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Fact Sheet

# Common Interferences in Pool and Spa Water Testing

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***Brought to you by the APSP Recreational Water Quality (RWQ) Committee***

## I. INTRODUCTION

Good water quality is essential in pools and spas to ensure a healthy, safe and pleasant experience. This requires timely and regular maintenance of the pool or spa. An important part of this maintenance schedule is regular water testing. In most cases water testing on a well maintained pool or spa, with good water quality, is simple and straightforward. However, there are instances when poor water quality or other circumstances cause erroneous test results. These are caused by interferences with the water quality tests. Understanding and being able to detect these interferences will help the pool and spa professional avoid poor test results. The following will discuss general testing tips and interferences in various water quality tests. The focus will be on common colorimetric and titrametric liquid, dry and strip reagents. Colorimeters and electrochemical sensors such as, pH meters, salt and conductivity meters, and ORP probes are mentioned briefly.

## II. GENERAL

Cleanliness and following instructions are important factors in testing equipment maintenance and procedures:

- Keep the reagent bottles, containers, vials, test tubes, comparators, dipcells and hands clean and dry.
- Remove any spills and drips.
- Cross contamination between reagents caused by sloppy technique can cause problems before testing is even started.
- Get a fresh water sample in a clean container.

- Rinse the sample container with the water and get a sample from well below the water surface.
- Avoid sampling near water inlets and returns.
- Never test the water immediately after shocking or other chemical addition.
- When testing, follow the instructions carefully, including any specified waiting times.
- If adding drops of a reagent, hold the bottle vertically to get even sized drops.
- If doing a visual colorimetric determination (a color match), use a white or neutral color for a background. Use indirect light with your back to the sun.
- If using a colorimeter, run the test in the shade if possible.
- Avoid testing at the very top or the very bottom of a test range. These portions of the range often have poor accuracy.
- After testing, clean and rinse equipment and allow it to air dry.
- Store the test kit and reagents in a cool dry place.
- Periodically, test your kits against known reference standards recommended by the manufacturer.

**pH**

Phenol Red is the most common reagent for testing the pH of pool and spa water. However, high chlorine or bromine concentrations can interfere with colorimetric pH results. Phenol Red reaction colors range from orange to red. But high concentrations of chlorine or bromine can turn the color to purple. If this happens, an accurate pH reading cannot be obtained. The addition of one to three drops of a chlorine inhibitor, such as thiosulfate, can eliminate the interference. Most Phenol Red reagents have an inhibitor that will neutralize up to 10 ppm chlorine and 20 ppm bromine. However, some of these inhibitors can cause a small shift in the pH. Combination inhibitors avoid this pH shift, so it is best to use pH reagents with a combination chlorine/bromine inhibitor that minimizes pH shifts. If possible, it is best to wait for the chlorine or bromine levels to drop before testing the pH.

Most Phenol Red pH indicator reagents have a pH of 7.5 – 7.6. This can result in an interference when the alkalinity is very low (50 ppm or less), because low alkalinity will allow small changes in the pH of the water sample. Addition of the Phenol Red indicator causes the pH of the sample to shift to the pH of the Phenol Red indicator. If a test indicates the alkalinity is very low and the pH is close to ideal, the pH may be wrong.

One other thing to watch out for is when the test result is at the top or bottom of the pH range where the indicator no longer changes color with variation in pH. The resulting test color at pH 8.4 is the same as the color at pH 9.0 or 9.5. The test color at pH 6.8 is the same as the color at pH 6.0 or 5.5. So the results can be over or under range when at the top or bottom of the range, respectively, without any indication of how far over or under range.

Also, if test strips are being used, be sure to use strips designed for pool and spa testing. Multi-pad pH strips for laboratory use will not work in low buffer pool and spa water. The correct reading could take up to 10 minutes with this type of pH test strip.

**Alkalinity**

There are two types of alkalinity tests, titration and colorimetric. The more accurate test is the titration. However, high chlorine and bromine levels can cause the endpoint color of the titration to be yellow, or colorless, instead of pink. Addition of a chlorine inhibitor, such as sodium thiosulfate, before the titration will neutralize the chlorine or bromine and give the correct endpoint color.

The alkalinity titration measures total alkalinity which mainly includes carbonate, bicarbonate, and cyanuric acid. In pools only alkalinity due to carbonate and bicarbonate is important for balanced pool water and the saturation index. The cyanuric acid contribution can be considered a positive interference. Subtract 1/3 of the cyanuric acid reading from the tested alkalinity reading when making adjustments to the pool alkalinity.[2, 3]

Many algaecides contain quats (quaternary ammonium cations) or polyquats. High levels of these can cause low readings in colorimetric alkalinity tests. Inhibitors are added to minimize this interference but over dosing with these algaecides can cause errors in alkalinity readings. Very high levels of biguanide have also been known to cause a similar interference.

**Chlorine/Bromine**

The most common interference in chlorine and bromine colorimetric testing with DPD is bleaching due to high levels of chlorine or bromine. What happens is that excess chlorine or bromine reacts with pink DPD to form a colorless DPD compound. The bleaching results in lower readings compared with the true concentration of chlorine or bromine. To minimize this bleaching reaction an excess of DPD reagent is needed. Bleaching starts to interfere between 5 and 10 ppm and becomes significant above 10 ppm chlorine. With bromine the interference starts above 10 ppm and is significant above 20 ppm. If bleaching is suspected add extra DPD, reduce the sample size, or do a dilution.

Combined chlorine will interfere in the DPD test for free chlorine if the reading is not taken within 30 seconds. This will result in high readings. If the free chlorine reading cannot be taken immediately, Steadifac can be added to freeze the free chlorine reading. Steadifac is 0.25% thioacetamide. Steadifac is also useful in preventing high readings from oxidized manganese. Another thing that can cause combined chlorine to show up in the free chlorine is residue from DPD3 reagent. This reagent speeds the reaction of DPD with combined chlorine. Any residue of DPD3 on testing equipment can cause a problem in testing for free chlorine. So after testing for total chlorine, immediately wash test equipment.[4]

Potassium monopersulfate (MPS or potassium peroxymonosulfate) is a non-chlorine oxidizer that will interfere in the total chlorine DPD test. Treating recreational water with MPS to remove bather waste can result in false high combined chlorine or total chlorine readings. To prevent this interference:

- Test free chlorine before adding MPS.
- After adding MPS, wait at least 12 hours before testing free chlorine.
- Use a test kit specified for MPS treated water.

**Cyanuric Acid**

When testing for cyanuric acid with a melamine-based turbidity test, the most significant interference is water temperature. High temperatures, above 90 °F, can result in readings as much as 15 ppm low. Low temperatures, below 60 °F, can result in readings that are 15 ppm high. The ideal temperature is about 75 °F. A problem with cyanuric acid test strips is that they are sensitive to the pH of the water. For the best result adjust the water pH to the ideal range, 7.4 to 7.6, before testing for cyanuric acid.

**Hardness**

A high level of metals, such as copper or iron, is the most common interference in calcium hardness titrations. Normally the endpoint of a hardness titration is a color change from red to blue. If the color change is red to purple, a high level of copper is usually the cause. The addition of metal sequestering agent to the pool or spa can minimize this problem. Many manufacturers provide directions for avoiding such metal interference.[5]

**Metals**

Metals in water exist in three major forms: insoluble (metal oxides and hydroxides), free, and complexed. Test methods used to determine the concentration of metals in pool water may not measure insoluble metals and, depending upon whether the method measures free or complexed dissolved metals, may exhibit interferences from chelators and sequestering agents.

Iron (Fe) Test Methods: Most total iron test methods require the reduction of iron to its ferrous form. Because a reducing agent is used in these tests, typical concentrations of chelators and sequestering agents may not interfere with these total iron tests. Elevated levels of these chemicals in the pool or spa water, however, may interfere with the iron test resulting in an inaccurate lower value. Additionally, depending upon the reducing agent used, insoluble suspended iron such as rust, may or may not be reduced to the ferrous form of iron and be measured. Consult the manufacturer's test instructions to determine if insoluble iron is measured by the test method.

Copper (Cu) Test Methods: Most copper test methods measure free un-sequestered copper. Typical concentrations of chelators or sequestering agents interfere with these tests, resulting in an inaccurate lower value for total copper. To determine the concentration of total dissolved copper (both free and sequestered), the use of a total copper test procedure is required. Consult the manufacturer's test instructions to determine if the test method used measures free copper or total copper.

### Meters

Colorimeters are becoming more common for running water tests. The main advantage of colorimeters is that they give an objective measurement of water tests. They also allow color blind persons to make accurate measurements. As many as 8 percent of men and 0.5 percent of women with Northern European ancestry have the common form of red-green color blindness.[6] Colorimeters work by measuring the passage of light through a sample. Anything that interferes with the passage of light through the sample will interfere in the test. This includes scratches, dirt, stains, fingerprints and water droplets on tubes or in the reaction chamber. Always clean the reaction tube or cell and rinse with distilled or deionized water immediately after use. Follow manufactures instructions for maintenance.

Portable electrochemical sensors and probes can also be subject to interferences. There are few interferences in pool water for pH probe measurements, other than dirty or poorly maintained probes. The interferences for pH testing with reagents mentioned above can be avoided with a pH probe. Calibrate probes on a regular basis with calibration solutions as recommended by the manufacturer. Rinse probes with distilled or deionized water before and after use. Most pH probes need to be stored in a storage solution or moist environment.

Salt and TDS meters are really conductivity meters with special calibrations. They measure any conductive ions in the water, including sodium, chloride, calcium, magnesium, sulfate and others. The interferences for salt meters are other ions and dirty and poorly maintained probes. Rinse these probes with distilled or deionized water after use and store dry. Do not allow fingerprints or other residues to remain on the probe.

The main interference for ORP probes is a change in pH. Another interference may be elevated cyanuric acid levels. As the pH drops, the ORP reading can increase and as pH increases the ORP reading can drop. Dirty probes are also a problem. Rinse probes with distilled or deionized water and store in a moist environment. In all cases, follow manufactures instructions for cleaning and maintenance.

## III. CONCLUSION

A good understanding of the interferences in water quality testing will help the pool and spa professional spot unusual and erroneous results. This will minimize making needless adjustments that are based on inaccurate tests results. Good technique, cleanliness and care of testing equipment will also minimize testing problems.

## IV. REFERENCES

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