POOLS AND SPAS

"TDS: Check it out when the water doesn't behave."
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TDS - Total Dissolved Solids - may be the most misunderstood factor in the whole field of pool & spa water chemistry. It is misunderstood because no one knows *exactly* what effect it is going to have on any particular body of water.

When everything else seems to be all right, and the water still acts screwy, check the TDS.

High TDS can result in corrosion of metal equipment and accessories, even though the water is balanced.

High TDS can cause eye and skin irritation, even though the pH is right and there are no chloramines in the water.

High TDS can permit an algae bloom, even with a 2-3 ppm chlorine residual.

But none of these symptoms will necessarily occur. It is the uncertain nature of problems caused by TDS that makes it such a headache to deal with.

As its name states, TDS is the sum total of all of the dissolved things in a given body of water. It's everything in the water that's not actually water. It includes hardness, alkalinity, cyanuric acid, chlorides, bromides, sulfates, silicates, and all manner of organic compounds.

Every time you add anything to the water, you are increasing its TDS. This includes not only sanitizing and pH adjusting chemicals, but also conditioner, algaecides, and tile and surface cleaners. It includes airborne pollutants and bather waste as well as dissolved minerals in the fill water.

At low levels, TDS does not present a problem. In fact, a certain amount of TDS is necessary for water balance. Hardness and Total Alkalinity are both part of TDS.

But at high levels - above 3,000 parts per million - you are welcoming problems. The National Spa & Pool Institute, in its standards for both swimming pools and spas, recommends an ideal TDS of between 1,000 and 2,000 ppm, with a maximum of 3,000 ppm.

No one knows exactly what mechanism is at work when you're dealing with high TDS water. One commonly held theory is that when you get a lot of dissolved substances in water, they interfere with the normal workings of sanitizers. They may do this by forming a chemical "shield" around bacteria, algae, and other substances normally attacked by chlorine or bromine. Or they may simply present "roadblocks" in the path of sanitizer molecules, preventing them from freely circulating.

TDS buildup is inevitable. As we've explained, every time you add chemicals to water, you're increasing the TDS. When the water evaporates, it leaves behind all of the solids that had been dissolved in it.

Just how much are you increasing the TDS when you chemically treat pool or spa water? Well, for every pound of dry chemical that you add to a 15,000 gallon pool, you are increasing the TDS by about 8 ppm.

"Parts Per Million" is what scientists refer to as a "weight to weight" measurement. That is, if you know how much the water weighs, and you know how much the stuff you are adding to the water weighs, you can calculate how many parts per million you are adding to the water.

As it happens, one gallon of water weighs 8.34 pounds. So if you know how many gallons are in a pool or spa, and you multiply that number by 8.34, you will know how many pounds of water are in the pool or spa.

So, how many pounds of water are in a 450 gallon spa? The answer is 3,753 pounds (450 x 8.34 = 3,753). How about a 15,000 gallon pool? Well, 15,000 x 8.34 = 125,100. So, there are 125,100 pounds of water in a 15,000 gallon pool.

OK, so now you know how much the water weighs. Now, take 1 million and divide it by the total weight of that water, and you will find out how many parts per million are contained in each pound of water. For example, 1,000,000/125,100 (pounds of water in our 15,000 gallon pool) = 7.99. We'll call it 8. That is, every pound of material added to a 15,000 gallon pool will contribute about 8 parts per million.

How about our 450 gallon spa? Take 1,000,000, divide it by 3,753 (the weight of the water in the spa), and you get 266.45. We'll settle on 266. So for every pound of stuff that you add to a 450 gallon spa, you will be increasing the TDS by 266 parts per million.

Effect of Dissolved Material on TDS - Pools

(How Much 1 Pound of Material Will Raise TDS In Pools of Various Sizes)

Pool Capacity	TDS per 1 Pound
5,000 gal.	24 ppm
10,000 gal.	12 ppm
15,000 gal.	8 ppm
20,000 gal	6 ppm
25,000 gal	4.8 ppm
50,000 gal	2.4 ppm
100,000 gal	1.2 ppm
150,000 gal	0.8 ppm

Effect of Dissolved Material on TDS - Spas

(How Much 1 Pound of Material Will Raise TDS In Pools of Various Sizes)

Pool Capacity	TDS per 1 Pound
400 gal.	300 ppm
450 gal.	266 ppm
500 gal.	240 ppm
550 gal	218 ppm
600 gal	200 ppm
650 gal	184 ppm
700 gal	171 ppm
750 gal	160 ppm

The above charts should give you a pretty good idea of why TDS builds up so rapidly in spa water and also why the effect of chemical treatment is so dramatic when you are dealing with a spa. The accompanying charts - one for pools and the other for spas - will also give you an idea of how much of an impact 1 pound of chemical added to the water will have on TDS in vessels of different sizes.

Incidentally, if you wanted to design a pool that would contain almost exactly 1 million pounds of water, it would be a 120,000 gallon vessel. In that pool, every 1 pound of solids dissolved in the water would increase the TDS by 1 ppm.

Every sanitizing chemical, and every pH adjusting chemical used in the pool and spa industry will eventually contribute to the TDS in a pool or spa. Some will contribute more than others. Because sanitizing compounds often require the additional use of pH adjusting chemicals, the chemical maintenance regimen you choose can have a dramatic effect on the buildup of TDS.

TDS is fairly easy to calculate for dry chemicals. It's a bit more complicated for liquid solutions. If a research lab were going to test the solids content of a liquid, they would take a precise volume of the liquid and then slowly heat it until the liquid itself had evaporated. Then they would dry the remaining solids and weight them.

The two most common liquid solutions used in our industry are muriatic acid and liquid chlorine (sodium hypochlorite). For your information, 1 gallon of muriatic acid will contribute 1.87 pounds of dissolved solids to the water. 1 gallon of liquid chlorine will contribute 2.2 pounds of dissolved solids.

You should also understand that every type of chlorine & sanitizer - including gas chlorine - eventually ends up contributing to TDS in the form of chloride. So every time you add a pound of dry chlorine compound, or infuse a pound of gas chlorine into a 15,000 gallon pool, you will wind up increasing the TDS by about 8 ppm.

TDS Testing

Short of a detailed laboratory analysis, the most dependable method of TDS testing is through the use of a portable TDS meter. These meters actually measure the *conductivity* of the water - its ability to conduct an electrical charge, which happens to increase as the TDS increases.

Hand-held TDS meters - usually in the $50.00 - $150.00 range, generally operate by either placing some water in a sample cell or dipping the meter directly in the pool water and pushing a button, which causes a small electric current to pass between two electrodes immersed in the water and separated by a specific distance.

The meter measures the current passing between the electrodes and uses that to deter mine the water's conductivity, the meter dial (or LCD readout) is calibrated to indicate TDS in parts per million.

The easiest way to reduce TDS is to drain the pool and refill it with fresh water. This can also be done in stages, taking the water level down 1 or 2 feet at a time and refilling over a period of days or weeks.

Under normal circumstances, pool water can be expected to last anywhere from 3 to 5 years before it has to be completely changed. Your choice of chemical treatment can help to determine just how long it lasts.