enhance the appearance of the water.

The regular use of a clarifier will assure your filter removes the maximum amount of particles from the water thus giving your customer the best water clarity. Using the product could not be easier.

CONTROL OF GREASE AND OILS

Hot and turbulent water are what make bathing such a relaxing experience. But they are also the factors that create challenges in managing the water quality. When we enter the water the warmth causes the pores of our skin to dilate or widen which exposes the natural oils of the skin to be exposed to the water. At the same time the rapidly moving water actually creates a "scrubbing" action that physically pulls these oils away and into the water. Complicating the matter is the increased rate of perspiration resulting from the warm water. The result is a water body that contains a large amount of organic wastes that place a tremendous stress on the sanitizer and filtration system.

Accumulations of body oils, cosmetics and other complex bather waste will result in the build up of these materials along the water line and in pipes and filters. This waste causes unattractive scum lines, increases foaming problems and interferes with the performance of the sanitizer, and generally create problems that will affect the overall appearance of the water and bathing pleasure.

These wastes can be most effectively controlled using enzymes. Enzymes are widely used today in both industrial and domestic applications. Many laundry detergents use enzymes to help in the breakdown and removal of stains and deep-set soil. Enzymes are naturally occurring biological catalysts, which means they help increase the breakdown rate of complex compounds. In spa/hot tub water, specially developed natural based enzymes are used to help breakdown complex materials like oils and grease. With regular use they will take these very complex and difficult to control materials and break

Notes:

them down into smaller fragments that can be readily destroyed by shock treatment.

However, it is important to point out that not all enzymes are well suited for spa/hot tub use. As stated above, enzymes are naturally occurring substances of biological origin. Since they are manufactured by living organisms and since Chlorine and other sanitizers destroy living substances, it is important to select enzymes that can tolerate the typical sanitizer levels commonly found in spa/hot tubs. It is also important to understand that enzymes are highly selective in terms of what substances they will breakdown. Therefore, one must use enzymes that have been properly selected for digestion of the types of oils and greases found in spa/hot tub water.

Used as part of a regular maintenance program, enzymes will minimize scum line formation and reduce the frequency for the need to clean along the water line as well as reduce the build up in pipes and equipment. In addition, the enzyme will help reduce the build up of these organic wastes on filter media and thus reduce the frequency of cleaning as well as improving water appearance.

Notes:

CHAPTER TWO - CHEMICAL FACTORS

Now that the physical processes are understood, we turn our attention to managing the chemical treatment of the water. Proper chemical treatment is needed in order to prevent a wide range of potential problems including scale and stain formation, colored or cloudy water, foaming, skin irritation, corrosion of equipment and to assure proper performance of the sanitizer being used.

There are five chemical factors that affect water quality. These are listed below in order of importance along with their ideal levels:

Chemical Factor	Recommended Level
1. pH	7.2-7.8
2. Total Alkalinity	80-150 ppm
3. Calcium Hardness	150-400 ppm
4. Stain Producing Minerals	Absent
5. Total Dissolved Solids (TDS)	Max 1500 ppm

The first three, along with the temperature of the water, determine the overall "Water Balance." Water balance is the term used to refer to the tendency of the water to be either "scale forming" or "corrosive or aggressive." Water that is referred to as having scale forming tendencies is one that is considered likely to suffer from problems related to high pH, high total alkalinity, hard water (elevated calcium level) or combinations of these. When these conditions are present, it is common for the water to be cloudy and for scale to form on surfaces especially heaters. Corrosive or aggressive water is most commonly associated with chemical factors, which is the opposite of those above, and results in corrosion of equipment such as heaters.

Maintaining proper chemical levels or providing good water balance can easily prevent these problems and others.

I. pH

pH is the term we use that tells us how active an acid or base is in the water. It is the single most important chemical factor in spa/hot tub chemistry. Because of the high water temperature and rapid rate of water movement a pH even slightly outside of the normal range will have a profound effect on water quality and the likelihood of scale formation or corrosion. pH is measured on a scale from 0 to 14 with 7 being neutral. A pH value between 0 and 7 is considered acidic with 0 being the greatest acid activity and getting weaker as it approaches a value of 7. A value between 7 and 14 is considered basic with 14 being the greatest base activity. Another word for basic is alkaline; however, this is not to be confused with total alkalinity and therefore we will use the term base in this discussion as pH and total alkalinity is not the same thing.

Notes:

The pH is best kept in the range of 7.2 to 7.8. When pH remains below 7.2, the water is considered to be corrosive. This means corrosion of metallic components in equipment such as heat exchangers will result. In addition, if you are going to use Chlorine to sanitizer the spa/hot tub water it will be more difficult to keep the Chlorine at the proper level because at pH levels below 7.2 Chlorine is much less stable resulting in the consumption of larger quantities of Chlorine than would be used at normal pH levels. It is interesting to point out that while the Chlorine level is harder to keep at the desired level, the Chlorine itself is actually more effective as a sanitizer when the pH is low. In fact as pH goes up the ability of Chlorine to control microorganisms actually goes down. This will be discussed in more detail in the Disinfection section of this book.

Maintaining the pH higher than 7.8 will increase the tendency to form scale or cloudy water. Calcium, the major component in scale, is a relatively unstable mineral and when the pH is high, the calcium is not as soluble and it will have a greater tendency to precipitate or "fall out" of solution resulting in cloudiness or scale. This is even more important in spa/hot tub water as the high water temperature actually increases the rate of scale formation. (See section on Calcium Hardness) High pH will also reduce Chlorine effectiveness, in those spa/hot tubs using Chlorine, resulting in the need to maintain higher Chlorine levels to achieve maximum sanitization.

The easiest means of controlling pH for most of your homeowner customers would be through the use of a "pH buffer" product. These unique products can be added to the water whenever the tub is drained and refilled with fresh water. When added they will "lock" the pH into the desired range and keep it there for up to three months. When present in the water they act as buffers to maintain pH in the desired range by automatically neutralizing those things that would otherwise raise or lower pH. By using one of these products your customer can all but eliminate the need to make regular adjustments to the pH. This reduces the difficulty often associated with water maintenance where "overshooting" the desired pH with acids or bases is a common complaint.

HOW TO ADJUST pH:

Some of your spa/hot tub owners may prefer to control the pH and other chemical factors themselves. In fact, if you are servicing the commercial spa/hot tub market the stresses of heavy use may lend itself to using separate acids and bases to adjust pH. Making these adjustments is easy using spa up or spa down in either liquid or dry forms.

If the pH is low add spa up. It is suggested that consumers or those with small water volume tubs use a liquid spa up as it is a gentler formula and they will have more comfortable control of the adjustment and are less likely to over shoot the desired pH range. Larger tubs or commercial facilities will get more control with the concentrated dry spa up.

Notes:

If the pH is high add spa down. Here too it is suggested that the liquid versions are better for small tubs or consumers and the dry forms are better used buy commercial facilities or larger consumer tubs.

Regardless of which form you select or if raising or lowering pH it is best to add small quantities each time, allow the water to completely mix and come into equilibrium before retesting and then adding an additional dose as may be required. Attempting to make large adjustments in one dose will often lead to frustration of driving the pH too far in one direction or the other.

II. TOTAL ALKALINITY

Changes in the pH of the water can be caused by many factors but the most significant cause is the sanitizer used. Since the sanitizer is likely the most frequently added chemical, it will have a powerful impact on pH and overall water quality. Changes in pH due to sanitizers or other factors can be minimized and controlled by the proper maintenance of the next chemical factor, total alkalinity.

Total alkalinity refers to the ability of the pool water to resist a change in pH. The key purpose total alkalinity serves is to help manage or control the pH in the water. It does this by acting as a buffer so that when materials are added to a spa that would cause the pH to go up or down these changes are controlled and do not result in severe changes to spa water balance. When a substance is added to spa water that could affect the pH, total alkalinity will react to neutralize it and help keep the pH in the desired range. Total alkalinity does not determine what the pH will be, but rather acts to help keep the pH in the range desired.

Total alkalinity is measured in parts per million (ppm) using a total alkalinity test kit or test strips. Total alkalinity is best kept in the range of 80-150 ppm. When the value is less than 80 ppm, the water can become aggressive and the pH can swing easily upward and downward and back again making it very difficult to control. If the value is higher than 150 ppm the water can become cloudy and scale forming and the pH will tend to drift upward.

Notes:

HOW TO ADJUST TOTAL ALKALINITY:

In adjusting total alkalinity downward, the same acids used to lower pH, are employed. When reducing total alkalinity, it is best to add only a small amount of acid at any one time as opposed to making large adjustments rapidly. Once the acid is added allow the water to circulate completely and wait at least four (4) hours before retesting and making the next addition if needed. Adding too much acid at once may result in lowering the pH so severely that corrosion of equipment would result.

When raising total alkalinity Sodium bicarbonate or Alkalinity Increaser is the product of choice.

To use:

1. Only use if total alkalinity is below 120 ppm.
2. Add no more than 1 oz at a time.
3. Allow mixing for at least 30 minutes.
4. Recheck total alkalinity and repeat dosage above if needed.

III. CALCIUM HARDNESS

The sum of all the calcium dissolved in water is referred to as the calcium hardness. Years ago, water with high levels of calcium was described as being hard to wash in. This is because water with high calcium levels does not clean clothes as well as water of a lower hardness. The term hardness is now used only to refer to the level of calcium. The term soft water refers to water with little or no levels of calcium.

Calcium is important in spa/hot tub chemistry since high levels are particularly unstable in warm water such as typical of spa/hot tubs. As water temperature rises, calcium becomes more likely to precipitate out of solution. The result can be significant scale formation in heaters. Calcium is actually more soluble in cold water, which is why scaling of heater equipment is so common. (Picture the inside of a tea kettle.) Calcium also becomes more unstable when the pH or the total alkalinity rise above the normal levels. Scale formation can be a serious problem in spa/hot tubs. When scale forms on heaters the result will be inefficient heat exchange due to the insulating properties of the scale. The scale formation in turn leads to higher energy consumption and costs or even a melt down of the heater tubing itself due to excessive heat.

Customers with tubs heated electrically will frequently complain of finding “chips” lying in the bottom of their tubs after they have used them and turned off the blowers and jets. This is not always a bad thing but it can be controlled. What happens is during periods of non-use where the circulation pump runs slowly as needed to keep the water at a temperature higher than ambient but high enough whereby the water can be heated to bathing temperature quickly, the slow water movement over the heater allows for some scale to be deposited on the heater element. When the unit is started up for use and the blowers and jets increase the water flow over the elements the natural abrasive action of the water actually strips the light

Notes:

scale formation off of the element. When the unit is again turned down any chips that did not get filtered out settle to the bottom where your customer sees them. You can explain to them that this is better than having the scale build up and cause heater failure later on. You can also recommend using a sequestering agent to prevent the formation of the scale. (See below.)

With all of the difficulties calcium can cause, it would seem logical to use soft water in the spa/hot tub. However, this is not the case! While high calcium levels can cause problems with cloudy water and scale, soft or low-calcium water is also of concern. Such water is aggressive and will actually attack metal fittings and heat exchangers resulting in destruction of the fittings or pinhole leaks in the heater. When such corrosion occurs, it is also common for stains to appear on surfaces.

HOW TO INCREASE CALCIUM LEVELS:

Calcium content is best in the range of 150-400 ppm with 150-250 ppm being ideal. Unlike pH or total alkalinity, however, both of which can be raised or lowered with reasonable ease, calcium levels cannot.

Adding calcium chloride to the water easily raises calcium levels. Conversely, there is no simple chemical addition that can be made that will reduce calcium hardness. The only way to reduce calcium hardness levels is through dilution with water of a lesser hardness. Over time, calcium hardness will naturally increase in spa/hot tub water due to evaporation.

To use calcium chloride:

1. Test calcium level with test kit to determine how much calcium chloride is needed.
2. Use 1 oz of calcium chloride to raise calcium level 7 ppm in 500 gallons of water.
3. Turn on all equipment and add required dose.
4. Run pump for 1-2 hours to assure complete mixing.

While it may be difficult to reduce calcium hardness, it is possible to control it so that a potential problem such as cloudy water or scale formation is prevented. The most effective way to control calcium in spa/hot tub water is through the use of a sequestering agent. A sequestering agent is a compound that, when added to water, will chemically bond with calcium and other minerals to make them, in a sense, more soluble. This means that calcium will still be present, but in a form that is less likely to cloud water or form scale in warm water or where the pH or other factors get out of balance. In addition, since calcium will still be in the water, you will not have the corrosion problems or foaming you would otherwise experience with soft water. A further advantage is that elevated levels of calcium can be tolerated without the need to use a water softener. This becomes especially important when the pool is located in hard water areas.

Notes:

HOW TO CONTROL HIGH CALCIUM LEVELS:

A reasonable level of calcium is desirable in spa/hot tub water. However, when levels increase they can cause problems with scale formation or cloudy water. While this most commonly occurs at levels above 400 ppm it can occur even at lower levels. Therefore it is best to use a sequestering agent as part of the normal treatment program in all spa/hot tub water. Select a product that is specially formulated to meet the demands of hot water systems. When used according to directions it will "tie-up" or chemically bond with the calcium to keep it in solution and prevent it from building up as scale.

HOW TO CONTROL FOAMING:

Foaming problems are fairly common in spa/hot tub water. While foaming can be caused by a variety of factors foaming is most frequently associated with soft water. When foaming is seen as frequent or persistent in a particular unit it is wise to have the calcium level tested and raised into the proper range if found to be low. Occasional foaming not resulting from soft water such as may occur with heavy bather load or failing to completely rinse a filter cartridge after cleaning is best controlled using a defoamer.

When foaming is noted simply squirt a little defoamer directly onto the foam and watch it disappear.

IV. STAIN PRODUCING MINERALS

Problems of stain formation on surfaces or colored water are most often associated with the metals iron or copper. Each of these metals can enter a spa/hot tub by several means and will react in very different ways. One of the most common ways these metals can enter the spa is via the fill water. Therefore, before filling a spa/hot tub, always be certain to have the water tested for metals in addition to the other chemical parameters. In this way you will be better prepared to deal with the initial treatment, both water balance and stain control.

IRON

When dissolved in water, iron is colorless but will react almost instantly with Chlorine or other oxidizers to produce a rusty red color in water, or worse, orange colored staining. As little as 0.1 ppm of iron is all that is needed to result in colored water and stains. The most common source of iron is the fill water. A second source of iron is corrosion or galvanic action taking place on equipment. Some heaters contain iron-based components. Galvanized "heat sinks" that are directly connected to copper heat exchange tubes are one such source. If a corrosive condition such as low pH or total alkalinity or soft water were to come into continuing contact with the heat sink it could corrode the iron leading to high levels of iron in the water. A second problem with such heat sinks directly connected to the copper can lead to galvanic corrosion from the two different metals in direct contact. In a sense it is like a battery where ions exchange one with the other. A good indication of these types of problems is heavy staining in the immediate vicinity of the return line discharge eyeball in the wall or floor of the spa/hot tub.

Notes:

COPPER

A common cause of green water and stains ranging in color from blue-green to black, is copper. Copper sources are more varied than iron. Copper can enter the water from corrosion or galvanic activity in copper heaters and from the source water. Copper problems are often indicated by water with a true clear green color. Copper is also the responsible agent when hair or fingernails turn green, not Chlorine, which is often blamed.

Corrosion of heaters that have copper heat exchange tubes results in copper entering the water flow, which, in turn, can lead to green water or stains. This type of corrosion is most commonly due to a chemical imbalance discussed above under Iron and includes low pH, low total alkalinity or low calcium hardness or a combination of these factors. As stated above a galvanic action can take place in heaters where the copper metal of the heater coil comes in contact with a different metal such as iron. At points where these two dissimilar metals are in direct contact, both metals can break down and find their way into the water. This particular problem is best solved by use of a "dielectric" coupling. This is typically a pipefitting made from a ceramic or similar inert material that is placed between the two metal components and prevents them from coming in direct contact with one another.

Copper can also come from the source water and will either be present as a normal component of the water or on a periodic basis. Many municipal water systems rely upon reservoirs for their water supply. These reservoirs frequently suffer from algae outbreaks and the algae are treated with copper. The copper level is often as much as 1.0 ppm, and if you fill or add water to your spa/hot tub, it will be green and could result in staining.

Notes:

HOW TO CONTROL METALS IN THE WATER:

The best time to treat for metals in the water is whenever you first fill the spa/hot tub or drain and refill the unit. This will assure your customer of clear water free of any staining right from the start. Use of a sequestering agent each week will control metals following this first treatment.

The important thing to understand is that all metals can easily be kept from causing problems with the regular use of a sequestering agent. As with calcium, a sequestering agent will chemically combine with the metals in the water and keep them from precipitating out of the water to cause staining. The best time to use is when the spa/hot tub is being filled for the first time, and thereafter as part of a regular preventive maintenance program. In this way, any metals that may be present in the fill water will be tied up or inactivated before they can cause a problem. Even if a test of the fill water does not show any metals are present it is wise to add a sequestering agent. Consider it is easier and less costly to prevent a problem than to correct it.

The regular use of a sequestering agent will assure that any metals that may find their way in later, either when water is added or from corrosive actions, will be prevented from causing staining. In other words, by adding a sequestering agent as part of the regular maintenance program, the unit will be protected from stains even when you did not expect metals to be present.

V. TOTAL DISSOLVED SOLIDS

Total dissolved solids (TDS) are normally the least worrisome factor when managing swimming pool water. However, while TDS may never become a problem in most pools, some commercial spas/hot tubs can see problems after as little as 24 hours of operation. Residential spas/hot tubs will take much longer to experience such problems because they have smaller bather loads but nevertheless they will require periodic draining and refilling. Therefore it is important to understand TDS and its role in spa/hot tub chemistry and management.

Simply put, TDS is the sum of all materials dissolved in the water and normally runs in the range of 250 ppm and higher. There is much discussion over what levels are considered too high, but there is no real lower limit. TDS is comprised of many different chemical compounds, which means that the issue of how much is too much actually depends more on what they consist of than how much there is. For example, sodium chloride or ordinary salt is extremely soluble and is therefore unlikely to cause a problem, whereas, as we have seen, calcium compounds can be a problem even at fairly low levels. By its nature of utilizing hot, turbulent water a spa/hot tub is prone to very rapid accumulation of excessive solids (TDS). In general, when the TDS exceeds approximately 1500 ppm, problems are likely to begin occurring.

Notes:

The hot, turbulent water causes excessive amounts of bather waste in a very small body of water. Managing these wastes in turn requires the use of relatively large amounts of sanitizer and other treatment compounds. All of these, wastes and treatment products, contain solids that accumulate over time. Add to this the increased evaporation rate in spa/hot tub water and the result will be a rapid increase in TDS. Keep in mind that as water evaporates, only the water itself is removed, not the solids it contains. As such the solids accumulate and reach unacceptable levels faster than in cooler less turbulent water such as that found in swimming pools.

At elevated levels, TDS can lead to cloudy or hazy water, difficulty in maintaining water balance, reduction in sanitizer activity and foaming. Unfortunately, the only way to reduce TDS is to drain the water and replace it with fresh water.

It is suggested that a residential spa/hot tub be drained and refilled every three to four months. This is only a general recommendation and actual frequency of water changes will depend upon how heavily the unit is used and the treatment program followed. It is often said that when one experiences unusual problems in managing the water, it is easier and less costly to drain and refill than to keep trying to make corrections.

Notes:

CHAPTER THREE - BIOLOGICAL FACTORS

Disinfection and shock treatment (control of bather waste) are the key elements in maintaining clean sanitary spa/hot tub water. The previous two chapters dealt with keeping the water clear, while here we will address how to keep it healthy and clean.

Notes:

I. DISINFECTION

The process of controlling bacteria and viruses in the water to assure the water will be healthy and safe for bathing is known as disinfection, or sometimes sanitization. This is a critical process in a spa/hot tub as the water temperature along with the aeration make this water an ideal environment for the growth of harmful bacteria. Add to the ideal growth temperature the heavy bather wastes that will place stress on the sanitizer used and one has all the ingredients needed to bring about explosive growth potential for undesirable microorganisms. This section will describe in detail what you need to know to keep your customers' water in clean and healthy condition for bathing.

As we have come to understand, the bather leaves behind a lot of organic waste in the water. But the bather is also the source of the bacteria that contaminate the water. In fact the bather is the primary contaminant of spa/hot tub water. If the cover were to remain in place most spa/hot tub water would remain clean almost indefinitely. It is most important to control both the microorganisms and waste products after bathing is completed. In doing so we control the populations of these organisms while they are at their lowest numbers. If we do not control them now with a proper sanitizer residual they can grow and multiply using the wastes left by the bathers as a food source. If they grow to large numbers they become a very real threat of disease to the next bather who enters the tub. However, if they are destroyed when the bathing experience is completed and a cover is put in place, the water will stay clean and clear ready for the next use.

While a wide variety of methods for disinfecting or sanitizing spa/hot tub water are available in the market, the two most common methods are Chlorine and bromine. Over the recent past, other processes have also gained more attention. These include PHMB (biguanide), Ozone and Ionizers. Each has its strengths and weaknesses.

CHLORINE

The most commonly recognized sanitizer is Chlorine, but it is not always the sanitizer of choice for use in spa/hot tub water. While available in a number of forms any of which could be used the most dominant form for this application is a granular form commonly known as Dichlor. Dichlor is white granular compound containing 56-62% available Chlorine. This means that for every one pound of Dichlor added to water 0.56-0.62 pounds of actual Chlorine will be present. In addition Dichlor contains cyanuric acid that is important in outdoor pool use where the cyanuric acid helps keep the Chlorine stable in the presence of sunlight. While the cyanuric acid is of little

value in outdoor or indoor spa/hot tub water it is of no harm either. What makes this form of Chlorine the best for spa/hot tub use is that it is virtually neutral in pH. Given the rather small water volume and demand for heavy use the neutral pH avoids unnecessary upsets to water balance.

Once the Chlorine has been added to the water, it can take several different forms, not all of which are desirable. The following sections on Free Chlorine, Combined Chlorine and Total Chlorine will address these different Chlorine forms in depth.

FREE CHLORINE

Free Chlorine is the most desirable form and is the form responsible for the actual disinfection activity in the water. It is measured using a Free Chlorine test kit or test strips and its level is critical in the water. If this form is not present, little or no sanitizing can take place. Free Chlorine is actually composed of two types of compounds: HOCl (hypochlorous acid) and OCl^- (hypochlorite ion). This is important because they exist together in a condition or state known as equilibrium. This means that together they make up 100% of the Free Chlorine content, but that content consists of some of each. For example, if 25% of the Free Chlorine is HOCl, then the OCl^- level will be the other 75%. It is important to note that only the HOCl component is effective as a sanitizer. Therefore, it seems logical that we would want as much of the Free Chlorine as possible to be in the form of HOCl. However, the level of HOCl and OCl^- present is dependent upon the pH. This is one of the critical reasons that the proper pH level in the water is so important. As the pH goes up or down, the relative amount of HOCl vs. OCl^- also increases or decreases. The following chart shows how much of each of these two compounds are present at different pH levels.

pH	%HOCl	%OCl^-
6.0	97	3
7.0	75	25
7.5	50	50
8.0	23	77
9.0	3	97

As the chart shows, at pH 7.5, only about half of the Free Chlorine exists in the desirable form of HOCl. The level of HOCl will increase as the pH goes down and it must also be pointed out that as the pH decreases, so does the stability of the Chlorine. As pH rises, the stability of the Free Chlorine will increase, but its activity as a sanitizer diminishes. In order to get the most effective and economic benefit of Chlorine, keep the pH in the desirable range of 7.2-7.8. Lower pH will be detrimental to equipment and make it more difficult to maintain a sufficient level of Free Chlorine, while higher pH levels will render Chlorine ineffective as a sanitizer and increase scaling conditions.

COMBINED CHLORINE

Free Chlorine is highly reactive, and once added to water, quickly attacks bacteria as well as bather and other wastes. When this occurs, the Chlorine is no longer considered Free Chlorine but rather its form has changed and is now

Notes:

referred to as Combined Chlorine. Bather and other wastes are largely made up of ammonia-type compounds and related nitrogen based wastes. For this reason, Combined Chlorine is also referred to as chloramines for the nitrogen portion of the compound. Combined Chlorine is very stable, but has little or no sanitizing ability. Not only is Combined Chlorine a very poor disinfectant, it is the agent responsible for eye burn and skin irritation and results in the unpleasant Chlorine odor often referred to as a pool with "too much Chlorine." It is therefore critical for bather health and comfort that Combined Chlorine be controlled and kept to a minimum. It is preferable that Combined Chlorine levels are kept to a maximum of 0.2 ppm. This can be a challenging task in spa/hot tub maintenance given the larger amounts of waste and increased dosages of Chlorine required as a result.

Notes:

TOTAL CHLORINE

Total Chlorine is the sum of the Free Chlorine and Combined Chlorine levels. Total Chlorine can be measured using most test kits and some test strips. To determine the Combined Chlorine level, first measure the Free Chlorine level and then the Total Chlorine level and then subtract the Free Chlorine reading from the total reading. The difference in values is the Combined Chlorine level.

HOW TO USE CHLORINE TO SANITIZE WATER:

If you prefer to use Chlorine for sanitizing the water, granular Dichlor is best. This form will provide a reliable and easy to use source of concentrated Chlorine.

To use:

1. Add 1/2oz for each 500 gallons of water prior to bathing.
2. Test water to be certain 2-3 ppm residual is present.
3. Shock-oxidize the water with a buffered non-Chlorine shock after bathing. (See Shock Treatment Section)

Note: Shock-oxidation treatment will destroy the organic bather waste.

BROMINE

Chlorine and bromine are both members of the same chemical family known as Halogens. While not as well known as Chlorine, bromine has gained wide acceptance as a sanitizer, especially in spa/hot tubs. The heavy waste accumulation places a stress on Chlorine resulting in odors and irritation due to the build up of Combined Chlorine. Bromine does not suffer from this problem. Bromine has become a dominant sanitizer for spa/hot tub applications because users do not experience problems of odors and skin irritation as they often do with Chlorine sanitizer. In addition bromine is far less pH dependent than is Chlorine.

When added to water, bromine forms hypobromous acid (HOBr) similarly to the hypochlorous acid formed by Chlorine. However, unlike Chlorine, the amount of hypobromous acid is less dependent on pH. The chart below shows how much more of the active species of HOBr is present over the same pH ranges in comparison to HOCl formed when Chlorine is used.

pH	%HOCl	%HOBr
6.0	97	100%
7.0	75	99%
7.5	50	94%
8.0	23	83%
9.0	3	30%

In addition to bromine activity working over a wider pH range than Chlorine there are other reasons that tend to favor its use in spa/hot tub water. The same waste products that place such a stress on Chlorine to result in the undesirable Combined Chlorine compounds also react with free bromine to form combined bromine in the water. However, unlike Combined Chlorine these combined bromine compounds do not cause eye and skin irritation or foul odors. But of greater advantage, the combined bromine is a very effective sanitizer virtually equivalent to free bromine. For this reason, it is not necessary to test for both free and combined bromine. Only a test for total bromine is needed. Since spa/hot tub water frequently contains heavy accumulations of waste products, a sanitizer such as bromine that does not cause adverse skin reactions or odors, or suffer from reduced effectiveness, is of real advantage.

Bromine is available in three basic forms: tablets, caplets or as a two product system. Bromine tablets or caplets are usually applied through some type of feeder device either in-line or a floater-type feeder. The two-product system relies upon the addition of small amounts of an inert sodium bromide salt, which by itself does little. The water is then treated with an oxidizer specially suited for this purpose. The oxidizer acts to convert the sodium bromide into free bromine. The two-product system has the advantage of reacting in the water to both control bacteria and oxidizes to destroy waste products in a single step. These will be discussed in more detail in the section below on how to use bromine.

HOW TO SANITIZE WITH BROMINE:

There are two distinct means of using bromine to sanitize spa/hot tub water. The first is with brominating tablets or caplets. These contain a combination of different bromine sanitizing compounds and are designed for use in a feeder system either in-line or more commonly in a feeder type that floats on the surface of the water. They slowly dissolve over time gradually releasing the bromine sanitizer to maintain a desired bromine level in the water. When used in this way these tablets will provide continuous bromine residual in the water for an extended period of time.

Notes:

To use:

1. Add a suitable number of tablets to a feeder and adjust the feeder per manufacturer directions.
2. Test bromine level daily to a residual of 2-4 ppm.
3. It is best to shock-oxidize the water after bathing using a non-Chlorine shock. This will destroy the organic wastes added by the bathers.

A second means of sanitizing with bromine is by using the two-product system. This type of system is different from other sanitizing systems and holds several advantages. The first product consists of a solution of a simple salt called sodium bromide, a natural constituent of seawater. This is added to the spa/hot tub water initially and then weekly thereafter. When added the sodium bromide does nothing by itself. However, when a buffered non-Chlorine shock oxidizer is added, it will oxidize the sodium bromide to result in producing active bromine sanitizer in the water. It is only after the non-Chlorine shock-oxidizer is added to the water that a sanitizer is actually present in the water.

Using the system could not be easier as you only need to add the non-Chlorine shock-oxidizer after bathing is done. One of the advantages then is that the bather using the tub is not exposed to any sanitizer while actually bathing. However, when the shock oxidizer is added to the water after bathing two critical things happen at the same time. Firstly, the production of bromine sanitizer as stated above destroys any microorganisms left behind by the bather. Secondly, the non-Chlorine shock oxidizer contains enough oxidizer to make both the active bromine sanitizer and provide the needed shock treatment to destroy organic wastes left behind by the bather. In one single step the two key requirements for clean spa/hot tub water are met. The time to add the shock oxidizer is after one is finished bathing. After exiting simply add the required dose and put the cover in place. The water will be fresh and clean ready for the next bather.

To use:

1. When the tub is first filled add the sodium bromide salt solution to the water.
2. Turn on filtration system to mix.
3. Add 2 ounces of buffered non-Chlorine shock-oxidizer for each 250 gallons of water.
4. Thereafter simply add non-Chlorine shock-oxidizer after each bathing period and put cover in place.
5. Weekly add 1 ounces of sodium bromide salt solution for each 250 gallons of water.

Notes:

BIGUANIDE (PHMB)

A more recent introduction to the sanitizer market for spa/hot tub water is biguanide, or PHMB. This compound has come to be known as a "non-Chlorine" sanitizer, but perhaps would be more accurately called "non-halogen" since it does not rely on either bromine or Chlorine. The PHMB system has created interest because it is said to be free of Chlorine odors and irritation. Frequently spa/hot tub owners and users speak of wanting to have something more natural than Chlorine or bromine for sanitizing their water. Biguanide is anything but natural. In fact it is a very complex organic molecule. When your customer asks you for something "more natural" or feels that the biguanide offers them a more natural option the reality may well be that they are equating an absence of skin irritation, they previously experienced with Chlorine, as showing them the biguanide is more natural. In simple terms the absence of irritation makes them think in terms of being natural but nothing could be more wrong. Still many people like the idea of getting away from the use of traditional sanitizers.

While biguanide can be effective in controlling most microorganisms, the system is not always the best to use and suffers some drawbacks. For example, the system does not tolerate the addition of Chlorine or bromine, and if one of these were added to a biguanide treated tub, the result could well be the formation of gummy deposits on surfaces and pipes. In addition these compounds are somewhat slower acting than Chlorine or bromine and do not tolerate heavy bather loads. On the positive side, the product is stable in the water and needs to be added only in top up doses every week or two.

OZONE

Ozone has gained wide acceptance and use in spa/hot tubs. Chemically, ozone is a highly reactive oxidizer and is the most effective of all oxidizers in its ability to kill the microorganisms it comes in contact with. Because it is so reactive, it must be produced on-site by specialized equipment or UV light. In nature, ozone is produced by electrical discharge such as occurs in lightning. While very effective as an oxidizer ozone is not very stable and it has a very short life especially in hot water. It is for that reason that only water and any contaminants it may contain that actually comes in contact with ozone at any given moment can be considered sanitary. Because ozone is so short lived in the water it cannot be used as the sole source of sanitizer in a spa/hot tub. It simply does not provide a residual capable of controlling all microorganisms and contaminants at one time and thus must be supported by the use of a backup sanitizer – usually Chlorine or bromine. The advantage ozone holds is that it will reduce the levels of Chlorine or bromine normally needed to maintain a spa/hot tub.

Notes:

MINERAL TREATMENT

Minerals such as silver, zinc and copper have long been recognized for their ability to keep water fresh for drinking. The pioneers used to place copper and silver coins in their barrels of drinking water as they traveled west. We now see these metals being used to treat spa/hot tub water. Copper and silver have received most of the attention and more recently zinc has gained interest, as well. For use in spa/hot tub water these metals are most commonly applied using proprietary controlled erosion in the form of specially designed capsules that fit into cartridge filters. In this system the water passing through the filter also passes over the mineral "purifier" capsule where it is treated with the benefits of the metals encased within the capsule. The metals act to suppress both bacteria and viruses in the water.

Unlike the previous systems discussed above these purifiers do not control organic waste and therefore these wastes must still be managed through oxidation. In addition the levels added to water do not assure control of all bacteria or algae and it is highly desirable to supplement these minerals with low levels of Chlorine or bromine. The combination of the halogens and the minerals result in a true synergistic action that controls undesirable organisms and wastes at low levels.

II. SHOCK TREATMENT

Regardless of which disinfection system is used, the control of bather and other wastes is critical. For example, one bather produces three pints of perspiration for each hour spent in a spa/hot tub. Perspiration contains a wide range of organic and inorganic contaminants and these along with natural oils, cosmetics, dead skin cells and other undesirable waste will accumulate. Water treated with Chlorine will result in forming the very undesirable Combined Chlorine that will cause poor sanitizing, odors and skin irritation. In bromine systems, although odors and irritation are not a problem with bromamines, the wastes themselves can build up and eventually make the water uncomfortable for bathing. Biguanide and mineral purifier systems also require regular removal of these built up wastes. Therefore, the removal of these wastes is a must regardless of which system is employed.

The best way to remove these wastes is with regular oxidation. The odor that is associated with Combined Chlorine is often mistakenly referred to as "too much Chlorine in the water," but actually indicates that there is too little. Shock treatment or super-chlorination is needed to destroy these wastes. We use the phrase "shock-oxidation" when referring to the use of non-Chlorine type shock. Conversely, the phrase "super chlorination" is used when referring to the use of a sudden large dose of Chlorine.

In either case, the goal is to destroy and remove bather waste in addition to preventing formation of Combined Chlorine or accumulation of irritating waste products.

SUPER CHLORINATION

Super chlorination is effective in eliminating wastes or destroying Combined Chlorine. To achieve successful super chlorination, a single

Notes:

large dose of Chlorine is applied to the water. Super chlorination actually works by first reacting with the organic wastes in the water to form more Combined Chlorine. Once a sufficient level of Chlorine has been added, all of the organics will have been reacted with (oxidized), and only then will the Combined Chlorine break down leaving Free Chlorine. Typically, the amount of Chlorine required is ten times the level of Combined Chlorine in the water.

Super chlorination may not be the best way to manage wastes or Combined Chlorine in a spa/hot tub. The primary source of Chlorine for spa/hot tub applications is Dichlor. While Dichlor will provide an effective Chlorine residual the large amount needed for super chlorination will also result in build up of solids in the water, most notably cyanuric acid. Additionally the unit cannot be used until the level of Chlorine drops down and if the cover is put in place after this large dose of Chlorine is added a build up of Chlorine odors themselves can result. When the cover is next removed the people around the unit tend to get a blast of very distasteful odor. Finally using Chlorine to destroy Combined Chlorine is only done after the Combined Chlorine has formed. It would make more sense to keep these compounds from building up in the water in the first place. That is the advantage given by using non-Chlorine shocks in "shock treatment." (See "Shock Oxidation Treatment" below.)

SHOCK OXIDATION TREATMENT

Shock-oxidation treatment is a phrase commonly used when referring to the use of a product that does not contain Chlorine to eliminate wastes in the water. Instead, it uses a unique oxidizer to control wastes. Most commonly referred to as "non-Chlorine" shock, it does not use Chlorine to destroy the wastes, as the name implies. Non-Chlorine shock oxidizer uses an oxidizer that will directly oxidize the waste itself, whereas Chlorine used in super chlorination works by first changing the waste into Combined Chlorine before final breakdown. Since a shock-oxidation product does not require Chlorine, it can be used to destroy waste products before they have a chance to form Combined Chlorine, and it offers several significant advantages including:

- Does not require excessive Chlorine use
- Does not produce Chlorine-like odors
- Compatible with all sanitizers except biguanide
- Will not upset water balance
- Easy to determine needed dosages
- Can be used daily or as needed

Shock-oxidation treatment is best done after each bathing episode. An example would be a family who uses their spa on a given day for anywhere from a few minutes to off and on over an hour or two. After they are done they add the required dose of shock oxidizer. By adding the dose then they will oxidize and thus remove non-living waste immediately after they were left by the users. In so doing they control the wastes before they can begin to cause odor problems. It is important to understand that shock oxidation treatment is needed even if one has an ozonator on their unit.

Notes:

III. ALGAE CONTROL

Rarely some outdoor spa/hot tubs develop problems with algae growth. This is most evident by a greenish slime or film that forms on walls the resulting slippery surface will cause a real safety hazard. This can be easily treated using a spa algaecide. Regular use will not only destroy existing algae but keep it from forming in the future.

SUMMARY

Spa/hot tub maintenance is not something that needs be difficult or tedious. It is more a matter of providing maintenance on a regular basis by following a few simple steps. If one keeps up with the maintenance, problems will be few or not at all. When a problem does come up you are well prepared to deal with it and to help your customer resolve it quickly. Thank you for reading through this manual. Your dedication to your business will not go unnoticed or unappreciated by your customer.

Notes:

Advantis™
TECHNOLOGIES
A Lonza Business

5660 New Northside Dr. NW
Suite 1100
Atlanta, GA 30328

PoolSpaCare.com