

Chemicals And Vinyl

Water balance is important to vinyl liner life

by Don Ridpath

With over 90% of all swimming pool sales in Canada being of the vinyl liner type, it is important to understand the relationship between good water balance and the life of a vinyl liner. Little has been written on this subject and its importance to the industry.

Everyone is familiar with the proper parameters in which the pool water balance should be maintained – 7.2-7.6 pH levels, total alkalinity of about 100 ppm, calcium hardness of 100 ppm minimum, and chlorine levels of 1.0 ppm to 2.0 ppm. The standard explanation is that your chlorine or bromine products work most effectively at these levels for clarity and sanitation purposes and bather comfort is maintained.

However, there is another side to this story that is just as important and this pertains to the life of the vinyl liner.

All Pool Finishes Respond To The Effects Of The Environment

All pool finishes, whether they be vinyl, plaster or painted, respond to the effects of their environment – sun, weather, and chemically treated water. Pool servicemen repeatedly stress the point to the pool owner to keep pool water pH, alkalinity, sanitizer concentration, calcium hardness and total dissolved solids within the specific concentration ranges.

If the chemistry is not kept in balance, all pool walls suffer, but most significantly vinyl liners.

This problem was important enough for two U.S. companies to conduct a two year study evaluating the effects of pool water pH and chlorine concentration on the U.S. industry's standard 20 mil vinyl liner.

The influence of adverse pool water chemistry on the vinyl was assessed through observation of changes in vinyl colour, weight, dimensions, tensile strength and elongation (stretching).

The laboratory studies revealed that the factors most affecting vinyl liners are high chlorine concentration, and more dramatically, pH that is either too high or too low. This form of pool water balance has seriously degrading effects upon pool vinyls, with low pH causing discolouration, wrinkling, stretching, loss of strength and an increase in weight.

High pH brings on shrinking, wrinkling and a decrease in weight, although high pH doesn't effect strength as much as low pH. At the same time, high chlorination levels cause discolouration while accelerating the effects of low pH.

pH Effects

The joint study investigated the effect on vinyl of water pH between 2.0 and 10.0. A total of 224 white, blue and black vinyl samples were exposed to the ambient temperature and water at various pH levels between 2.0 and 10.0 for an extended period of time. During the test period, the total alkalinity in the test water was maintained at 150 parts per million, calcium hardness was at 100 ppm and the starting cyanuric acid concentration was 100 ppm.

Tests were conducted with the free available chlorine maintained at either 1.5 ppm or 20.0 ppm (The low value was used because it reflects common sanitizer usage levels; the high value was chosen because intermediate levels had limited effects on the vinyl. Throughout all investigations, pH was observed as the more significant variable.)

The effects upon the vinyl of water pH in the 2.0 to 10.0 range were determined with the free chlorine maintained at 1.5 ppm. The results were as follows:

- Exposed samples where pH was maintained in the 7.0 to 7.5 range exhibited no adverse effects on the vinyl.
- The lower the water pH drops below 7.0, the greater the incidence of wrinkling, loss of tensile strength, elongation and fading. Low pH (the acidic range) was found to have a more adverse effect than high pH (the alkaline range).
- As the pH increases above 7.6, the vinyl loses weight and expands.
- The lower the water pH drops below 7.0, the greater the vinyl's weight increase.

It is important to note that the vinyl material remained functional throughout the tests.

Chlorine Concentration

Vinyl samples were exposed to test water with free available chlorine concentrations of 1.5 ppm and 20.0 ppm. Again, the chlorine concentration of 1.5 ppm was selected because it is the average recommended level for proper sanitization of pool water. The 20.0 ppm concentration level was selected to determine the influence of an excessive amount of available chlorine upon the vinyl.

The four different sources of chlorine used in the exposure tests were trichloro-s-triazine, sodium dichlor-s-triazinetrione calcium hypochlorite and lithium hypochlorite. The effects of chlorine concentration upon vinyl appeared to be independent of the chlorine source.

The study revealed that water with a chlorine concen-

tration of 20.0 ppm adversely affected the vinyl. The results of the exposure of vinyl to water with 20.0 ppm chlorine, where the pH was maintained in the 7.0 to 7.5 range, were as follows:

- There was significant vinyl colour degradation. The white vinyl turned yellow, the blue became faded and dull in colour and the black faded slightly but was least affected by the high chlorine concentration.
- High chlorine concentration caused pronounced wrinkling of the vinyl.

The studies revealed that the combination of high chlorine concentration and low pH caused greater wrinkling of the vinyl than low pH alone. Also, regardless of the adverse effect of high chlorine and low pH, the vinyl did remain functional as a liner.

Chemical Bleaching

After an incident of unexplained bleaching in a vinyl, swimming pool liner, a series of experiments were conducted to determine the bleaching effect of various common chemicals used in swimming pool water care.

Of the common chemicals used, only 90% available chlorine trichlorisocyanurate caused bleaching of the liner on its own. It bleached five out of six vinyl film strips with a large bleached cloud. According to the tests, this material will bleach vinyl in both granular and tablet form.

The laboratory procedure used was drastic and designed to grossly exaggerate any condition which would occur in an actual swimming pool under normal conditions.

In chemical mixture tests where several chemicals were mixed in applications, it was noted that a reaction between the chemicals produced effervescent bubbles and a cloud in the water as soon as they were added to the water in a beaker.

Results of the bleaching tests provided these conclusions:

- a) Contamination of ACL 60 or calcium hypochlorite, **even with minute quantities** of the other chemical, may result in the bleaching of many vinyl films if the mixture comes in direct contact with the film.
- b) A mixture of calcium hypochlorite and sodium bisulphate (dry acid) may result in bleaching of vinyl films if the mixture comes in direct contact with the film.
- c) Most uncontaminated common chemicals used in swimming pool water care will not materially affect the colour of vinyl films used as swimming pool liners.
- d) The tests confirm that trichlorisocyanurate in granular or tablet form may bleach most vinyl liners if it comes in direct contact with the film.
- e) Some vinyl films are more resistant to chemical bleaching than others.

The tests give another reason for warning the user of swimming pool chemicals to take extreme care not to mix any chemicals in a dry state. A mixture can explode due to the reaction between two chemicals, and bleaching of the liner can result if the mixture is added to the pool and allowed to remain in direct contact with the liner.

Recommendations For Care Of Vinyl Lined Swimming Pools

1. Maintain proper water balance:
 - (a) pH in the 7.2 to 7.6 range.
 - (b) Total alkalinity in about 100 ppm.
 - (c) Calcium hardness: 100 ppm minimum.
2. Maintain free chlorine residual between 1.0 and 1.5 ppm. If free chlorine drifts below 1.0 ppm algae and bacterial growth can take hold more easily and may cause staining of the vinyl liner.
3. A low pH of less than 7.0 should be especially avoided, since it can cause liner to form wrinkles and with a greater probability if the water is not stabilized with cyanuric acid. For this reason it is recommended that all vinyl lined swimming pools be routinely stabilized with cyanuric acid and that a minimum of 25 ppm be maintained.
4. Avoid using hydrochloric (muriatic) acid for pH adjustment*. This acid will chemically attack the print pattern on the liner and in time will make it more susceptible to wearing off due to abrasion.
*The exception is the use of hydrochloric acid for total alkalinity reduction, since much of the acid is consumed in the process.
5. Test for the presence of dissolved metals in pool water. Dissolved metals may cause staining of the vinyl liner directly or may combine with calcium hardness and form discoloured deposits on vinyl liner. Follow manufacturer's recommendations concerning the use of chelating materials to inactivate dissolved metals.
6. Chemicals should never be mixed together and added to the pool water at the same time. Certain combinations of the chemicals that individually will have no effect can cause bleaching of the liner if concentration is allowed to remain high in the vicinity of the liner. Always allow a chemical to disperse throughout the pool by means of water recirculation, before adding a second chemical.
7. Never close a pool without circulating the pool water for several hours after the final addition of chemicals. Even liquid chlorine can concentrate in the deep end and cause liner bleaching, if not sufficiently blended with the rest of the pool water.
8. Use a well fitting winter pool cover that is tightly sealed around the entire perimeter of the pool to prevent accumulation of debris such as leaves, worms, etc. during the winter period. Organic matter has the potential to cause staining and/or bleaching of vinyl liner. □