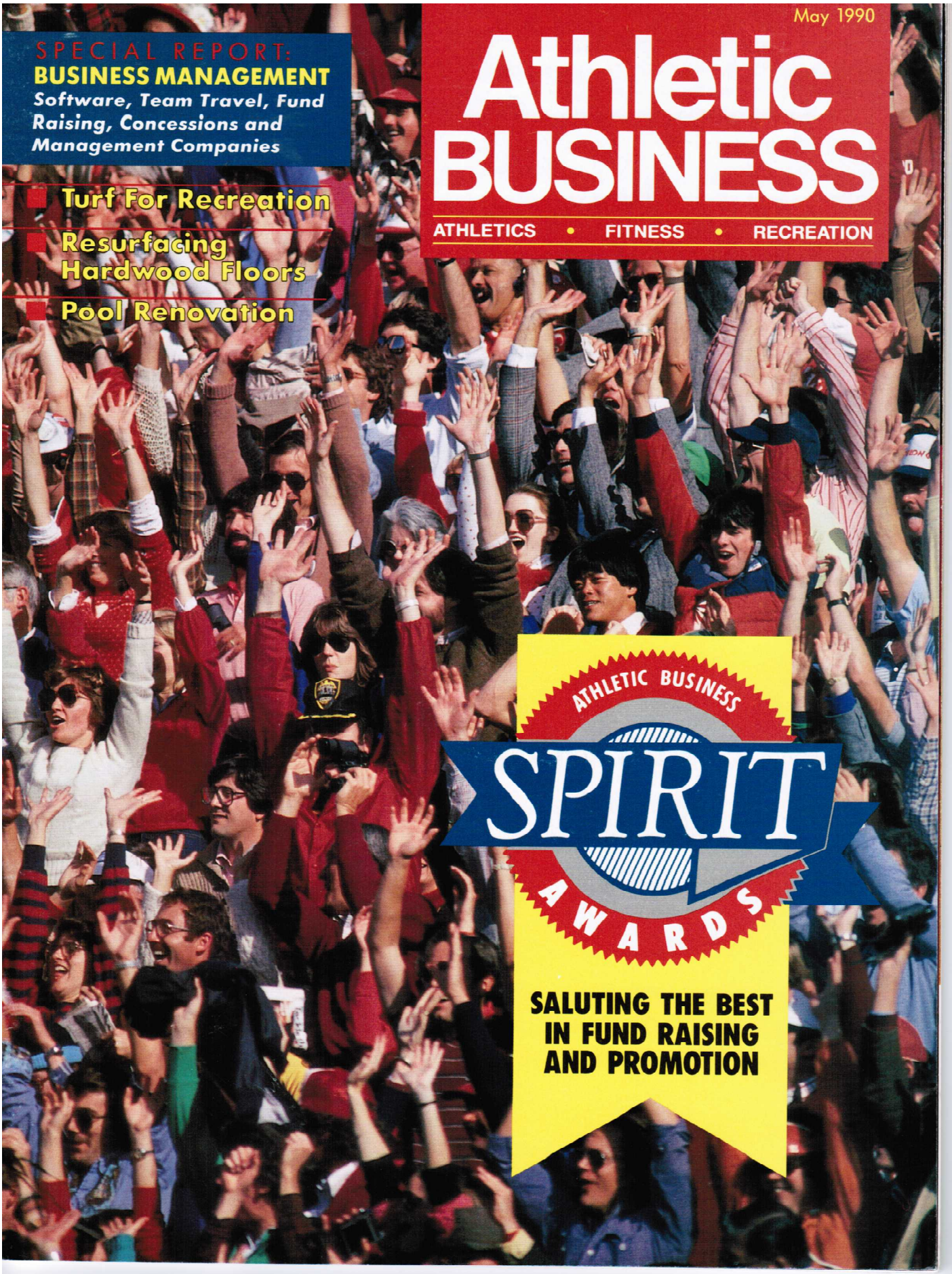

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Picture-perfect pools

Does your pool need revitalizing? If walls are stained or deteriorating, or the water is frequently cloudy, here's help from a leading pool consultant.

by Alison Osinski

Do swimmers using your pool complain about eye irritation? Is your pool's plaster shell deteriorating or mineral-stained? Is your pool water frequently cloudy?

Knowing how to identify the causes of these problems and solve them will make your job more pleasant and improve both the appearance and safety of your pool.

Swimmer eye irritation and the unpleasant chlorine odor associated with swimming pools most often result from the presence of measurable chloramine levels, although pH imbalance, excessive turbidity or even reflective sunlight burning swimmers' corneas are possible causes.

Chloramines form when chlorine levels are maintained below the "break point" and organic materials in the water are incompletely oxidized.

When chlorine is introduced into the water, bacteria are destroyed. Regardless of what form of chlorine is used as the primary bactericide, the same chemical reaction takes place. Some chlorine is lost through dissipation into the air. Hypochlorous acid (HoCl), an effective oxidizer and sanitizer, is formed and breaks down matter into inactive compounds.

The amount of chlorine needed to destroy bacteria and organic matter already present in the water is called the chlorine demand. The chlorine left over is called the chlorine residual.

Residual chlorine is maintained as a type of insurance policy to react with bacteria and organic matter that the operator anticipates will be introduced into the pool. The residual chlorine that is free or available to immediately attack contaminants is known as free available chlorine (FAC).

Hydrochloric acid (HCl) also forms as a byproduct of the chlorination process and causes a drop in pH. Hydrochloric acid has a tendency to combine with ammonias (NH_3) and other nitrogen compounds introduced by swimmers to form tightly combined molecules called combined available chlorine (CAC), or chloramines.

Although chloramines are present in the water as a residual, they are not freely available and are undesirable. They will kill bacteria, but at a rate approximately 100 times

The outdoor social pool at Tulane University's Reily Student Recreation Center in New Orleans.

Photo ©Jerry Ward.

Table 1

Amount of Available Chlorine Necessary to Raise the Chlorine Level 1 ppm per 10,000 Gallons of Pool Water

Type of Chlorine	Percentage of Available Chlorine	Amount Needed per 10,000 Gallons
Sodium Hypochlorite	10%	1.5 cups
Sodium Hypochlorite	12%	1.3 cups
Sodium Hypochlorite	15%	1 cup
Sodium Dichloro-s-triazinetrione	60%	2.25 ounces
Calcium Hypochlorite	65%	2 ounces
Trichloro-s-triazinetrione	85%	1.5 ounces
Gas Chlorine	100%	1.3 ounces

slower than free available chlorine. In addition, they give off an unpleasant odor, and are a major cause of eye irritation, itchy skin and mucous membrane irritation.

Chloramines are removed by superchlorinating or shocking the water. Superchlorination is an all-or-nothing reaction that occurs when a chemical break point is reached. The purpose of doing this is threefold: it oxidizes organic material in the water, destroys chloramines and kills algae. The concentration of chlorine in the water is increased to the point where bacteria and other organic matter are completely oxidized. Nitrogen and other wastes will "gas off."

Chloramines are removed by superchlorinating or shocking the water.

Superchlorination of pool water should be done periodically, at least once a week in pools, daily in commercial whirlpools, or when the amount of CAC present in the water is greater than 0.3 parts per million.

The amount of chlorine needed to reach the break point can be mathematically calculated. Use a DPD colormetric or titration test kit to determine the amount of combined chlorines present in the water. If the CAC level is 0.3 ppm or greater, multiply the CAC by 10. Use this number and a standard chart to determine the amount of chlorine you must introduce into the pool water (see Table 1). You must also know the volume in gallons of water in the pool, the type of chlorine being used and its percentage of available chlorine.

Before superchlorinating, make sure the water is chemically balanced. Shocking a pool with unbalanced or oversaturated water, particularly with a high (basic) pH or high total alkalinity, will result in the formation of a carbonate precipitate that will cloud the water.

Although chlorine is not dangerous to humans in concentrations normally found in pool water, some health department regulations prohibit swimmers from using the pool when the chlorine concentration is raised. Because of this regulation, it's best to superchlorinate in the evening or during hours the pool is not in operation to allow chlorine levels to

drop to acceptable levels. If it's necessary to superchlorinate during operating hours, add sodium thiosulfate to the water after superchlorinating to neutralize and bring down the chlorine present in the water.

Non-chlorine oxidizers (potassium peroxymonosulfate) can be used instead of chlorine to shock or oxidize chloramines and other organic contaminants from the water. Unlike chlorine, which must reach a break point to cause total oxidation, any amount of potassium peroxymonosulfate added to water will oxidize some material.

Non-chlorine oxidizers won't raise chlorine to unacceptable levels, and won't cause bleaching or affect water balance or pH. Oxidation can be performed while bathers are in the water. The product is especially recommended for pools with high bather load-to-water volume ratios, such as whirlpools, where total dissolved solids and ammonia build up at a rapid pace, and for indoor pools with poor ventilation.

A majority of commercial pools in the U.S. are constructed of pneumatically applied shotcrete or Gunite™ finished with a plaster surface. Recently, severe plaster deterioration problems, including mottling, spot etching, ghosting, bond failure and staining have plagued the industry.

The National Spa and Pool Institute-sponsored Florida Marcite Committee and the California Plasterers Council are trying to determine what's causing the problems. Suspected causes under examination include improper troweling equipment, the application process, textural or composition defects in the marcite itself, improper water quality maintenance, climatic conditions, the cement-to-sand ratio of the mixture, the grade of calcium chloride used, the method of filling the pool with water, and start-up procedures.

Minerals or dissolved metals in pool water are unwelcome because they stain pool surfaces.

Because of the industry's inability to find a solution to the plaster deterioration problems, alternatives to plaster are increasing in popularity. Epoxy, chlorinated rubber and water-based paints can be applied; aluminum or stainless steel inserts, or new PVC membranes can be installed; or the surface can be tiled.

Many operators are considering the application of fiberglass to cosmetically improve the appearance of their pools. After proper surface preparation, which includes sandblasting to remove old surface materials, tile repair and patching of cracks, a bonding coat is applied. Then, depending on the application process used, either fiberglass mat is laid or chopped fiberglass is pneumatically sprayed on, and layers of fiberglass resin or gel coat are added.

When compared to the alternatives, fiberglass is reasonably priced, long lasting (warranties of up to 15 years are common), easily patched or recoated, and simple to maintain. The smooth surface retains heat, doesn't leak, is stain-resistant and inhibits algae growth.

Potential drawbacks to the use of fiberglass are few, but do include the appearance of cobalt stains caused when cobalt in the resin migrates to the surface and is oxidized by chlorine in the water, bond failure if the

surface is not prepared properly, and delamination due to frequent freezing and thawing cycles.

Minerals or dissolved metals in pool water are unwelcome because they impart color to pool water and stain pool surfaces. A test kit should be used to test for the presence of unoxidized minerals, but some dissolved metals can be identified by the color they bestow (see Table 2).

Minerals, particularly copper, cause blond-, gray- or white-haired swimmers' hair to turn green. Minerals are present in source water and in many products added to the water. Metal staining occurs as a result of electrolysis or through deterioration of pipes due to poor water balance, and is easier to prevent than to get rid of.

Superchlorination will oxidize dissolved minerals out of the water, eliminating potential problems. Sequestering or chelating agents can be added to the water to help prevent mineral staining and calcification by reacting with metal ions in the water, surrounding them and keeping them in solution.

Mineral staining also can be reduced by installing magnetic water conditioners. These lightweight, ceramic magnets give off an extremely concentrated magnetic force that alters the water's electrical charge by producing positively charged ions. The magnets can easily be installed in minutes by an operator over a pool recirculation line. Although some manufacturers' claims of usefulness as effective algicides, clarifiers and water balance stabilizers are exaggerated, magnetic water conditioners have no replacement parts, do not wear out, need no power to operate, have no known side effects and are effective over time.

Table 2

Stain Color	Dissolved Metal
Clear Green	Iron
Greenish-Blue	Copper
Brownish-Black	Manganese
White	Calcium

If preventive measures are not taken and mineral staining occurs, stains must be removed by acid washing. Following is the procedure for acid washing a plaster pool:

►Visually inspect the pool. Look for discoloration, mineral staining, plaster etching or mottling, chipped tile, broken steps and cracks.

►Drain the pool.

►Inspect the entire surface of the empty pool. Tap the walls and pool bottom, looking for loose plaster or hollow spots.

►Sand off any excessive calcium buildup. Make sure the pool is dry and you've taken all appropriate safety precautions for working with an electrical sander. Remember, water and electricity do not mix.

►Rinse down the whole pool with water from a high-pressure hose.

►Mix water and TSP (trisodium phosphate) in a plastic sprinkling can. Add about one-quarter cup of tile soap to the mixture.

►Pour the TSP mixture from the deck down, a small area at a time. Scrub with an industrial pool deck brush to remove the oil residue that has built up over time. After completing the pool walls, scrub the pool bottom in a similar manner. Be careful not to slip.

►Rinse the entire pool with fresh water.

►Acid wash with a mild (usually 1-to-4) acid-to-water solution. Scrub a small area at a time until the surface feels like fine sandpaper. Keep the rinse water on at all times. Move the sump pump around to avoid leaving a pump footprint on the bottom.

►"Acid wash aid" can be added to the acid and water solution to help

cut down on fumes, but it doesn't really help much, and makes the plaster harder to etch and the pool extremely slippery.

► After completing the acid wash, rinse the pool several times with fresh water.

► Pour sodium carbonate (soda ash) down the main drain to help neutralize any acid left in the drains and recirculation lines.

► Repeat the TSP wash to neutralize the pool shell.

► Rinse again with fresh water.

Before acid washing a pool, make sure to read the Material Safety Data Sheets (MSDS) for all chemicals to be used during the procedure. In addition, wear protective clothing that covers all areas of exposed skin. Wear a full face shield and respirator with fresh acid cartridges, rubber boots and gloves. Also make sure that the room or area is extremely well ventilated, that you're not working alone, and that both you and your partner are knowledgeable in first aid procedures for acid burns and respiratory emergencies if one of you should be overcome by fumes.

Cloudy or white turbid water may result from any of several possible problems, including insufficient turnover rate, high total dissolved solids, oversaturated water, chemicals added to pool water too quickly or in too large a concentration, high combined available chlorine levels, diatomaceous earth passing through the filter elements, infrequent vacuuming, filters improperly sized or insufficient to meet user demand.

Alternatives to plaster are increasing in popularity.

dirty filters or over-extended filter runs, or excessively high cyanuric acid levels.

Problems associated with poor water clarity can be improved through the use of flocculants, also known as clarifiers, which are chemicals that promote the coagulation or combination of suspended debris in water, making it easier to remove with a filter.

Coagulated particles also may become heavy enough to settle to the pool bottom where they can be removed by vacuuming. Flocculants make small particles bigger, aid the filtration process and decrease water turbidity.

Flocculants such as aluminum sulfate (alum), commonly used in the past, are being replaced because of problems associated with their use with cartridge or diatomaceous earth filters. Biodegradable polymer products that work both as clarifiers and as sequestering agents are now more commonly used.

The newer non-alum flocculants were developed from chitin extracted from sea organisms, particularly crab or shrimp shells. They can be used with any type of pool filter, are non-toxic, safe to handle, effective, non-polluting, biodegradable, and can be used to treat drinking water, salt water and fresh water pools.

Learning to identify problems and their causes may take some time, but a clean and attractive pool will keep swimmers returning again and again. Once a problem is identified, solve it as soon as possible and you'll find that your old pool will be good as new again. □

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