How specialty chemicals work to aid water quality

By Doug Walsh

Known by any number of special monikers — clarifiers, algicides, stain and scale preventers, enzymes, tile cleaners and filter aids — specialty chemicals are really just that: Chemicals used for a specific purpose.

But the ugly industry truth is that if proper water balance is maintained on the pool, specialty chemicals are not really needed.

That's right. Monitor the water chemistry. Make the proper adjustments on a regular basis. Keep the pool surface clear of foreign debris. Maintain the filter at optimum efficiency.

Do all of this and guess what? Any problems that would require special additives or treatments are eliminated.

Well, there is one slight problem. The money saved on chemical additives will likely by eaten up by the added time that pool operators or service technicians will need to spend poolside.

That monitoring of the chemistry will have to be done several times a day — especially after the kids have invited a few friends over.

Keeping the pool surface clean may require near constant skimming — especially if the yard has trees, plants or grass — and nature hurls a little wind and rain in the pool's direction.

Any of these situations or a number of others can create havoc on water chemistry or throw a huge roadblock in front of all honest efforts at efficient filtration.

The pH drops, metals begin dissolving in the water — and a stain will soon appear. Miss a spot of debris on the pool surface while the chlorine level is low — and an algae bloom may develop.

Short of maintaining a constant vigil

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over their customers' pools, many service professionals do indeed resort to using any number of chemical treatments grouped under the heading of specialty chemicals.

While chlorine and bromine compounds, pH adjusters and shock treatments are generally referred to a general-purpose chemicals, specialty chemicals are those used for very specific purposes — to clear up an algae bloom, remove oils from the water or filter, bring the water back to a sparkling clarity, or remove a stain or scale.

Better yet, these chemicals can be used even more successfully as a preventative measure to keep the problem from occurring in the first place.

Anytime a chemical product is used to accomplish a narrow, specific purpose, it is a specialty chemical.

But in the pool and spa industry, these chemicals are usually one of four types of specialty products:

- Those that are aimed at combating algae.
- Those that are used to control the formation of stains and scale.
- Those that are used as a water clarifier or brightener.
- Those that are promoted as enzymes.

Non-Chlorine Shock Eliminates Many Drawbacks Associated With Superchlorination

Since its introduction to the swimming pool and spa industry decades ago, potassium monopersulfate — or non-chlorine shock, as it is often better known — has grown to be one of the more commonly used specialty chemicals in the industry.

Periodic shocking is the only way to rid a pool of built-up contaminants, whether left behind by bathers in the form of urine and perspiration, cosmetic products, sunscreens and lotion or naturally introduced in the form of dust, dirt, pollen, insects, plant and grass debris.

These contaminants combine with the chlorine in the water to make chloramines. It's these very chloramines that can cause a foul smell and can lead to cloudy, dull water. While still a killing form of sanitizer, the effectiveness of this combined form of chlorine is minimized and, if left unattended, can lead to poor water quality.

Another common problem, of course, is finding the proper level of chlorine to add in order to reach the breakpoint. As chlorine is added, the chloramine levels are raised even higher and higher, and if the breakpoint level is not reached, the undesirable effects are merely increased.

Also, high chlorine levels in the pool can cause significant down time while the sanitizer levels return to normal.

It's problems such as these that have led to the increasing use of a non-chlorine shock.

Developed by the giant chemical company, DuPont, potassium monopersulfate is a strong, odorless, oxygen-based oxi-

Even the most carefully maintained pool can develop an occasional bout with algae given the right climatic conditions. Service professionals normally tackle the outbreak with one of five chemical products designed to kill or prevent an algae bloom.

Metallic Algicides normally contain either copper or silver and kill by blocking the algae's metabolism. That is, they interfere with the plant's ability to feed and breathe.

Algae, remember, are simple, green plants that requires food and light to live. The light usually comes from the sun, which explains why algae grow better in warm, sunny climates, while the food usually comes from phosphates in the water that have escaped the kill normally provided by chlorine or bromine.

Phosphate Removers commonly use a chloride-based metallic salt, which combines with the dissolved phosphates in the water to form a solid material that can be filtered out through normal circulation processes. Phosphate removing products have become increasingly important in the winterizing process, to assure that food is not available for algae to begin growth as the weather begins to warm up in the spring.

Quats — short for quaternary ammonium compounds — contain some form of ammonia and have a positive electri-

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are introduced into the water, the sanitizer — which should be working on killing bacteria and virus — shifts and tries to do its secondary job as an oxidizer.

Chemically, we say that there is a sanitizer demand.

Unfortunately, as the sanitizer is called upon to oxidize to destroy organic contaminants, its efficiency of the sanitizer is significantly reduced.

To overcome the buildup of the combined forms of sanitizer, the industry standard has been to superchlorinate or shock the water. In this process, the chlorine level is raised to about 10 times the normal readings on a chemical test to reach what is called *breakpoint.*

At this point, the chloramines are broken down, bringing the chlorine back to its free — and best killing — form.

It is common, however, for a small amount of combined chlorine to remain in the water after a corrective breakpoint has been reached, especially when organic nitrogen compounds are present in the pool water.

And in the real world, the chlorine will continue to combine with contaminants that

natives.

Unaffected by UV degradation, non-chlorine shock can be added to pool water day or night, and swimming can resume after just a short waiting period.

The product is fast dissolving, and when broadcast uniformly over the water with the circulation system running, it will quickly mix into solution with the pool water.

Rather than waiting for combined chlorine readings to rise above proper levels, many pool operators and service professionals are using monopersulfates on a regular basis as a preventative measure to oxidize contaminants before they combine to cause water quality problems.

The advantages to oxidation without chlorine include that fact that there is no added production of chloramines and sanitizer efficiency is increased without raising the chlorine level. Chlorine and bromine — without the added duty of oxidizing — are then free to do their job as a bacteria killers.

With regular, preventative use, the water will be better quality, there will be longer periods of uninterrupted swim time and

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service professionals will end up with a more manageable maintenance schedule.

Recommended doses are one pound per 10,000 gallons of pool water, but more frequent and higher doses may be useful in commercial pool applications. In spas, manufacturers recommend oxidizing with non-chlorine shock after each use. Recommended dosage for spas is 1-2 ounces per 250 gallons.

Manufacturers recommend its use on a regular basis rather than waiting for problems to occur.

The rationale for using this preventative medicine for a customer's pool is a strong one. When the quality of water deteriorates to the degree that shocking becomes necessary, how can pool operators be sure they are providing enough sanitation?

And it doesn't take a chemist to know that is makes more sense to prevent a problem that it does to try and fix one. The work associated with corrective action can be significantly more time-consuming than the few minutes added to a routine maintenance schedule that it takes to add non-chlorine shock on a regular basis.

Add to this that fact that while superchlorinating, pools may be unusable, which can be especially troublesome in commercial pools.

On the down side, potassium monopersulfate does not kill bacteria and cannot replace use of a sanitizer. And because of its acidic nature, regular use will also lower pH and total alkalinity. Soda ash or bicarbonate should be added to maintain acceptable levels of pH and alkalinity.

When testing, technicians should be aware that while no interference will be detected when using OTO test kits, the potassium in the monopersulfate compound can produce some false readings on DPD tests. There are test kits available to eliminate monopersulfate interference, and tests have also been developed for monitoring monopersulfate levels in the water.

Monopersulfates, even when used on a regular basis as part of a prevention program, are not the cure-all for all water problems.

Naturally, technicians still need to consider adequate flow and turnover rates for their circulation systems; properly maintained filter elements and media; regular vacuuming to prevent the buildup of particles that make the water cloudy; and water balance.

With these considerations addressed and problems persisting, they may need to consider water clarifiers or other preventative specialty chemicals to maximize water quality.

But routine shocking to allow sufficient free available sanitizer and minimize the problems that can develop with combined forms of chlorine can go a long way to controlling problems before they occur. ■

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cal charge. Because algae have a negative charge, they are attracted to the quats. The quat interferes with the plant's cell membrane, causing the algae to suffocate.

Polymers are huge molecules containing several repeating parts. Because they are also positively charged, they work in much the same way that quats do and suffocate the algae after attaching itself onto the plant's cell membrane.

Though they do not kill algae by themselves and cannot be called algicides, *chlorine enhancers* work by combining with the chlorine already present in the water. The algae recognize the enhancer/chlorine combination as a source of food, ingest it and are then killed by it.

Sequestering Agents

Stains and scale are caused by metals present in or added to the water. The specialty chemical normally used to combat problem metals that can caused stains and scale formation are called chelating or sequestering agents.

Scale occurs if the metals precipitate — that is, they come out of solution — and form a hard deposit on the pool wall. Stains occur when the precipitated metal is allowed to discolor the pool wall. These precipitated metals can also remain suspended in the water, causing cloudiness or discoloration.

Depending on the type of water-treatment chemicals being used to sanitize and prevent algae or the source water being used to refill the pool, service professionals should be aware that they could quite possibly be adding metals to pool water each week.

Unfortunately, they may not be aware that they even have a metal problem until a stain appears. They can quickly add a sequestering agent, hoping to pull the precipitated metal off the walls of the pool. While this does occasionally work, sequestering agents generally do a better job when used as a preventative measure.

This is because the metals present in the water can be attacked more easily than the stain or scale that they can cause. When metals are dissolved in water, they exist as electrically charged particles called ions. Metal ions happen to be positively charged, which is also a key to their removal chemically.

Whether they are called stain and scale inhibitors, stain and scale preventers, metal suspenders or metal removers, sequestering and chelating agents have a common bond. That is, they react with the metal ions in the water to keep them dissolved in the water.

The most widely used metal-control agents fall into one of three categories: EDTA; Polymers; and HEDP. Each group works differently and has its own strengths and weaknesses.

ETDA is short for *ethylenediaminetriacetic acid*, an organic compound made up of carbon, hydrogen, nitrogen and oxygen. Its chemical make-up is such that it has six metal-complexing sites. Along with other chemicals in this group, EDTA prevents staining by "tying up" or "blocking" the reactive sites on a metal ion in the water, thereby preventing it from combining with other substances and precipitating.

The EDTA family of compounds all have an affinity for heavy metals, such as iron, copper, nickel, lead, zinc, cobalt and aluminum. Once it has reacted with all of these, it there is any EDTA left in the water, it will then react with lighter metals, such as calcium and magnesium.

The next category are the polymers. Again, a polymer is a huge molecule that contains many repeating parts. Scientists have developed many synthetic polymers, some of which are used in the pool and spa industry as water clarifiers, algicides and sequestering agents.

As a sequestering agent, the polymers interfere with the formation of metallic crystals, either preventing them from forming or causing their shapes to be distorted. This makes polymer-based sequestering agents particularly effective against scale buildup.

By interfering with the crystal formation, polymer-based sequestering agents cause the crystals to be relatively smooth, with more rounded edges. Scale crystals tend to start a toe-hold on the pool wall and build on top of one another, but this is harder to accomplish with the rounded edges the polymer induces.

The third category of metal-control agents in the industry is *hydroxyethylidene* — which is normally shortened to HEDP. These agents containing many of the same characteristics of both the EDTA and polymer-based types, acting to lock up the metal ions and prevent them from joining with other ions, precipitating and then causing a stain. The HEDP is also a negatively charged electrolyte, capable of distorting crystal formation, which helps prevent scale formation.

Though they are often marketed as stain and scale removers, sequestering agents are usually more effective as a preventative measure. Using a sequestering agent at startup and as part of a regular maintenance program — especially if a metal-based algicide is used as part of the normal chemical treatment — is a wise investment.

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Once a stain or scale problem presents itself, sequestering agents may not work. Check the specialty manufacturer's product label to see whether it is intended for use as a "remover."

Clarifiers

Even if the filtration system is running at optimum efficiency, the best any system can do is remove particles down to a few microns. A micron, remember, is a unit of measurement equal to about one millionth of a meter. In other words, a micron is something so small that the human eye cannot recognize anything smaller than that which equals about 35 microns.

So what's the problem if the filter is working sufficiently to remove particles down to just a few of these tiny, unseen things?

One of the problems is that they are so small they lack any real gravity and can remain suspended in the water. Collect enough of them floating through the pool water and they can really affect the clarity.

Another problem is that they reflect light, causing the water to appear murky. And they are negatively charged particles, meaning that they repel one another so they do not clump together where they could be removed by regular filtration.

As with other water problems, it is this negatively charged quality of these tiny floating objects that is the key to the development of specialty chemicals that can bring clarity back to pool water.

Obviously, if hundreds or even thousands of these tiny particles could be glued together until they form a larger unit, they could be successfully removed by the filter.

This idea is far from new. People in ancient Egypt and India were known to have used crushed nuts and beans in their drinking water supply, waiting for impurities in the water to glom onto them, then skim off the added material and drink the water. The ancient Chinese found that they could clarify water using a natural salt compound, later identified as aluminum sulfate.

That salt compound is now known as alum.

Over the years this process of agglomeration, or coagulation, has been refined and developed into an effective tool for water clarification. The idea behind it is simple enough: the dissolved particles form a clot either around another foreign object, or become heavy enough on their own to fall to the bottom of the water.

While the earliest people had no clue why adding salts to the water worked, scientists now understand. When alum and water combine, they form aluminum hydroxide. This compound tends to stick together, trapping small particles into bundles as they fall through the water. These bundles are called flocs, and the process is called flocculation.

Some service professionals still use alum, but other metallic salt compounds work in a similar fashion, producing a heavy sediment that is usually vacuumed away. This process can be time-consuming, however, because the pH of the water needs to be adjusted to about 7.0 to work effectively.

The alum itself also works to further lower the water's pH and total alkalinity, causing major adjustments in water chemistry with its use.

For this reason, most service pros today use some form of synthetic polymer as a water clarifier. These polymer chemicals carry positively charged ions that attract themselves to the negatively charged dirt particles suspended in the water. As they attach together in a clump or floc, the larger material can be filtered or vacuumed out of the water.

While not pH-sensitive like alum, polymer clarifiers can be oxidized by high levels of chlorine. They are also highly concentrated and require dilution.

More than 200 different water clarification polymers are on the market, often blended by the manufacturer to achieve specific characteristics. These include the ability to withstand high temperatures, high chlorine levels, extreme turbulence and floc breakdown.

Regardless of the type of polymer being used, pool operators should be sure to check the manufacturer's label and follow proper directions for use.

Enzymes

Especially in spas and commercial pool applications, oil buildup can be a serious problem.

Oils can be a haven for and even promote bacteria growth and algae while at the same time prevent sanitizers from reaching and killing them. They can also cause unsightly residue on the tile line or in the gutter.

And because they are a present in natural body oils from swimmers as well as a key ingredient in suntan lotions, body lotions, hair products and many cosmetics, keeping oils out of the water is a near impossible task.

While some specialty tile-cleaning products temporarily clean or even breakup the oils, the development and acceptance of enzymes over the last few decades has helped many control the problem on a more permanent basis.

An enzyme is a protein-based material that speeds up a chemical reaction without itself being changed. It is what

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chemists call a catalyst.

While the main goal of enzymes in pools and spas is to digest oils present, they can also digest small particles of organic materials such as dirt, pollen, algae, hair, plants and dust. Enzymes are not usually strong enough, nor are they in contact with them long enough, to digest larger organics.

Because of their very nature, enzymes should not be looked at as a quick fix for a problem pool or spa. Breaking up the scum so that it can be cleaned and removed with a brush, enzymes work slowly through a process called *biodegrading*. This process slowly turns the oils and organics into carbon dioxide and water, leaving no residue, sediment or byproducts to remove.

This process speeds up in warm spa water. But in cooler pool water, digestion is normally slow and can take several days to produce noticeable results.

For this reason, patience is a necessary quality for anyone using enzymes to remove oil and organics from pool water.

In addition to cleaning the water and pool or spa shell, the filter — whether of a sand, cartridge or DE variety — is actually cleaned in the process. Oils penetrate the filter media, restricting the flow of water through the system, and they can make the dirt cake harder to remove through normal cleaning.

Manufacturers claim that use of enzymes can extend filter-cleaning intervals by as much as three times their normal cycles.

Enzymes can be added directly to the circulating water or poured into the skimmer with equal success. However, each pool or spa should be dosed according to its particular oil problem, and service professionals should remember that patience is often a key to success.

Especially in pool applications, it may take two to three doses and perhaps a month to noticeably remove all oil from the water. In spa applications, as many as 4 or 5 doses may be needed over a 2-week period to show positive results.

Experts also advise that a slight increase in spa foaming may initially result before foaming is then eliminated.

Enzymes are affected by high levels of oxidizer and their use should not follow a shock treatment. But normal levels of pool and spa chemicals — up to 4 parts per million of chlorine and even double that for bromine — do not appear to have an adverse affect on enzyme use.

As a side benefit to enzyme effectiveness in removing oils from a spa, the digestion process also eliminates the source of foaming and reduces the need for silicone-based defoamers. Also, because the enzymes digest the source of many pool and spa odors, they are excellent and effective odor removers.

Because of their slow-working nature, enzymes have become increasingly effective during the winterizing process. Oils, organic matter, scum and foreign matter are slowly digested, so the condition of the water, bottom and walls is much improved in the spring.

In Conclusion

Especially because of their effectiveness as a preventative against a number of water ailments, specialty chemicals are often at the forefront of the professional service technician's chemical assault team.

While there is no substitute for proper water balance, an efficient filtration system and a clean pool environment, specific knowledge in the use of these chemicals can assist anyone in maintaining — and restoring — great looking pools and spas. ■